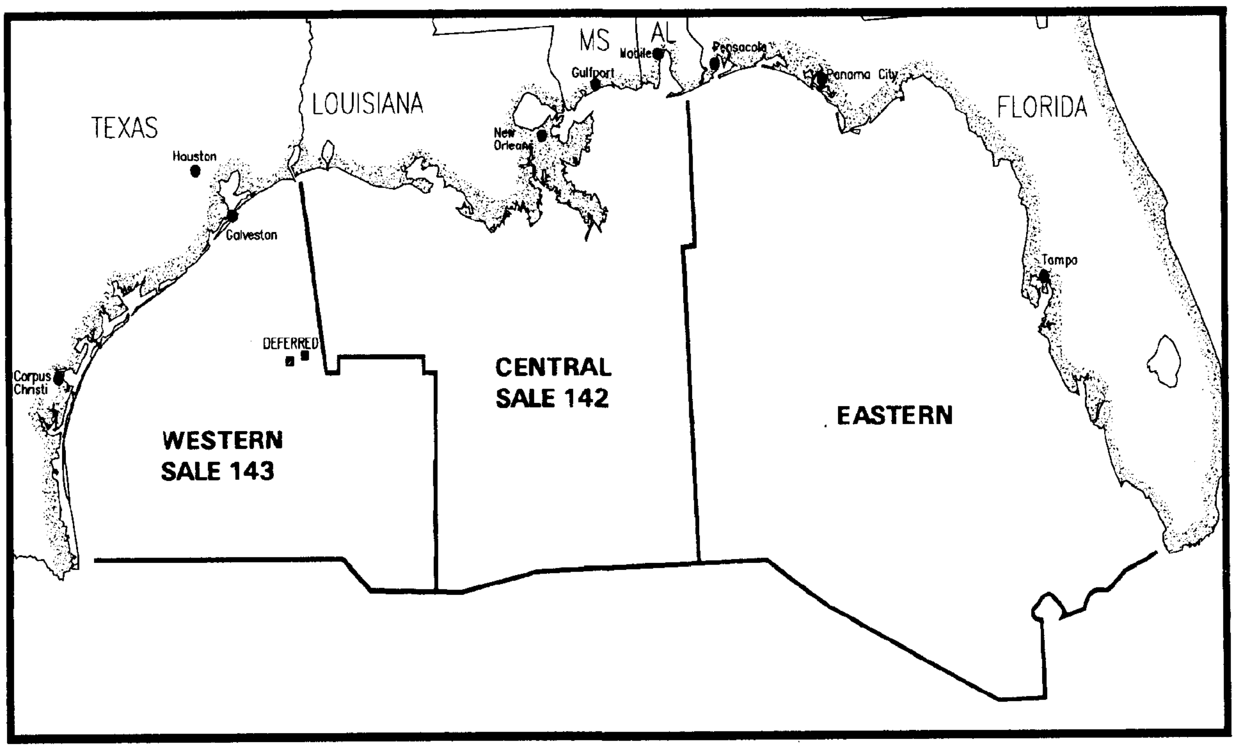
OCS EIS/EA
MMS 92-0007

Gulf of Mexico Sales 142 and 143:

Central and Western Planning Areas

Draft Environmental Impact Statement

Volume I: Sections I through IV.C.



U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Region

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Gulf of Mexico OCS Region

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REGIONAL DIRECTOR'S NOTE

This Draft Environmental Impact Statement (EIS) covering the proposed OCS oil and gas lease sales in the Gulf of Mexico for 1993 is a product of the Minerals Management Service (MMS) in New Orleans, Louisiana. The proposed sales are Central Gulf of Mexico Sale 142 (March 1993) and Western Gulf of Mexico Sale 143 (August 1993). This document includes the purpose and background of the proposed actions, the alternatives, the description of the affected environment, and the potential environmental impacts of the proposed actions and alternatives. Mitigating measures and their effects and potential cumulative impacts are also discussed. Most of the visuals that are referred to in this document were distributed with the Draft EIS for Sales 131, 135, and 137. Visual No. 2, Areas of Multiple Use, was revised and was distributed with the Draft EIS for Sales 139 and 141.

Additional copies of this Draft EIS and the referenced visuals may be obtained from the MMS, Gulf of Mexico OCS Region, 1201 Elmwood Park Boulevard, New Orleans, Louisiana 70123-2394, Attention: MS 5034, or by telephone (504) 736-2519.

Comments on this Draft EIS should be sent to the same address, Attention: MS 5410.

J. Rogers Pearcy
Regional Director
Minerals Management Service
Gulf of Mexico OCS Region

COVER SHEET

Environmental Impact Statement for Proposed Central Gulf of Mexico OCS Lease Sale 142 (March 1993) and Proposed Western Gulf of Mexico OCS Lease Sale 143 (August 1993)

Draft (x) Final ( )

Type of Action:

Administrative (x) Legislative ( )

Area of Potential Impact:

Offshore Marine Environment and Coastal Counties/Parishes of Alabama, Mississippi, Louisiana, and Texas

Lead Agency:

Send Comments To:

U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, LA 70123-2394
Attention: MS 5410

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ABBREVIATIONS AND ACRONYMS

ac	acre
ACAA	Alabama Coastal Area Act
ACAMP	Alabama Coastal Area Management Program
ADECA	Alabama Department of Community Affairs
ADEM	Alabama Department of Environmental Management
AFB	Air Force Base
APD	Application for Permit to Drill
API	American Petroleum Institute
ARTC	Armament Research and Test Center
B.P.	before present
BACT	best available control technology
BAST	best available and safest technology
BAT	best available technology
Bbbl	billion barrels
bbl	barrels
BBO	billion barrels of oil
bcf	billion cubic feet
BLM	Bureau of Land Management
BMR	Bureau of Marine Resources
BOD	biological oxygen demand
BOP	blowout preventer
BPD	barrels per day
Btu	British thermal unit
CAA	Clean Air Act
CAB	Coastal Area Board
Call	Call for Information and Nominations
CBRA	Coastal Barrier Resources Act of 1982
CBRS	Coastal Barrier Resource System
CEE	Center for Environmental Education
CEI	Coastal Environments, Inc.
CEQ	Council on Environmental Quality
CER	categorical exclusion review
CERCLA	Comprehensive Environmental Compensation and Liability Act
CFR	Code of Federal Regulations
CGA	Clean Gulf Associates
cm	centimeter
COE	Corps of Engineers (U.S. Army)
CPA	Central Planning Area
CRCPD	Conference of Radiation Program Directors
CSA	Continental Shelf Associates
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
dB	decibel
DER	Department of Environmental Regulation
DM	Departmental Manual
DOC	Department of Commerce (U.S.) (also: USDOC)
DOCD	Development Operations Coordination Document
DOD	Department of Defense (U.S.)
DOE	Department of Energy (U.S.)

DOI	Department of the Interior (U.S.) (also: USDOI)
DOT	Department of Transportation (U.S.) (also: USDOT)
DPP	Development/Production Plan
DST	deep stratigraphic test
DWG	Dispersant Working Group
dwt	deadweight tonnage
EA	environmental assessment
EIS	environmental impact statement
EP	Exploration Plan
EPA	Eastern Planning Area
ESD	Emergency Shutdown System
ESP	Environmental Studies Program
ESS	Emergency Support System
FAA	Federal Aviation Administration
FCF	Fishermen's Contingency Fund
FCMP	Florida Coastal Management Program
FERC	Federal Energy Regulatory Commission
FMC	Fisheries Management Council
FMP	Fishery Management Plan
FR	Federal Register
FRS	Fast Response System
FSV	flow safety valve
ft	foot
FWPCA	Federal Water Pollution Control Act
FWS	Fish and Wildlife Service
FY	fiscal year
G&G	geological and geophysical
GIWW	Gulf Intracoastal Waterway
GMFMC	Gulf of Mexico Fishery Management Council
GS	Geological Survey (U.S.) (also: USGS)
H.R.	House Resolution (U.S. Congress)
ha	hectare
HAPC	Habitat Area of Particular Concern
HOSS	High-Volume Open Sea Skimmer System
IMCO	Intergovernmental Maritime Consultative Organization
in	inch
IPF	impact-producing factor
ITL	Information to Lessees and Operators
ITS	Incidental Take Statement
km	kilometer
kn	knots
LCZMP	Louisiana Coastal Zone Management Program
LGS	Louisiana Geological Survey
LNG	liquefied natural gas
LOOP	Louisiana Offshore Oil Port
LSH	level sensor high
LSL	level sensor low
LTL	Letter to Lessees and Operators
m	meter
MAFLA	Mississippi, Alabama, Florida
MCP	Mississippi Coastal Program
MFCMA	Magnuson Fishery Conservation and Management Act of 1976

mi	mile
MIRG	Marine Industry Research Group
MMbbl	million barrels
MMC	Marine Mammal Commission
MMcf	million cubic feet
MMRI	Mississippi Mineral Resources Institute
MMS	Minerals Management Service
MOU	Memorandum of Understanding
MPA	Marine Preservation Association
MSRC	Marine Spill Response Corporation
mta	million metric tons annually
MWD	measurement while drilling
NAAQS	National Ambient Air Quality Standards
NAS	National Academy of Sciences
NCP	National Contingency Plan
NCSC	Naval Command System Center
NEPA	National Environmental Policy Act
NERBC	New England River Basins Commission
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NODC	National Oceanographic Data Center
NOI	Notice of Intent to Prepare an EIS
NORM	naturally occurring radioactive materials
NPA	National Planning Association Data Services, Inc.
NPDES	National Pollution and Discharge Elimination System
NPS	National Park Service
NRC	National Research Council
NRT	National Response Team
NSPS	new source performance standards
NTL	Notice to Lessees and Operators
OCDM	Offshore Coastal Dispersion Model
OCRM	Office of Ocean and Coastal Resource Management
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OHMSETT	Oil and Hazardous Materials Simulated Environmental Test Tank
OSC	On-Scene Coordinator
OSCP	Oil Spill Contingency Plan
OSRA	Oil Spill Risk Analysis
OTA	Office of Technology Assessment (U.S. Congress)
P.L.	Public Law
PINC	Potential Incident of Noncompliance
PIRS	Pollution Incident Reporting System
ppm	parts per million
PSD	Prevention of Significant Deterioration
PSH	high-pressure sensor
PSL	low-pressure sensor
PSV	pressure relief valve
PWSA	Ports and Waterways Safety Act
RCP	Regional Contingency Plan
RCRA	Resource Conservation and Recovery Act
RD	Regional Director

ROTAC	Regional Operations Technology Assessment Committee
RRT	Regional Response Team
RTWG	Regional Technical Working Group
SARA	Superfund Amendments and Reauthorizations Act of 1986
SEL	Site Evaluation List
SIC	Standard Industrial Classification
SMA	Special Management Area
SMSA	Standard Metropolitan Statistical Area
SPCC	Spill Prevention Control and Countermeasure
SPR	Strategic Petroleum Reserve
SSSV	subsurface safety valve
STOCS	South Texas Outer Continental Shelf
SUSIO	State University System of Florida, Institute of Oceanography
tcf	trillion cubic feet
TSP	total suspended particulates
TSS	traffic separation schemes
U.S.	United States
U.S.C.	United States Code
USAF	U.S. Air Force
USCG	U.S. Coast Guard
USDOC	U.S. Department of Commerce (also: DOC)
USDOI	U.S. Department of the Interior (also: DOI)
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
VOC	volatile organic compounds
VOSS	Vessel of Opportunity Skimming System
WPA	Western Planning Area
yd	yard
yr	year

SUMMARY

This environmental impact statement (EIS) addresses two proposed Federal actions, lease Sales 142 and 143, that will offer for lease Gulf of Mexico Outer Continental Shelf (OCS) areas that may contain economically recoverable oil and gas resources. The lease sales are proposed for 1993 and include lease blocks in the Central Gulf of Mexico Planning Area (CPA) and Western Gulf of Mexico Planning Area (WPA). Figure I-1 provides statistics on the leasing status in these two areas. Approximately 9,900 blocks will be available for lease under the two proposed actions; only a small percentage is expected to be actually leased. On average, 434 blocks in the Central Gulf and 264 blocks in the Western Gulf have been leased in individual Gulf of Mexico OCS lease sales since 1984. Of the blocks that will be leased as a result of the two proposed actions, only a portion will be drilled and result in subsequent production.

The analytical methods used in this EIS have been formulated over a period of years. The first step of the analysis is the identification of significant environmental and socioeconomic resources through the scoping process outlined in Section I.B.2.c.(1). A range of energy resource estimates is derived from geologic and economic assumptions and alternatives to the proposed action are established. Estimated levels of exploration and development activity are assumed for the purposes of the analysis. An analysis of the potential interaction between the significant environmental resources and the OCS-related activities is then conducted.

The scoping process (Section I.B.2.) was used to obtain information and comments on the proposed actions and the potential environmental effects from diverse interests, including the affected States, Federal agencies, the petroleum industry, environmental and public interest groups, and concerned individuals. The input from these sources aided in the identification of significant issues, possible alternatives to the proposed actions, and potential mitigating measures. The following are brief descriptions of the proposed actions, alternatives, mitigating measures, and issues addressed in this EIS.

Proposed Actions and Alternatives

Proposed Central Gulf Sale 142 and the Alternatives

Alternative A (Proposed Central Gulf Sale 142) is scheduled to be held in March 1993 and may offer approximately 5,194 unleased blocks (as of January 1992) comprising about 28.0 million acres in the CPA. This area includes acreage located from 3 to 219 mi offshore in water depths ranging from 13 to over 11,000 ft. There are no areas deferred from the CPA. This alternative includes existing regulations and proposed lease stipulations designed to reduce environmental risks. It is estimated that the proposal could result in the production of 0.14 billion bbl of oil (BBO) and 1.40 trillion cubic feet (tcf) of gas.

Alternative B (The Proposed Action Excluding the Blocks Near Biologically Sensitive Topographic Features) would delete all unleased blocks of the 167 total blocks on or near biologically sensitive areas of the topographic features in the Central Gulf. All of the remaining unleased area would be available for leasing.

Alternative C (No Action) equates to cancellation of the sale. Neither potential environmental effects nor oil and gas production, which could result from the proposed action, would occur. Alternative energy resources that might be used to replace energy resources lost by cancellation of this sale are discussed in Appendix D.

Proposed Western Gulf Sale 143 and the Alternatives

Alternative A (Proposed Western Gulf Sale 143) is scheduled to be held in August 1993 and may offer approximately 4,715 unleased blocks (as of January 1992), comprising about 25.8 million acres in the WPA. This area is located from 9 to 221 mi offshore in water depths ranging from 26 to over 9,000 ft. Excluded from this proposed action are Blocks A-375 (East Flower Garden Bank) and A-398 (West Flower Garden Bank) in the High Island Area; these blocks are deferred because of the environmentally sensitive nature of the biological communities located there. The East and West Flower Garden Banks have officially been designated as marine sanctuaries. This alternative includes existing regulations and proposed lease stipulations designed to reduce environmental risks. It is estimated that the proposal could result in the production of 0.05 BBO and 0.74 tcf of gas.

Alternative B (The Proposed Action Excluding the Blocks Near Biologically Sensitive Topographic Features) would delete all unleased blocks of the 200 total blocks on or near biologically sensitive areas of the topographic features in the Western Gulf. All of the remaining unleased areas would be available for leasing, except for the two deferred blocks at the Flower Garden Banks.

Alternative C (The Proposed Action Excluding Blocks Contained in the Western Naval Operations Area) would delete approximately 340 blocks contained in the Western Naval Operations Area near Corpus Christi, Texas.

Alternative D (No Action) equates to cancellation of the sale. Neither potential environmental effects nor oil and gas production, which could result from the proposed action, would occur. Alternative energy resources that might be used to replace energy resources lost by cancellation of this sale are discussed in Appendix D.

Mitigating Measures

Four potential stipulations have historically been applied to appropriate Gulf OCS leases, and these are analyzed as part of the proposed actions. These stipulations are the Live Bottom (Pinnacle Trend), Topographic Features, Archaeological Resource, and Military Area Stipulations for the Central Gulf sale; and the Topographic Features, Archaeological Resource, and Military Area Stipulations for the Western Gulf sale. Actual application of these stipulations to leases that may result from the proposed actions are options available to the Secretary of the Interior.

Action Scenarios Analyzed

Oil and gas resources estimated to be leased and developed from the proposed lease sales are the basis for environmental analyses of resources that may be impacted by OCS activities. These estimates, based on many factors such as geologic structure, economic assumptions, proximity to existing development, etc., fall within a large range. From these ranges, two scenarios are developed. The primary scenario is called the Base Case and assumes the mean or expected amounts of undiscovered, unleased hydrocarbon resources, and resultant development activities. The second scenario is the High Case, which is the relatively less likely possibility that the upper end of the range of energy resource estimates will be leased, discovered, and developed.

An additional analysis is given of the environmental impacts that result from the incremental impact of the lease sales when added to all past, present, and reasonably foreseeable future human activities. The outcome of this analysis is labeled the cumulative impact on the particular resource under discussion and covers a period of 35 years. This term, however, should not be confused with the cumulative impacts attributable to OCS activities.

The environmental analyses are based on levels of assumed development activities correlated with the amount of resources estimated to be leased (Table S-1). These activities include the number of platforms, wells, pipelines, service vessel trips, etc. The interaction of all OCS activities that result from the lease sale with environmental resources is analyzed.

Significant Issues

Table S-2 lists the resources and activities determined through the scoping process to be sufficiently important to warrant inclusion in this environmental analysis. The scoping process is an ongoing effort, and contacts are made with other Federal and State Agencies, the public, academia, and environmental groups to identify those resources about which there is concern. This process determines the significant resources and activities to be addressed in the EIS.

Impact Conclusions

Tables S-3 and S-4 provide a summary of the impacts of proposed Sales 142 and 143 and their alternatives under the Base Case, High Case, and cumulative analyses.

Table S-1

Oil and Gas Resource and OCS Development Activity Estimates: Sales 142 and 143

	Central Planning Area Sale 142 Base Case	Western Planning Area Sale 143 Base Case
Acreage Available for Leasing[1]		
(million of acres)	28.0	25.8
Resources Expected to be Developed[2]		
Oil (billion barrels)	0.14	0.05
Gas (trillion cubic feet)	1.40	0.74
OCS Development Activity		
Exploration and Delineation Wells	340	210
Platform Installations	30	10
Development Wells	250	110
Pipelines (kilometers)	240	80

[1]Unleased acreage available for leasing (deferred acreage not included) as of January 1992 for the Central and Western Gulf sales.
[2]The methodology used to estimate resources is explained in Appendix C.

Source: USDOI, Minerals Management Service, Gulf of Mexico OCS Region estimates, 1991.

Table S-2

Significant Environmental Resources and Activities Analyzed

Central Gulf Sale 142

- Coastal Environments
  - Coastal Barrier Beaches
  - Wetlands
- Offshore Environments
  - Live-bottoms (Pinnacle Trend)
  - Deep-water Benthic Communities
  - Topographic Features
- Water Quality
- Air Quality
- Coastal and Marine Mammals
  - Marine Mammals
    - Nonendangered and Nonthreatened Species
    - Endangered and Threatened Species
  - Alabama, Choctawhatchee, and Perdido Key Beach Mice
- Marine Turtles
- Coastal and Marine Birds
  - Nonendangered and Nonthreatened Species
  - Endangered and Threatened Species
- Gulf Sturgeon
- Commercial Fisheries
- Recreational Resources and Activities
  - Beach Use
  - Marine Fishing
- Archaeological Resources
  - Historic
  - Prehistoric
- Socioeconomic Conditions
  - Population, Labor, and Employment
  - Public Services and Infrastructure
  - Social Patterns

Western Gulf Sale 143

- Coastal Environments
  - Coastal Barrier Beaches
  - Wetlands
- Offshore Environments
  - Deep-water Benthic Communities
  - Topographic Features
- Water Quality
- Air Quality
- Marine Mammals
  - Nonendangered and Nonthreatened Species
  - Endangered and Threatened Species
- Marine Turtles
- Coastal and Marine Birds
  - Nonendangered and Nonthreatened Species
  - Endangered and Threatened Species
- Commercial Fisheries
- Recreational Resources and Activities
  - Beach Use
  - Marine Fishing
- Archaeological Resources
  - Historic
  - Prehistoric
- Socioeconomic Conditions
  - Population, Labor, and Employment
  - Public Services and Infrastructure
  - Social Patterns

Table S-3

Comparison and Summary of Impacts for Alternatives A-C
and Cumulative in the Central Planning Area (Sale 142)

Alternatives	Resource Categories		
	Coastal Barrier Beaches	Wetlands	Live Bottom (Pinnacle Trend)
Alternative A Base Case	The proposed action is not expected to result in permanent alterations of barrier beach configurations, except in localized areas downdrift from navigation channels that have been dredged and deepened. The contribution to this localized erosion is expected to be less than 1 percent.	The proposed action is expected to result in dieback and mortality of 10-15 ha of wetlands vegetation as a result of contacts from onshore oil spills. All but 2 ha of these wetlands will recover within 10 years; the remaining 2 ha will be converted to open water. About 5.5 ha of wetlands are projected to be eroded along channel margins as a result of OCS vessel wake erosion, and 3.5 ha of wetlands are projected to be created as a result of beneficial disposal of dredged material from channel-deepening projects.	The impact of the proposed action is expected to be such that any changes in the regional physical integrity, species diversity, or biological productivity of the Pinnacle Trend region would recover to pre-impact conditions in less than 2 years, more probably on the order of 2-4 months.
Alternative A High Case	Same as Alternative A - Base Case.	The proposed action is expected to result in dieback and mortality of 10-15 ha of wetlands vegetation as a result of contacts from onshore oil spills. All but 2 ha of these wetlands will recover within 10 years; the remaining 2 ha will be converted to open water. About 11 ha of wetlands are projected to be eroded along channel margins as a result of OCS vessel wake erosion, and 7 ha of wetlands are projected to be created as a result of beneficial disposal of dredged material from channel-deepening projects.	Same as Alternative A - Base Case.
Alternative B[1]	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative C[2]	No effect.	No effect.	No effect.
Cumulative Impacts	The observed erosional trend of barrier features is expected to continue in onshore Subareas C-1, C-2, and C-3. The major causes of these impacts are sediment deficits and relative sea-level rise.	Large losses of wetlands are expected to continue to occur. The main cause of these losses, particularly in coastal Louisiana where the largest amount of wetlands will be lost, is sediment deprivation and rapid coastal submergence. Other contributing factors include tideland oil and gas development, the erosion of navigation channel margins, and, to a lesser extent, impacts from oil spills.	The cumulative impacts are expected to be such that this damage to one or more components of a few regionally common habitats or communities results in changes to physical integrity, species diversity, or biological productivity that exceeds natural variability (observed prior to the damage); recovery to pre-impact conditions is expected to take longer than 10 years.

Table S-3 Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Central Planning Area (Sale 142) (continued)

Alternatives	Resource Categories		
	Deep-water Benthic Communities	Topographic Features	Water Quality
Alternative A Base Case	The proposed action is expected to cause little damage to the physical integrity, species diversity, or biological productivity of either the widespread, low-density chemosynthetic communities or the rarer, widely scattered, high-density Bush Hill-type chemosynthetic communities. Recovery from any damage is expected to take less than 2 years.	The proposed action is expected to cause little to no damage to the physical integrity, species diversity, or biological productivity of the habitats of the topographic features of the Gulf of Mexico. Small areas of 5-10 m^2 would be impacted, and recovery from this damage to pre-impact conditions is expected to take less than 2 years, probably on the order of 2-4 weeks.	An identifiable change to the ambient concentration of one or more water quality parameters will be evident up to several hundred to 1,000 m from the source and for a period lasting up to several weeks in duration in marine and coastal waters. Chronic, low-level pollution related to the proposal will occur throughout the life of the proposed action.
Alternative A High Case	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative B[1]	Same as Alternative A - Base Case.	Alternative B is expected to cause little to no damage to the physical integrity, species diversity, or biological productivity of the habitats of the topographic features of the Gulf of Mexico. Small areas of 5-10 m^2 would be impacted, and recovery from this damage to pre-impact conditions is expected to take less than 2 years, probably on the order of 2-4 weeks. Selection of Alternative B would preclude oil and gas operations in the unleased blocks affected by the proposed Topographic Features Stipulation.	Same as Alternative A - Base Case.
Alternative C[2]	No effect.	No effect.	No effect.
Cumulative Impacts	The cumulative impacts are expected to cause little damage to the physical integrity, species diversity, or biological productivity of either the widespread, low-density chemosynthetic communities or the rarer, widely scattered, high-density Bush Hill-type chemosynthetic communities. Recovery from any damage is expected to take less than 2 years.	The Cumulative scenario is expected to cause little to no damage to the physical integrity, species diversity, or biological productivity of the habitats of the topographic features of the Gulf of Mexico. Small areas of 5-10 m^2 would be impacted, and recovery from this damage to pre-impact conditions is expected to take less than 2 years, probably on the order of 2-4 weeks.	Cumulative demands resulting from the proposal are expected to result in significant changes to the ambient concentration of one or more water quality parameters up to several hundred to 1,000 m from the source of activities and for a period lasting up to several weeks or months in duration. Chronic, low-level pollution related to the proposal will occur throughout the life of the proposed action. Overall cumulative impacts, which include the effects of non-OCS-related factors and OCS activities, will signifi- cantly degrade water quality, primarily within the Gulf of Mexico's coastal zone, in highly urbanized and industrialized coastal areas. Maritime activities will contribute to water quality degradation near ports and major navigation channels. In restricted or poorly flushed coastal waterbodies, localized increases in pollutant concentrations may be severe and persist for months or longer. Chronic, low-level pollution will continue to persist in marine and coastal waters.

Table S-3 Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Central Planning Area (Sale 142) (continued)

Alternatives	Resource Categories			
		Marine Mammals		
	Air Quality	Nonendangered and Nonthreatened	Endangered and Threatened	Alabama, Choctawhatchee, and Perdido Key Beach Mice
Alternative A Base Case	Emission of pollutants into the atmosphere are expected to have concentrations that would not change onshore air quality classifications. An increase in onshore concentrations of air pollutants is estimated to be about 1 μgm^{-3}. This concentration will have minimal impacts during winter because onshore winds occur only about 37 percent of the time, with maximum impacts in summer when onshore winds occur 61 percent of the time.	The impact on nonendangered and nonthreatened marine mammals within the potentially affected area is expected to result in sublethal effects that are chronic and could result in persistent physiological or behavioral changes, as well as some degree of avoidance of the impacted area.	The impact on endangered and threatened marine mammals within the potentially affected area is expected to result in sublethal effects that are chronic and could result in persistent physiological or behavioral changes, as well as some degree of avoidance of the impacted area.	The impact on beach mice within the potentially affected area is expected to result in sublethal effects that seldom occur and may cause short-term physiological or behavioral changes.
Alternative A High Case	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative B[1]	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative C[2]	No effect.	No effect.	No effect.	No effect.
Cumulative Impacts	Emission of pollutants into the atmosphere from the activities assumed for the OCS program are expected to have concentrations that may change onshore air quality classifications. Increases in onshore concentrations of air pollutants are estimated to be between 1 and 14.5 μgm^{3} (box model steady concentrations). This concentration will have minimal impact during winter because onshore winds occur only 37 percent of the time, with maximum impacts in summer when onshore winds occur 61 percent of the time.	The impact on nonendangered and nonthreatened marine mammals within the potentially affected area is expected to result in a decline in species numbers or a temporary displacement from their current distribution, a decline or displacement that will last more than one generation.	The impact on endangered and threatened marine mammals within the potentially affected area is expected to result in a decline in species numbers or a temporary displacement from their current distribution, a decline or displacement that will last more than one generation.	The cumulative impact on beach mice within the potentially affected area is expected to result in a decline in species numbers or a temporary displacement from their current distribution, a decline or displacement that will last more than one generation.

Table S-3 Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Central Planning Area (Sale 142) (continued)

Alternatives	Resource Categories			
		Coastal and Marine Birds		
	Marine Turtles	Nonendangered and Nonthreatened	Endangered and Threatened	Gulf Sturgeon
Alternative A Base Case	The impact on marine turtles within the potentially affected area is expected to result in sublethal effects that are chronic and could result in persistent physiological or behavioral changes.	The impact on nonendangered and nonthreatened coastal and marine birds within the potentially affected area is expected to result in no discernible decline in a population or species and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to predisturbance condition in less than one generation.	The impact on endangered and threatened birds within the potentially affected area is expected to result in no discernible decline in a population or species and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to predisturbance condition in less than one generation.	The impact on the Gulf sturgeon within the potentially affected area is expected to result in sublethal effects and cause short-term physiological or behavioral changes.
Alternative A High Case	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative B[1]	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative C[2]	No effect.	No effect.	No effect.	No effect.
Cumulative Impacts	The cumulative impact on marine turtles within the potentially affected area is expected to result in a decline in species numbers or a temporary displacement from their current distribution, a decline or displacement that will last more than one generation.	The cumulative effect on coastal and marine birds within the potentially affected area is expected to result in a discernible decline in a local coastal or marine bird population or species, resulting in a change in distribution or abundance. Recruitment will return the population or affected species to their pre-impact level and/or condition within one to two generations. It is doubtful that this impact will affect regional populations.	The impact on endangered and threatened birds within the potentially affected area is expected to result in a decline in species number or a temporary displacement from their current distribution, a decline or displacement that will last more than one generation.	The impact on the Gulf sturgeon within the potentially affected area is expected to result in a decline in species number or a temporary displacement from their current distribution, a decline or displacement that will last more than one generation.

Table S-3 Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Central Planning Area (Sale 142) (continued)

Alternatives	Resource Categories: Commercial Fisheries	Beach Use	Marine Fishing
Alternative A Base Case	The impact on commercial fisheries within the potentially affected area is expected to result in a short-term decrease in a portion of a population of commercial importance, in an essential habitat, or in commercial fisheries on a local scale. Any affected population is expected to recover to predisturbance condition in one generation.	The proposed action is expected to result in minor pollution events and nearshore operations that may adversely affect the enjoyment of some beach users on Texas and Louisiana beaches.	Platforms installed within 30 mi of shore will attract fish and are likely to attract fishermen and improve fishing for a period of about 20 years, but are unlikely to affect offshore fishing patterns in general unless the platforms are installed in nearshore locations where no platforms currently exist.
Alternative A High Case	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	The High Case scenario will likely result in a few more platforms that will be productive sports fish areas accessible to and used by offshore recreational fishermen throughout the CPA, but it is unlikely to have a detectable impact on the recreational fishing industry at the regional level. A few local fishing markets could suffer short-term (up to one month) loss of business from a major pollution event; however, these same markets should experience long-term (15-20 yrs) benefit from platform installations accessible to local fishermen.
Alternative B[1]	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative C[2]	No effect.	No effect.	No effect.
Cumulative Impacts	The cumulative effect on the commercial fishing industry within the potentially affected area is expected to result in a discernible decline in populations of commercial importance, in the quality of essential habitats, or in commercial fishing activity. Recruitment will return any affected population, habitat, or activity to pre-impact level and/or condition within two to three generations.	Although trash and accidental oil spills will continue to affect the ambience of recreational beaches between Alabama and Texas, the level of chronic pollution should decline during the life of the proposed action. Beach use at the regional level is unlikely to change; however, closure of specific beached or parks directly impacted by one or two oil spills greater than or equal to 1,000 bbl is likely during cleanup operations.	Continued offshore oil and gas development over the next 35 years will continue to support, maintain, and facilitate offshore recreational fishing in the CPA and will extend the time offshore oil and gas structures are a focus of offshore fishing activity.

Table S-3 Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Central Planning Area (Sale 142) (continued)

Alternatives	Resource Categories	
	Archaeological Resources	
	Historic	Prehistoric
Alternative A Base Case	There is a very small possibility of an impact between OCS oil and gas activities and a historic shipwreck or site. Should such an impact occur, unique or significant historic archaeological information could be lost.	There is a very small possibility of an impact between OCS oil and gas activities and a prehistoric site. Should such an impact occur, unique or significant prehistoric archaeological information could be lost.
Alternative A High Case	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative B[1]	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative C[2]	No effect.	No effect.
Cumulative Impacts	The total of OCS program and non-program related impact-producing factors has likely resulted in and may yet result in loss of significant or unique historic archaeological information.	The total of OCS program and non-program-related impact-producing factors has likely resulted in and may yet result in loss of significant or unique prehistoric archaeological information.

Table S-3 Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Central Planning Area (Sale 142) (continued)

Alternatives	Resource Categories		
	Socioeconomic Conditions		
	Population, Labor, and Employment	Public Services and Infrastructure	Social Patterns
Alternative A Base Case	The impact in the Central Gulf on the population, labor, and employment of the counties and parishes of the Central and Western Gulf coastal impact area is expected to be less than 1 percent of the levels expected in the absence of the proposal.	Population and employment impacts will not result in disruptions to community infrastructure and public services beyond what is anticipated by in-place planning and development agencies.	It is expected that no net migration will occur as a result of the proposed action. Deleterious impacts to social patterns are expected to occur in some individual cases as a result of extended work schedules, displacement from traditional occupations, and relative wages.
Alternative A High Case	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative B[1]	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative C[2]	No effect.	No effect.	No effect.
Cumulative Impacts	On a regional level, the cumulative impact from prior sales, the proposed actions, and future sales on the population, labor, and employment of the counties and parishes of the Central Gulf coastal impact area is significant, amounting to approximately 3,310,400 person-years of employment over the life of the proposed action plus at least an additional 11,050 person-years of employment associated with the clean-up of three oil spills. Locally, the cumulative impact to population, labor, and employment is higher for coastal Subareas C-1 and C-2 along the western and central Louisiana coastline, lower for coastal Subarea C-3 in southeast Louisiana, and lowest for coastal Subarea C-4 in Mississippi and Alabama. Employment needs in support of OCS oil and gas activity are likely to be met with the existing population and available labor force.	The cumulative impact is expected to result in deteriorating conditions of existing infrastructure and difficulties in delivering satisfactory levels of public services.	It is expected that some loss of traditional occupations will occur. Deleterious impacts to cultural heritage and family life are also expected to occur in some individual cases. It is expected that these impacts will be greatest in coastal Subareas C-1, C-2, and C-3.

[1]Alternative B - The Proposed Action Excluding the Blocks Near Biologically Sensitive Topographic Features.
[2]Alternative C - No Action.

Table S-4
Comparison and Summary of Impacts for Alternatives A-D
and Cumulative in the Western Planning Area (Sale 143)

Alternatives	Resource Categories			
	Coastal Barrier Beaches	Wetlands	Deep-water Benthic Communities	Topographic Features
Alternative A Base Case	The proposed action is not expected to result in permanent alterations of barrier beach configurations, except in localized areas downdrift from channels that have been dredged and deepened. The contribution to this localized erosion is expected to be less than 1 percent.	The proposed action is expected to result in no permanent alterations of wetland habitat, except for the erosion of less than 1 ha of wetlands along navigation channel margins. These losses could be offset or even exceeded by wetland gains from the beneficial disposal of dredged material generated during channel maintenance and deepening operations.	The proposed action is expected to cause little damage to the physical integrity, species diversity, or biological productivity of either the widespread, low-density chemosynthetic communities or the rare, widely scattered, high-density Bush Hill-type chemosynthetic communities. Recovery from any damage is expected to take less than 2 years.	The proposed action is expected to cause little to no damage to the physical integrity, species diversity, or biological productivity of the habitats of the topographic features of the Gulf of Mexico. Small areas of 5-10 m^2 would be impacted, and recovery from this damage to pre-impact conditions is expected to take less than 2 years, probably on the order of 2-4 weeks.
Alternative A High Case	Same as Alternative A - Base Case.	The proposed action is expected to result in no permanent alterations of wetland habitat, except for the erosion of less than 2 ha of wetlands along navigation channel margins. These losses could be offset or even exceeded by wetland gains from the beneficial disposal of dredged material generated during channel maintenance and deepening operations.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative B[1]	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Alternative B is expected to cause little to no damage to the physical integrity, species diversity, or biological productivity of the habitats of the topographic features of the Gulf of Mexico. Small areas of 5-10 m^2 would be impacted, and recovery from this damage to pre-impact conditions is expected to take less than 2 years, probably on the order of 2-4 weeks. Selection of Alternative B would preclude oil and gas operations in the unleased blocks affected by the proposed Topographic Features Stipulation.
Alternative C[2]	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.

Table S-4 Comparison and Summary of Impacts for Alternatives A-D and Cumulative in the Western Planning Area (Sale 143) (continued)

Alternatives	Resource Categories			
	Coastal Barrier Beaches	Wetlands	Deep-Water Benthic Communities	Topographic Features
Alternative D[3]	No effect.	No effect.	No effect.	No effect.
Cumulative Impacts	The observed erosional trend of barrier features will continue along the Gulf Coast in the area of potential impact. The major causes of the impacts is the reduction in sediment being delivered to the coastal littoral system, sea-level rise, the effects of navigational and erosion control structures, and some recreational impacts.	Losses of wetlands are expected to continue. The major cause of this loss is expected to be coastal submergence.	The Cumulative Scenario is expected to cause little damage to the physical integrity, species diversity, or biological productivity of either the widespread, low-density chemosynthetic communities or the rare, widely scattered, high-density Bush Hill-type chemosynthetic communities. Recovery from any damage is expected to take less than 2 years.	The Cumulative Scenario is expected to cause little to no damage to physical integrity, species diversity, or biological productivity of the habitats of the topographic features of the Gulf of Mexico. Small areas of 5-10 m^2 would be impacted, and recovery from this damage to pre-impact conditions is expected to take less than 2 years, probably on the order of 2-4 weeks.

Table S-4 Comparison and Summary of Impacts for Alternatives A-D and Cumulative in the Western Planning Area (Sale 143) (continued)

Alternatives	Resource Categories			
			Marine Mammals	
	Water Quality	Air Quality	Nonendangered and Nonthreatened	Endangered and Threatened
Alternative A Base Case	An identifiable change to the ambient concentration of one or more water quality parameters will be evident up to several hundred to 1,000 m from the source and for a period lasting up to several weeks in duration in marine and coastal waters. Chronic, low-level pollution related to the proposal will occur throughout the life of the proposed action.	Emissions of pollutants into the atmosphere are expected to have concentrations that would not change onshore air quality classifications. Increase in onshore concentrations of air pollutants are estimated to be about 1 μgm^{-3}. This concentration will have minimal impacts during winter because onshore winds occur only about 34 percent of the time, with maximum impacts in summer when onshore winds occur 85 percent of the time.	The impact on nonendangered and nonthreatened marine mammals within the potentially affected area is expected to result in sublethal effects that occur periodically and result in short-term physiological or behavioral changes, as well as some degree of avoidance of the impacted area(s).	The impact on endangered and threatened marine mammals within the potentially affected area is expected to result in sublethal effects that occur periodically and result in short-term physiological or behavioral changes, as well as some degree of avoidance of the impacted area(s).
Alternative A High Case	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	The impact on nonendangered and nonthreatened marine mammals within the potentially affected area is expected to result in sublethal effects that are chronic and could result in persistent physiological or behavioral changes, as well as some degree of avoidance of the impacted area(s).	The impact on endangered and threatened marine mammals within the potentially affected area is expected to result in sublethal effects that are chronic and could result in persistent physiological or behavioral changes, as well as, some degree of avoidance of the impacted area(s).
Alternative B[1]	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative C[2]	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative D[3]	No effect.	No effect.	No effect.	No effect.

Table S-4 Comparison and Summary of Impacts for Alternatives A-D and Cumulative in the Western Planning Area (Sale 143) (continued)

Alternatives	Resource Categories			
			Marine Mammals	
	Water Quality	Air Quality	Nonendangered and Nonthreatened	Endangered and Threatened
Cumulative Impacts	Cumulative demands resulting from the proposal are expected to result in significant changes to the ambient concentration of one or more water quality parameters up to several hundred to 1,000 m from the source of activities and for a period lasting up to several weeks or months in duration. Chronic pollution related to the proposal will occur throughout the life of the proposed action. Overall cumulative impacts, which include the effects of non-OCS-related factors and OCS activities, will significantly degrade water quality, primarily within the Gulf of Mexico's coastal zone in highly urbanized and industrialized coastal areas. Maritime activities will contribute to water quality degradation near ports and major navigation channels. In restricted or poorly flushed coastal waterbodies, localized increases in pollutant concentration (nutrients, organic matter, trace metals, organotins, hydrocarbons, etc.) may be severe and persist for months or longer. Chronic, low-level pollution will continue to persist in marine and coastal waters.	Emission of pollutants into the atmosphere from the activities assumed for the OCS program within the WPA are expected to have concentrations that would not change onshore air quality classifications. Increases in onshore concentrations of air pollutants from the High Case are estimated to be between 1 and 14.5 μgm^3 (box model steady concentrations). This concentration will have minimal impact during winter because onshore winds occur only 34 percent of the time, with maximum impact in winter when onshore winds occur 85 percent of the time.	The impact on nonendangered and nonthreatened marine mammals within the potentially affected area is expected to result in a decline in species numbers or temporary displacement from their current distribution, a decline or displacement that will last more than one generation.	The impact on endangered and threatened marine mammals within the potentially affected area is expected to result in a decline in species numbers or temporary displacement from their current distribution, a decline or displacement that will last more than one generation.

Table S-4 Comparison and Summary of Impacts for Alternatives A-D and Cumulative in the Western Planning Area (Sale 143) (continued)

Alternatives	Resource Categories			
		Coastal and Marine Birds		
	Marine Turtles	Nonendangered and Nonthreatened	Endangered and Threatened	Commercial Fisheries
Alternative A Base Case	The impact on marine turtles within the potentially affected area is expected to result in sublethal effects that are chronic and could result in persistent physiological or behavioral changes.	The impact on nonendangered and nonthreatened coastal and marine birds within the potentially affected area is expected to result in no discernible decline in a population or species and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to predisturbance condition in less than one generation.	The impact on endangered and threatened birds within the potentially affected area is expected to result in no discernible decline in a population or species and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to predisturbance conditions in less than one generation.	The impact on commercial fisheries within the potentially affected area is expected to result in no discernible decrease in a population of commercial importance, its essential habitat, or in commercial fisheries on a local scale. Any affected population is expected to recover to predisturbance condition in one generation.
Alternative A High Case	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative B[1]	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative C[2]	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative D[3]	No effect.	No effect.	No effect.	No effect.
Cumulative Impacts	The impact on marine turtles within the potentially affected area is expected to result in a decline in species numbers or temporary displacement from their current distribution, a decline or displacement that will last more than one generation.	The cumulative effect on coastal and marine birds within the potentially affected area is expected to result in a discernible decline in a local coastal or marine bird population or species, resulting in a change in distribution or abundance. Recruitment will return the population or affected species to its pre-impact level and/or condition within one to two generations. It is doubtful that this impact will affect regional populations.	The impact of the Cumulative Case Scenario on endangered and threatened birds within the potentially affected area is expected to result in a decline in species number or temporary displacement from their current distribution, a decline or displacement that will last more than one generation.	The cumulative on the commercial fishing industry within the potentially affected area is expected to result in a discernible decline in populations of commercial importance, in the quality of essential habitats, or in commercial fishing activity. Recruitment will return any affected population, habitat, or activity to pre-impact level and/or condition within two to three generations.

Table S-4 (continued) Comparison and Summary of Impacts for Alternatives A-D and Cumulative in the Western Planning Area (Sale 143)

Alternatives	Resource Categories			
	Recreational Resources and Activiies		Archaeological Resources	
	Beach Use	Marine Fishing	Historic	Prehistoric
Alternative A Base Case	The proposed action is expected to result in periodic loss of solid waste items likely to wash up on recreational beaches, which is expected to diminish enjoyment of some beach visits but is unlikely to affect the number or type of visits currently occurring on Texas beaches.	One platform complex (2-3 structures) installed as a result of this proposal within 30 mi of shore is expected to attract fishermen and improve fishing success in the vicinity of the platform complex for a period of about 20 years.	There is a very small possibility of an impact between OCS oil and gas activities and a historic shipwreck or site. Should such an impact occur, unique or significant historic archaeological information could be lost.	There is a very small possibility of an impact between OCS oil and gas activities and a prehistoric site. Should such an impact occur, unique or significant prehistoric archaeological information could be lost.
Alternative A High Case	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative B[1]	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative C[2]	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative D[3]	No effect.	No effect.	No effect.	No effect.
Cumulative Impacts	Although trash and accidental oil spills will continue to affect the ambience of Texas recreational beaches, the level of chronic pollution should decline during the life of the proposed action. Beach use at the regional level is unlikely to change; however, closure of specific beaches or parks directly impacted by one or two oil spills greater than or equal to 1,000 bbl is likely during cleanup operations.	Continued offshore oil and gas development over the next 35 years will continue to support, maintain, and facilitate offshore recreational fishing in the WPA and extend the time offshore oil and gas production structures are a focus of offshore fishing activity.	The total of OCS program and nonprogram-related impact-producing factors have likely resulted in loss and may yet result in loss of significant or unique historic archaeological information.	The total of OCS program and nonprogram-related impact-producing factors have likely resulted in loss and may yet result in loss of significant or unique prehistoric archaeological information.

Table S-4 Comparison and Summary of Impacts for Alternatives A-D and Cumulative in the Western Planning Area (Sale 143) (continued)

Alternatives	Resource Categories		
	Socioeconomic Conditions		
	Population, Labor, and Employment	Public Services and Infrastructure	Social Patterns
Alternative A Base Case	The impact in the Western Gulf on the population, labor, and employment of the counties and parishes of the Central and Western Gulf Coastal impact area is expected to be less than 1 percent of the levels expected in the absence of the proposal.	Population and employment impacts will not result in disruptions to community infrastructure and public services beyond what is anticipated by in-place planning and development agencies.	It is expected that no net migration will occur as a result of the proposed action. Deleterious impacts to social patterns are expected to occur in some individual cases as a result of extended work schedules, displacement from traditional occupations, and relative wages.
Alternative A High Case	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative B[1]	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative C[2]	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative D[3]	No effect.	No effect.	No effect.
Cumulative Impacts	The impact from prior sales, the proposed actions, and future sales on the population, labor, and employment of the counties and of the coastal impact area is significant, amounting to approximately 277,300 person-years of employment over the life of the proposed action. Employment needs in support of OCS oil and gas activity are likely to be met with the existing population and available labor force.	The impact on public services and community infrastructure is not expected to result in long-term (greater than 3 years) disruptions in delivery of public services or maintenance of community infrastructure because of the diversified local economy and the small percentage of impact of the OCS program on local employers and demographies.	Under the cumulative scenario, it is expected that some loss of traditional occupations will occur. Deleterious impacts to cultural heritage and family life are also expected to occur in some individual cases.

[1]Alternative B - The Proposed Action Excluding the Blocks Near Biologically Sensitive Topographic Features
[2]Alternative C - The Proposed Action Excluding the Western Naval Operations Area
[3]Alternative D - No Action

I

II

III

IV

V

VI

VII

VIII

IX

SECTION I

THE PROPOSED ACTIONS

I

I. THE PROPOSED ACTIONS

A. PURPOSE, NEED, AND DESCRIPTION

The purpose of the two proposed Federal actions addressed in this Environmental Impact Statement (EIS) is the offering for lease of areas on the Central and Western Gulf of Mexico Outer Continental Shelf (OCS) for the exploration and development of recoverable oil and gas resources. The Department of the Interior (DOI) is required, under the Outer Continental Shelf Lands Act (OCSLA), as amended, to manage the leasing, exploration, development, and production of oil and gas resources on the OCS. The Secretary of the Interior (Secretary) oversees the OCS oil and gas program and is required to balance orderly resource development with protection of the human, marine, and coastal environments while simultaneously ensuring that the public receives an equitable return for these resources and that free-market competition is maintained.

The proposed sales are part of DOI's proposed 5-Year Program, which covers the period from mid-1992 to mid-1997. The proposed sales are scheduled to occur in 1993. The sale areas are depicted in Figure I-1 and lease blocks and lease status are shown on Visual No. 1. The East and West Flower Garden Banks deferral areas shown on Figure I-1 are not drawn to scale and are not as large as they appear. In addition, it should be pointed out that some areas adjacent to the two blocks containing the Flower Garden Banks are also included in the area not offered under Alternative B. Nearly 9,900 blocks will be available for lease under the two proposed actions, but only a small percentage are expected to actually be leased. The average number of blocks leased in individual Gulf of Mexico OCS lease sales since 1984 have been 434 (8 sales) in the Central Gulf and 264 (8 sales) in the Western Gulf.

The following are brief descriptions of the proposed actions, alternatives, and mitigating measures. Also provided are assumptions and estimates of the amounts, locations, and timing for OCS exploration, development, and production operations that are used in the analysis of potential impacts from the proposed actions (Base Case). More detail is available elsewhere in the document (alternatives, Sections I.B.2.a. and II.A. and B.; potential mitigating measures, Sections I.B.2.b., II.A.1.c., and II.B.1.c; and the proposed actions scenario description, Section IV.A.).

Proposed Central Gulf Sale 142 is scheduled to be held in March 1993 and will offer approximately 5,194 unleased blocks (as of January 1992), comprising about 28.0 million acres in the Central Planning Area (CPA). This area includes acreage located from 4.8 to 354 kilometers (km) offshore in water depths ranging from 4 to 3,425 meters (m). The alternatives are to delete all unleased blocks of the 167 total blocks on or near biologically sensitive areas of the topographic features or to take no action (cancel the sale). The following are assumptions regarding amounts and timing of activities that will result from proposed sale 142 (Base Case):

- During the exploration phase, 1994-2004, 340 wells will be drilled.

- During the development phase, 1995-2017, 130 oil wells and 120 gas wells will be drilled and 30 platform complexes will be installed.

- During the production phase, 1995-2026, 0.140 billion bbl of oil (BBO) and 1.40 trillion cubic feet (tcf) of gas will be produced.

- By the end of 2027, all platforms associated with the proposed action will be removed, with 20 structures being removed explosively, and the remaining 10 being removed by nonexplosive methods.

- The transportation of this oil and gas will require the following:

  - the construction of 240 km of gathering pipelines, which will be connected to existing trunklines prior to landfall (at offshore locations);

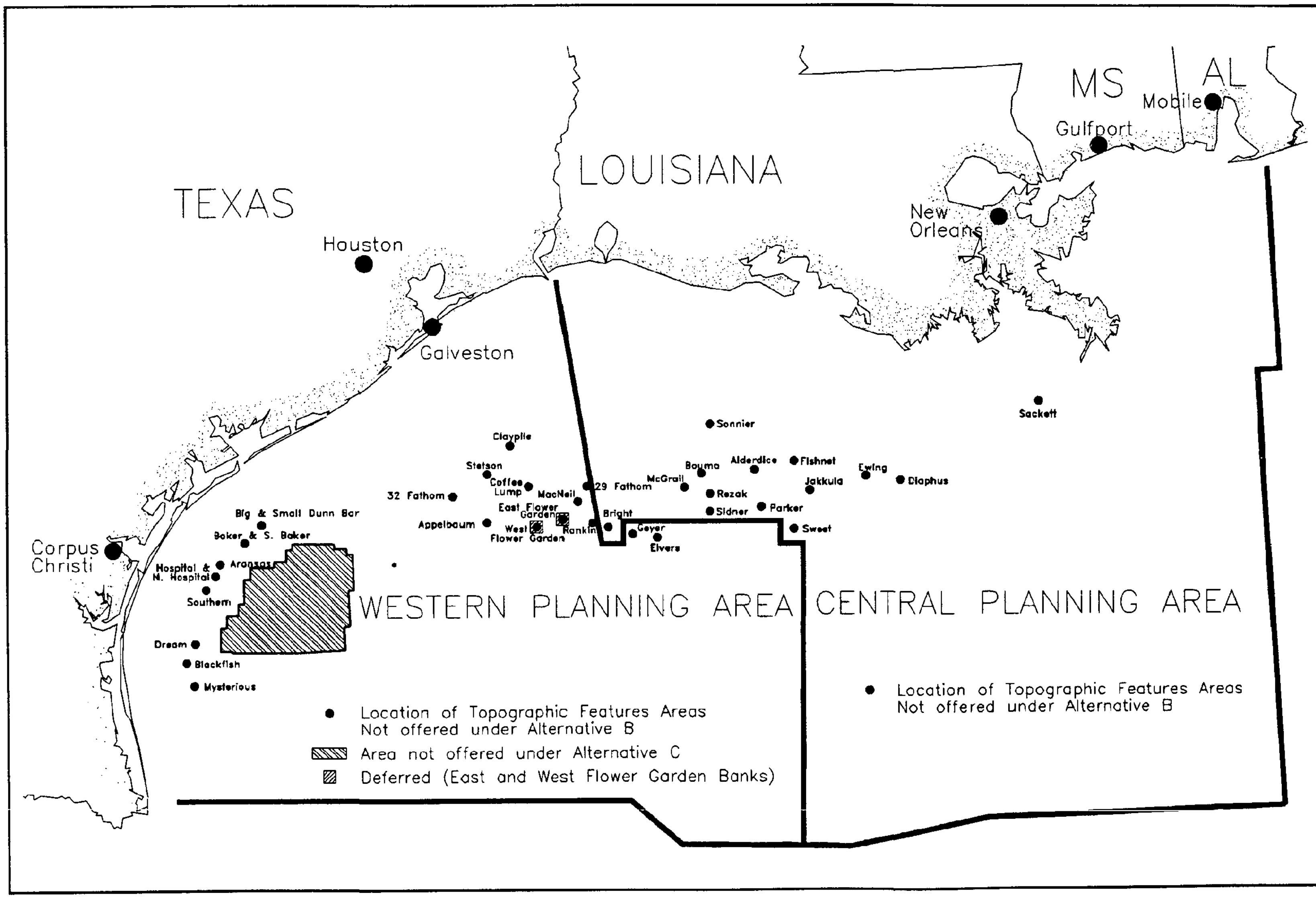


Figure I-1. Central and Western Gulf Planning Areas, Indicating Deferred Areas and Areas Affected by the Alternatives.

- 77 barge trips carrying oil to eight existing shore terminals along the Texas and Louisiana coasts; and

- 2 shuttle tanker trips carrying oil to Mississippi River terminals.

- No new onshore support or processing facility construction is expected; existing OCS-related facilities will be utilized.

- Major offshore transport of personnel and supplies will involve 368,000 helicopter trips and 17,600 service vessel trips.

- Potential accidents include the following:

  - four blowouts (Section IV.A.2.d.(8)); and

  - one large offshore spill of 6,500 barrels (bbl) with a 2 percent probability of contacting land within 10 days; a few offshore spills between 50 and 1,000 bbl; and several spills greater than 1 bbl but less than 50 bbl occurring from both onshore and offshore operations.

Section IV.A. fully describes activities and impact-producing factors assumed to occur from proposed Sale 142.

Proposed Western Gulf Sale 143 is scheduled to be held in August 1993 and will offer approximately 4,715 unleased blocks (as of January 1992), comprising about 25.8 million acres in the Western Planning Area (WPA). This area is located from 14 to 357 km offshore in water depths ranging from 8 to over 3,000 m.

Blocks A-375 (East Flower Garden Bank) and A-398 (West Flower Garden Bank) in High Island Area, East Addition, South Extension, were deferred (or excluded) from this proposed action because of the environmentally sensitive nature of the biological communities located in the blocks. The alternatives are to delete all unleased blocks of the 200 total blocks on or near biologically sensitive areas of the topographic features, to delete approximately 340 blocks (about 1.8 million acres) contained in the Western Naval Operating Area near Corpus Christi, Texas, or to take no action (cancel the sale). The following are assumptions regarding the amounts and timing of activities that will result from proposed Sale 143 (Base Case):

- During the exploration phase, 1994-2004, 210 wells will be drilled.

- During the development phase, 1995-2017, 50 oil wells and 60 gas wells will be drilled and 10 platform complexes will be installed.

- During the production phase, 1995-2026, 0.05 BBO and 0.74 tcf of gas will be produced.

- By the end of 2027, all platforms associated with the proposed action will be removed, with six being removed explosively, and the remaining four being removed by nonexplosive methods.

- The transportation of gas and oil will require the following:

  - the construction of 80 km of gathering pipelines, which will be connected to existing trunklines prior to landfall (at offshore locations);

  - 9 barge trips carrying oil to three existing shore terminals along the Texas and Louisiana coasts; and

  - 66 shuttle tanker trips carrying oil to both Texas and Louisiana terminals.

- No new major onshore support or processing facility construction is expected; existing OCS-related facilities will be utilized.

- Major offshore transport of personnel and supplies will involve 131,000 helicopter trips and 6,600 service vessel trips.

- Potential accidents include the following:

  - two blowouts (Section IV.A.2.d.(8)); and

  - several spills greater than 1 bbl less than 50 bbl occurring both onshore and offshore.

Section IV.A. fully describes activities and impact-producing factors assumed to occur from proposed Sale 143.

In addition to the alternatives that are options for each proposed lease sale, there are a number of statutory requirements, regulations, and procedures in place that are designed to avoid environmental/safety-related problems. These requirements, regulations, and procedures have evolved over the 35+ years of leasing for oil and gas on the OCS. The following are examples of some of the most important of these measures.

Exploration Plans (EP's) must be submitted and approved by the Minerals Management Service (MMS) before an operator can begin exploratory drilling on any OCS lease. Development and production activities require a Development Operations Coordination Document (DOCD) as described later. Both types of plans must include supporting information providing an analysis of onshore and offshore impacts that may occur as a result of implementation of the plan. Based on this and other available information, MMS prepares either a Categorical Exclusion Review (CER), an Environmental Assessment (EA), and/or an EIS. Plans must also include a certification of consistency with the approved Coastal Zone Management (CZM) program of the affected State (the only Gulf Coast state that does not have such a program is Texas). The certification assures that the activities described in the plan will be conducted in a manner consistent with the program. More information on the requirements of these plans is available in Sections I.B.3.d.(1)(a) and (b).

Oil Spill Contingency Plans (OSCP) must be submitted by an operator for approval with, or prior to, an EP or a DOCD. This contingency plan, outlining the availability of spill containment and cleanup equipment and trained personnel, is reviewed and updated annually. The OSCP must assure that full-response capability could be committed during an oil-spill emergency. This commitment would include specifications for appropriate equipment and materials, their availability, and the time needed for deployment. The OSCP also must include provisions for varying degrees of response effort, depending on the severity of the spill. See Sections I.B.3.d.(1)(c) and IV.C.5. for more information.

Inspections are conducted by MMS, in accordance with the OCSLA, before, during, and after operations to assure that safety and pollution-prevention requirements are met. Inspections are to include all safety equipment designed to prevent or ameliorate blowouts, fires, spillage, or other major accidents. Inspections assure that the best available and safest technology (BAST) is used for operations and procedures that, if failed, could have a significant effect on safety, health, or the environment. See Sections I.B.3.d.(2)(a) and I.B.3.d.(3)(a) for more information on inspections and BAST.

Training of oil-field personnel is another important factor in ensuring that OCS operations are carried out in a manner that emphasizes safety and minimizes the risk of environmental damage. Everyone directly concerned with the actual drilling of a well is required to have passed a course in well control at an MMS approved school. In addition, all operators must have trained personnel to operate oil-spill cleanup equipment or must have retained a trained contractor to operate the equipment for them. Additional training requirements exist for workovers, completions, and production operations. For more information see Section I.B.3.d.(3)(d).

B. BACKGROUND

1. Administrative Events Leading to the Proposed Actions

On June 13, 1991, the Call for Information and Nominations (Call) and the Notice of Intent to Prepare an EIS (NOI) for the 1993 lease sales were published in the *Federal Register.* Federal, State, and local governments, along with other interested parties, were requested to send written comments to the Region on the scope of the EIS, on significant issues that should be addressed, and on alternatives and mitigating measures that should be considered. Sending the Call/NOI to individuals, environmental groups, and industry, along with Federal, State, and local governments, provides those individuals with an interest in the OCS program an early opportunity to participate in the events leading to the publication of the Draft EIS.

Even though the Call and NOI formally initiate the scoping process for the EIS, scoping efforts and other coordination meetings were also conducted prior to publication of the Call and NOI in the *Federal Register.*

In April 1991, a Regional Technical Working Group (RTWG) meeting was held to discuss a variety of OCS-related matters, including the status of the draft EIS's in preparation at the time. A meeting held under the provisions of Section 655 of the Departmental Manual (DM 655) was convened on November 15, 1990, to discuss a wide variety of matters, including visual representation of environmental data, stipulations, and other mitigating measures. Relevant comments and information from these meetings are incorporated into the Draft EIS.

The OCSLA requires that DOI prepare a 5-year program that specifies, as precisely as possible, the size, timing, and location of areas to be assessed for Federal offshore natural gas and oil leasing. The new program, referred to as the *Comprehensive Outer Continental Shelf Natural Gas and Oil Resource Management Program, 1992-1997*, is now in the draft stage and is scheduled for completion in mid-1992. A new Area Evaluation and Decision Process (AEDP) for the consideration of leasing has been included which, among many other features, heightens attention to the adequacy of information for decisionmaking. In the Gulf of Mexico, the first proposed OCS lease sales that would be planned and analyzed in accordance with this new proposed process include proposed Sales 142 and 143. The July 1991 announcement of the Proposed Comprehensive Program for 1992-1997 included a description of the AEDP. Under the AEDP, the area proposed for leasing and the stipulations that are included in the analysis of the proposed action will be included in the notice of sale that will be made available concurrently with this Draft EIS.

The first step of the new AEDP is called the Information Base Review. The Information Base Review is a formal documented MMS assessment of the status of and plans regarding additions to the information base for potential decisions on a leasing proposal that acknowledges the concerns of other interested parties. This assessment can be used as a guide to subsequent planning and consultation efforts for the development of a specific leasing proposal and as an indication of the focus and timing of future studies and analytical efforts. This review covers environmental, geologic, and operational information.

The Information Base Review, completed in May 1991, consisted of three principal steps: (a) a two-day comprehensive review of available environmental information and proposed new environmental studies was held at the Gulf of Mexico RTWG meeting on April 2-3, 1991; (b) an internal review of available data and planned studies was conducted by the Gulf Region to obtain a comprehensive assessment of the status of the information base; and (c) letters were sent to various interested parties, which included RTWG members, Coastal Zone Management offices, State government representatives, and environmental groups, to solicit their participation in the Information Base Review process. Personal contacts with interested parties were also made by MMS, Gulf of Mexico Region personnel.

On May 30, 1991, a scoping workshop was held in Mobile, Alabama; this followed a public hearing on the Draft EIS for Sales 139 and 141. Notice of this scoping workshop was included in approximately 800 notices that were mailed out for the public hearing. In addition, approximately 150 separate notices regarding the scoping workshop were distributed to interested parties in the Alabama and Mississippi coastal areas. However, only three individuals attended the workshop-- two from the Louisiana Department of Natural Resources in Baton Rouge, Louisiana, and one from Shell Oil Company in New Orleans, Louisiana. Topics discussed included normally occurring radioactive materials (NORM), CZM issues, onshore disposal of waste generated by OCS activities, and whether existing navigation channels would have to be enlarged to accommodate passage of larger structures as oil and gas activities move into deeper offshore waters.

2. Scoping Activities and Findings

Scoping is the process by which issues related to the proposed actions are identified. A scoping effort was conducted for this EIS to provide additional information for the development of appropriate alternatives and mitigating measures, as well as to identify significant issues. The governors of the Gulf States; Federal, State, and local agencies; industry; environmental groups; and interested individuals were given an opportunity to comment. Section V contains a detailed description of this consultation and coordination process. The result of the scoping effort was the selection of the alternatives, mitigating measures, and issues described below.

a. Alternatives

(1) Alternatives for Proposed Central Gulf Sale 142

Alternative A (The Proposed Action): The proposed action for Sale 142 is to offer for lease all unleased blocks, approximately 28.0 million acres, or a maximum of 5,194 blocks (as of January 1992), within the CPA for oil and gas operations. Acreage and block counts are subject to change as a result of ongoing activity.

Alternative B (The Proposed Action Excluding the Blocks Near Biologically Sensitive Topographic Features): This alternative would delete all unleased blocks within a total of 167 blocks potentially affected by the Topographic Features Stipulation and offer for lease all remaining blocks.

Alternative C (No Action): This alternative is equivalent to cancellation of a sale scheduled for a specific timeframe on an approved 5-year OCS Oil & Gas Leasing Schedule. The opportunity for development of the estimated oil and gas resources that could have resulted from this sale is foregone or postponed, and any potential environmental impacts resulting from the proposed action would not occur or would be postponed.

(2) Alternatives for Proposed Western Gulf Sale 143

Alternative A (The Proposed Action): The proposed action for Sale 143 is to offer for lease all unleased blocks, except 2, within the WPA for oil and gas operations. This totals approximately 25.8 million acres or 4,715 blocks as of January 1992. The exceptions are Blocks A-375 and A-398 in High Island Area, East Addition, South Extension (East and West Flower Garden Banks, respectively). The deferral of the two Flower Garden blocks were established in the Area Identification for the proposed sales. Acreage and block counts to be offered for lease are subject to change as a result of ongoing activity.

Alternative B (The Proposed Action Excluding the Blocks Near Biologically Sensitive Topographic Features): This alternative would delete all unleased blocks within a total of 200 blocks potentially affected by the Topographic Features Stipulation and lease all remaining blocks.

Alternative C (The Proposed Action Excluding Blocks Contained in the Western Naval Operations Area): This alternative would delete approximately 340 blocks contained in the Western Naval Operations Area near Corpus Christi, Texas.

Alternative D (No Action): This alternative is equivalent to cancellation of a sale scheduled for a specific timeframe. The opportunity for development of the estimated oil and gas resources that could have resulted from proposed Sale 143 would be precluded or postponed. Also, any potential environmental impacts resulting from the proposed action would not occur or would be postponed.

(3) Alternatives Considered But Not Offered

Delete Live-bottom Areas (Pinnacle Trend): This alternative would delete the pinnacle trend area, a region of topographic features in the northeastern corner of the CPA. The blocks in this portion of the planning area, which contain topographic features and/or dense biological communities that warrant protection, are not yet fully defined. Ongoing studies will more accurately delimit these features and communities. Any of these blocks, which may be leased as a result of the proposed action, may contain a lease stipulation, at the Secretary's discretion, designed to provide adequate protection to the benthic biota of the area. Removal of these blocks is not necessary for their protection at this time.

Limit the Amount of Drilling with Substitution of Alternative Energy to Meet National Energy Needs: This alternative would provide for replacement of 20, 40, 60, and 80 percent of the oil and gas from the Gulf of Mexico with energy from alternative sources. Appendix C of the Draft EIS for the Comprehensive Program for 1992-1997 includes a comparative environmental analysis of energy alternatives to OCS oil and gas (USDOI, MMS, 1991a), and this analysis is also included in Appendix D of this EIS.

b. Mitigating Measures

(1) Potential Mitigating Measures Analyzed in the EIS

The potential mitigating measures included for analyses in this EIS were developed as the result of the scoping efforts accomplished early in the EIS process and over recent years for the continuing OCS program.

Four stipulations that have been applied to appropriate Gulf OCS leases for many years with considerable success have been included for analysis for proposed lease Sales 142 and 143. These are the Live Bottom (Pinnacle Trend), Topographic Features, Archaeological Resource, and Military Areas Stipulations for the Central Gulf sale; and the Topographic Features, Archaeological Resource, and Military Areas Stipulations for the Western Gulf sale. The effectiveness of the proposed stipulations is discussed in Section II. The analysis of these stipulations as proposed mitigating measures does not preclude a decision by the Secretary not to apply the stipulations to leases that may result from the proposed actions nor does it preclude minor modifications in wording during subsequent steps in the sale process if comments indicate changes are necessary or if conditions change.

Live Bottom Stipulation

The Live Bottom Stipulation included for analysis in proposed Sale 142 covers the pinnacle trend area of the CPA. The northeastern portion of the Central Gulf contains a band of pinnacles between 67 and 109 m (220-360 ft) in depth, which extends into the northwestern portion of the Eastern Gulf. The pinnacles appear to be dead reefal structures with limited biotal coverage, but they may provide structural habitat for a variety of pelagic fish. A Live Bottom Stipulation has been made a part of previously issued leases and is a part of many active leases in the Central Gulf. This stipulation has been deemed necessary in the past since the position and extent of many of the sensitive and high-value, live-bottom areas were poorly known. These areas are, for the most part, patchy and scattered. A discussion of the effectiveness of this proposed stipulation is in Section II.

Topographic Features Stipulation

The topographic features of the Central and Western Gulf provide habitat for coral and coral-community organisms. These communities would be severely and adversely impacted if unrestricted oil and gas activities resulting from the proposed actions took place on, or in proximity to, them. The Department has recognized this problem for some years and, since 1973, topographic features stipulations have been made a part of leases for blocks on or near these biotic communities. The proposed Topographic Features Stipulation--developed through close consultation and coordination between various State, Federal, and local agencies--uses the results of the latest topographic-features studies and industry monitoring reports, and may be made, at the Secretary's discretion, a part of appropriate leases resulting from proposed Sales 142 and 143. A discussion of the effectiveness of this proposed stipulation is in Section II.

Archaeological Resource Stipulation

This proposed stipulation was first implemented in 1973 in response to the requirements of the National Historic Preservation Act of 1966, as amended. In addition, the OCSLA, as amended, specifically states in Section 11(g)(3) that such exploration (oil and gas) will not ". . . disturb any site, structure, or object of historical or archaeological significance." Therefore, this stipulation may be made a part of leases resulting from proposed Sales 142 and 143. The proposed stipulation includes a clause that requires an archaeological assessment of geophysical survey data within areas where the Regional Director has a reason to believe that an archaeological resource is likely to exist. Archaeological management zones derived from the findings of the Gulf of Mexico cultural resources baseline study (CEI, 1977), as well as a more recent study of shipwrecks in the northern Gulf of Mexico (Garrison et al., 1989). The zones of prehistoric and historic high probability are used as the basis for invoking the archaeological survey requirement. Most tracts leased within the refined high probability zone for historic shipwrecks, where there is a high potential for the occurrence of historic sites, require a survey of 150-m linespacing. Those tracts that have a high probability for historic shipwrecks and are defined as occurring in water depths greater than 60 m require archaeological analysis based on standard shallow hazard survey parameters with 300-m linespacing. Tracts leased within Zone 2, where there is only the potential for the occurrence of prehistoric sites, require a survey of 300-m linespacing. The requirements for the archaeological survey and report are detailed in Notice to Lessees and Operators (NTL) 92-01 (Appendix E). The proposed archaeological stipulation may reduce the potential impacts to proposed archaeological sites from oil and gas development by allowing detection of potential sites prior to development, thereby making avoidance possible.

Military Areas Stipulations

A standard Military Areas Stipulation has been applied to all blocks leased in military areas in the Gulf of Mexico since 1977. One of the requirements of the proposed stipulation is that the operator would notify the military prior to conducting oil and gas activities in an area. The effectiveness of the stipulation may be illustrated by the fact that there have been no reported accidents in the Gulf resulting from conflicts between oil and gas operations and military activities. Therefore, this stipulation may be made, at the Secretary's discretion, a part of leases resulting from both proposed Sales 142 and 143. A discussion of the effectiveness of this stipulation is in Section II.

(2) Mitigating Measures Considered But Not Analyzed

Five potential mitigating measures were considered for possible analysis in this EIS, but subsequently rejected from further discussion. These measures are described below, along with the reasons for not offering them as potential mitigation.

Oil-Spill Response Stipulation (or regulations): The development of an oil-spill response stipulation for the Central and Western Gulf of Mexico, similar to those in place for portions of the Eastern Planning Area (EPA), was proposed by the Sierra Club in response to the Draft EIS for Sales 139 and 141. The protection afforded by such a stipulation can be achieved through the oil-spill response equipment sharing effort currently being required. This equipment sharing effort results in suitably equipped vessels being strategically sited at offshore locations throughout the Gulf of Mexico. The number of rig/platform sites in proximity to one another makes a spill-response equipment sharing approach practicable while also providing the necessary benefits of significantly reduced spill-response times. Working with industry through the existing regulatory framework allows greater flexibility in updating equipment siting as warranted through the review of oil-spill contingency plans, ongoing research, or recommendations made as a result of the unannounced oil-spill response drilling program.

Add Sebree, Big Adam, Little Adam, and Phleger Banks to the List of Banks Covered by the Topographic Features Stipulation: The National Oceanic and Atmospheric Administration (NOAA) recommended that Sebree Bank (off south Texas) be afforded the protection of either the Topographic Features Stipulation or the Live Bottom Stipulation. Sebree Bank contains no biological assemblages requiring the protection of a restrictive stipulation. It is a low-relief, biologically depauperate bank with sparse occurrences of *Oculina diffusa* in a muddy, turbid environment. The area of Sebree Bank should not be subjected to either of these biological stipulations. For similar reasons, the other three banks have never been considered for the protection of the stipulation and are not candidates for such protection at this time.

Stipulation to Protect Chemosynthetic Biological Communities: The NOAA recommended that a chemosynthetic community stipulation similar to NTL 88-11 be adopted. Adequate and appropriate protection is afforded the chemosynthetic communities by NTL 88-11. The NTL is applied and enforced on all leases, existing or future, which potentially contain chemosynthetic communities. A stipulation would apply only to any future leases to which the stipulation may be attached. Incorporation of similar requirements into a lease stipulation would be redundant.

Prohibit All Discharges from OCS Facilities: The Delta Chapter of the Sierra Club requested that all discharges from OCS facilities be prohibited. Discharges from OCS facilities are governed through the National Pollution Discharge Elimination System (NPDES) administered by the U.S. Environmental Protection Agency (USEPA). The USEPA is establishing effluent limitations for operational discharges from OCS oil and gas exploration, development, and production activities. These limitations, as well as monitoring and other requirements, will be included in two general NPDES permits covering all Gulf OCS oil and gas operations. Prior to the issuance of the permit, public comments are being solicited and will be considered for incorporation into the permit requirements. These permit and effluent limitations will assure that there is no significant degradation of regional water quality characteristics.

Require Alternative Procedures to Explosive Structure Removal: The Sierra Club (Houston Regional Group) and the Office of the Attorney General (State of Texas) have recommended that MMS require alternative methods to explosive structure removal. The most effective methods of structure removal are the use of explosives and underwater arc cutting. Some operators have used nonexplosive removal methods where feasible. During 1990, approximately 19 percent of all structure removals were accomplished by nonexplosive techniques. The feasibility of using these techniques is largely dependent upon the type of structure as well as the individual design. More perfection of nonexplosive structure removal techniques is needed before a universal requirement is imposed.

c. Issues

(1) Significant Issues

Issues are defined by the Council of Environmental Quality (CEQ) to represent those principal "effects" that the EIS should evaluate in-depth. The CEQ is clear that scoping should identify specific environmental resources or activities, rather than identify "causes" as significant issues (CEQ Guidance on Scoping, April 30, 1981). The analysis can then show the degree of change from present conditions for each issue due to the relevant actions related to the proposal.

Selection of environmental and socioeconomic issues to be analyzed was based on the following criteria:

- The resource/activity was identified through the scoping process or from comments on a draft EIS;

- The resource/activity must be vulnerable to one or more of the impact-producing factors (IPF) associated with the OCS program. A reasonable probability of an interaction between the resource/activity and IPF should exist; or

- New information has become available that indicates a need to reevaluate the potential impacts to a resource/activity.

The following resource topics have been determined to be significant environmental issues and are analyzed in Section IV.D. For a list of specific resources analyzed under each proposed sale, see Table S-2.

- Air Quality
- Alabama, Choctawatchee, and Perdido Key Beach Mice
- Archaeological Resources
- Coastal Barrier Beaches
- Coastal and Marine Birds
- Commercial Fisheries
- Deep-water Benthic Communities
- Gulf Sturgeon
- Live Bottoms (Pinnacle Trend)
- Marine Mammals
- Marine Turtles
- Recreational Resources and Activities
- Socioeconomic Issues
- Topographic Features
- Water Quality
- Wetlands

(2) Issues Considered But Not Analyzed

The following issue was raised during the scoping process but was determined not to warrant further analysis in the EIS as explained below.

Designated environmental preservation areas were considered for analysis, but it has been determined that they do not constitute an environmental issue, which requires a separate analysis in the EIS. In the past, the National Park Service (NPS) has expressed concern over MMS' apparent lack of acknowledgement of the nationally-recognized conservation values of the Gulf Island National Seashore, in particular, the wilderness designation areas of the Seashore. The Sierra Club has asked for special protection for the Shoalwater Bay area in Louisiana. In comments on the latest draft EIS, the Houston Regional Group of the Sierra Club emphasized the need for designated environmental preservation areas to be considered a significant issue. The MMS focuses the recreational analysis of OCS lease sale impacts on shorefront beaches, which includes national, State, or local park and recreational areas, as well as State and Federal wildlife areas. Nationally-recognized values such as the National Seashore and National Wilderness Areas are accounted for under this analysis.

3. Regulatory and Administrative Framework

a. Outer Continental Shelf Lands Act

The OCSLA of 1953 (67 Stat. 462), as amended (43 U.S.C. 1331 et seq. (1988)) established Federal jurisdiction over submerged lands on the OCS seaward of State boundaries (generally 3 geographic miles seaward of the coastline). Under the OCSLA, the Secretary of the Interior is responsible for the administration of mineral exploration and development of the OCS. The Act empowers the Secretary to grant leases to the highest qualified responsible bidder(s) on the basis of sealed competitive bids and to formulate such regulations as necessary to carry out the provisions of the Act.

The Act, as amended, provides guidelines for implementing an OCS oil and gas exploration and development program. The basic goals of the Act include the following:

(1) to establish policies and procedures for managing the oil and natural gas resources of the Outer Continental Shelf that are intended to result in expedited exploration and development of the OCS in order to achieve national economic and energy policy goals, assure national security, reduce dependence on foreign sources, and maintain a favorable balance of payments in world trade;

(2) to preserve, protect, and develop oil and natural gas resources of the Outer Continental Shelf in a manner that is consistent with the need

(a) to make such resources available to meet the nation's energy needs as rapidly as possible;

(b) to balance orderly resource development with protection of the human, marine, and coastal environments;

(c) to ensure the public a fair and equitable return on the resources of the Outer Continental Shelf; and

(d) to preserve and maintain free enterprise competition; and

(3) to encourage development of new and improved technology for energy resource production, which will eliminate or minimize risk of damage to the human, marine, and coastal environments.

The Secretary of the Interior has designated MMS as the administrative agency responsible for the mineral leasing of submerged OCS lands and for the supervision of offshore operations after lease issuance. Regulations administered by MMS govern the leasing of oil, gas, and sulphur mineral deposits on the OCS (30 CFR 256); the conduct of mineral operations is contained in 30 CFR 250 and 30 CFR 251. Pertinent regulations are also found at 30 CFR 252, 259, 260, and 270.

b. National Environmental Policy Act

The purpose of the National Environmental Policy Act (NEPA) of 1969 is to provide a national policy that encourages "productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man . . . " (42 U.S.C. 4371 et seq.). The NEPA requires that all Federal agencies shall use a systematic, interdisciplinary approach to protection of the human environment; this approach will ensure the integrated use of the natural and social sciences in any planning and decisionmaking that may have an impact upon the environment. The NEPA also requires the preparation of a detailed EIS on any major Federal action that may have a significant impact on the environment. This EIS must include any adverse environmental effects that cannot be avoided or mitigated, alternatives to the proposed action, the relationship between short-term uses and long-term productivity of the environment, and any irreversible and irretrievable commitments of resources involved in the project. In 1979, CEQ published regulations that established uniform guidelines for implementing the procedural provisions of NEPA. These regulations (40 CFR 1500-1508, revised July 1, 1980) provide for the use of the NEPA process to identify and assess the reasonable alternatives to proposed actions that avoid or minimize adverse effects of these actions upon the quality of the human environment. A procedure known as "scoping" is used to identify the scope and significance of important environmental issues associated with a proposed Federal action through coordination with Federal, State, and local agencies; the public; and any interested individual or organization prior to the development of an impact statement (40 CFR 1501.7). The process is also intended to identify and eliminate, from further detailed study, issues that are not significant or that have been covered by prior environmental review.

c. Presale Activities

(1) Federal/State Coordination

In addition to scoping activities conducted with the public and other Federal agencies, as described in the scoping section above and in Section I.B.3.b., the OCSLA provides a statutory foundation for DOI's policy of coordination with the affected States and, to a more limited extent, local governments. At each step of the procedures that lead to lease issuance, participation from the affected States and other interested parties is encouraged and sought.

The MMS issues the Call/NOI, which is published in the *Federal Register*, in order to gather information and nominations within a lease planning area from all interested parties. Responses must be received no later than 45 days after publication of the Call/NOI. The information collected from the Call is used to help identify the potential areas for oil and gas development, to help identify issues/concerns of industry, to help identify the environmental effects and potential use conflicts in proximity of the area, to initiate the scoping process and identify alternatives to the proposed action for the EIS, to help develop lease terms and conditions, to ensure safe operations, and to help identify potential conflicts between offshore oil and gas activities and a State Coastal Management Program. The NOI is published pursuant to the regulations at 40 CFR 1501.7, implementing the procedural provisions of NEPA (42 U.S.C. 4321 et seq.). The NOI also serves to announce the scoping process, which affords State and local governments the opportunity to aid MMS in determining significant issues and alternatives to be analyzed in the EIS.

When soliciting information for the leasing of lands within 3 mi of the seaward boundary of any coastal State, additional information is provided to the Governors of those States. The Governors must be informed of the identity of, and schedule for, the area proposed for leasing; the geographic, geological, and ecological characteristics of the area within 3 mi of the seaward boundary; estimated oil and gas reserves in these areas; and any field, trap, or geologic structure thought to be located in these areas (43 U.S.C. 1337 (g)). The Secretary subsequently consults with the Governors in determining whether any areas may contain one or more oil or gas pools or fields underlying both the OCS and lands subject to State jurisdiction. The ultimate goal of the coordination is the fair and equitable disposition of revenues generated by the Federal lease.

The Governors are also provided with a summary of data to aid them in anticipating possible onshore effects of OCS development and production. The summary includes estimated oil and gas reserves in areas leased or to be leased, estimated size and timing of development, pipeline locations, and the general location and nature of onshore facilities. The OCSLA, as amended, also requires the transmittal of an index of all relevant actual or proposed programs, plans, reports, EIS's, and other lease-sale information to each affected State (43 U.S.C. 1352 (d)).

Pursuant to the Coastal Zone Reauthorization Amendments of 1990, all Federal activities, including OCS oil and gas lease sales, must be consistent with each affected State's CZM program. For presale consistency determinations, MMS reviews the State's coastal zone program, analyzes potential impacts based primarily on the Minerals Management Service's proposed lease sale EIS and the Action Update Memorandum (AUM), and makes an assessment of consistency with the State's program. Consistency determination protocols for plan and permit activities are discussed in more detail in Section I.B.3.d.(1)(h).

Each State's approved CZM program is summarized in Section III.C.6. and an analysis of impacts of the OCS oil and gas leasing program in these State programs is provided in Sections IV.D.1.e and IV.D.2.e.

The OCS Lands Act requires that DOI prepare a 5-year program that specifies, as precisely as possible, the size, timing, and location of areas to be assessed for Federal offshore natural gas and oil leasing. The Department has developed a new proposed program that will take effect in mid-1992 and last through mid-1997. In keeping with President Bush's June 26, 1990, statement, a new direction for the management of OCS natural gas and oil activities will be taken. The hallmarks of the proposed program include a new planning and consultative process, and a more careful focus on promising geologic basins that appear to be appropriate for leasing and development in an environmentally sound manner. The proposed program represents a new, comprehensive, long-term approach to planning and managing all aspects of natural gas and oil activities off the Nation's coasts.

The program provides for a new Area Evaluation and Decision Process (AEDP), which is designed to provide more consultations between the Federal Government and the States and localities. The AEDP emphasizes three objectives: (a) improving the acquisition and integration of environmental, mineral resource, and socioeconomic information to improve the quality of decisions; (b) defining leasing proposals more selectively; and (c) enhancing the opportunities for States, coastal communities, and other concerned parties to provide input.

The proposed comprehensive program considers 12 lease sales in the Gulf of Mexico for the years 1992 through 1997 and maintains an annual pace of leasing for the Central and Western Gulf. In the Western Gulf, two blocks, which contain the East and West Flower Garden Banks (Blocks A-375 and A-398, High Island Area, East Addition, South Extension), have been excluded from leasing consideration. In the Eastern Gulf, two sales will be considered (generally west of 84°W. longitude and north of 26°N. latitude), one in 1994 and one in 1997.

(2) Geological and Geophysical Exploration Regulations/Coordination

Geological and geophysical (G&G) surveys and analyses provide most of the resource and hazards information used by government and industry on the offshore areas. The collecting of G&G data begins prior to leasing and continues throughout the term of offshore mineral leases.

Pursuant to 30 CFR 251.4, a permit or notice must be obtained in order to conduct either geological or geophysical exploration for mineral resources or geological or geophysical scientific research of areas of the Gulf OCS, except for a lessee on a lease. A permit is approved for a specified period of time of not more than 1 year under which a party has the right to conduct geological or geophysical exploration for mineral resources or geological or geophysical scientific research in accordance with the appropriate statutes, regulations, and stipulations. A notice is a statement of intent to conduct geological scientific research on the OCS for a specified period of not more than a year.

"Geological exploration for mineral resources" means any operation conducted on the OCS that uses geological and geochemical techniques, including, but not limited to, core and test drilling, well-logging techniques, and various bottom-sampling methods to produce information and data on mineral resources, including information and data in support of possible exploration and development activity, including pipelines. "Geophysical exploration for mineral resources" means any operation conducted on the OCS that uses geophysical techniques, including, but not limited to, gravity, magnetic, and various seismic methods to produce information and data in support of possible exploration and development activity. "Geological or geophysical scientific research" means any investigation conducted on the OCS that uses scientific methods and/or techniques to gather and analyze geological and/or geophysical data and information for scholarly or academic purposes with no direct commercial application.

Permit applications for G&G activity must be submitted to MMS in accordance with the requirements outlined in 30 CFR 251.5 and 30 CFR 251.6 and explained further in Letter(s) to Permittees. The Letter to Permittees dated January 20, 1989, includes a listing of forms and maps that apply to most G&G permit activity. The regulations under 30 CFR 251 do not apply to G&G exploration activities conducted by, or on the behalf of, the lessee on a leased block on the Gulf OCS. Geological and geophysical activities by the lessee on his existing leases are governed by the regulations in 30 CFR 250 and by the notification procedures for explosives, dredging, and geotechnical surveys outlined in the Letter dated November 8, 1990.

When required under a CZM program approved under the CZMA, activities proposed by an applicant for a G&G permit must receive State concurrence in its coastal zone consistency certification prior to MMS approval of any of the activities covered under the permit (30 CFR 251.6-2(c)(1)). The Gulf Coast States are not involved in the review process for specific G&G applications prior to issuance of the permit, except for continental offshore stratigraphic tests (COST's). The COST's involve penetration into the sea bottom on unleased lands that involve more than 15 m (50 ft) of consolidated rock or a total of 91 m (300 ft) of unconsolidated material. Shallow test drilling involves drilling into the sea bottom at depths less than those specified for COST's. Environmental reports are required in accordance with 30 CFR 251.6-2(c)(2) for COST's; and when required under a coastal zone management program, they must receive State concurrence prior to approval of any activities covered under the permit. The plan and report is also made available to appropriate Federal agencies and the public in accordance with established practices and procedures. Shallow test drilling or COST's must use the best available and safest technologies. Additional environmental information may be required for G&G applications proposing the use of solid or liquid explosives. The use of explosives may also lead to initiation by MMS of consultation with the National Marine Fisheries Service (NMFS) under Section 7 of the Endangered Species Act.

After receiving a G&G permit application, MMS prepares either a CER, EA, and/or EIS in accordance with NEPA and other applicable MMS policies and guidelines as described in Section I.B.3.d.(1)(a). A CER is prepared for most G&G permit applications. Activities that include the drilling of COST holes involve the use of solid or liquid explosives, or that otherwise have the potential to significantly affect the quality of the human environment automatically require the preparation of an EA.

d. Postsale Activities

The MMS is responsible for regulating and monitoring the oil and gas operations on the Federal OCS. The regulations at 30 CFR 250.5(a) provide for the Director to regulate all operations conducted under a lease, right of use and easement, or DOI pipeline right-of-way to promote orderly exploration, development, and production of mineral resources and to prevent harm or damage to, or waste of, any natural resource, any life or property; or the marine, coastal, or human environment. Prior to either exploration, development, or production activities being conducted in a lease block, other than on-lease preliminary activities, companies must submit plans to MMS for review and approval. Within these plans, specific requirements must be met relative to operating conditions and environmental considerations. The regulations now allow for penetration of the seabed up to 152 m (500 ft) for on-lease preliminary activities, provided such activities do not result in any significant adverse impact on the natural resources of the OCS (30 CFR 250.31). Prior notification is required by MMS for certain on-lease preliminary activities as outlined in the Letter to Lessees and Operators (LTL) dated November 8, 1990, and amended June 21, 1991.

(1) Review, Coordination, and Approval of Exploration, Development, and Production Activities

(a) Exploration Plans

Pursuant to OCSLA (43 U.S.C. 1340) and 30 CFR 250.33, an Exploration Plan (EP) and its supporting information must be submitted for approval to MMS before an operator may begin exploratory drilling on a lease. The EP describes all exploration activities planned by the operator for a specific lease(s), the timing of these activities, information concerning drilling vessels, the location of each well, and other relevant information. A revised plan is a revision to an approved plan that proposes changes such as those in surface location, type of drilling unit, or location of the onshore support base. A supplemental plan constitutes a revision to an approved plan that proposes the addition of an activity that requires a permit. An amended plan is any revision to a plan pending approval. Each of these types of plans need contain only that information related to or affected by the proposed revision.

The revised rule provides for submission of supporting information for MMS and CZM State evaluation as outlined in 30 CFR 250.33(b)(1) through (21). The operator may limit the amount of information submitted to that which is listed in the LTL dated October 12, 1988, as amended by the LTL dated September 5, 1989. Environmental reports are not considered part of the plan. This was intended in part to eliminate unnecessary duplication. The MMS can require modification of a plan based on inadequate or inaccurate supporting information.

The supporting information provides an analysis of both offshore and onshore impacts that may occur as a result of implementation of the plan. In accordance with the CZMA, as amended, EP's requiring State review must contain a certification of consistency with approved CZM programs of States that could be affected by the exploration activities. States with approved programs may take up to 6 months for consistency reviews but must agree with or request an extension within 3 months after receipt of their copy of the EP. In the Gulf of Mexico, Louisiana, Mississippi, Alabama, and Florida have federally approved CZM programs. The guidelines and environmental information requirements for lessees and operators submitting an EP are discussed further in Section I.B.3.d.(1)(e).

The MMS prepares a CER, EA, or EIS based on available information, which may include the geophysical report (for determining the potential for the presence of deep-water benthic communities), archaeological report (30 CFR 250.33(b)(15)), air emissions data, live-bottom survey/report (30 CFR 250.33(b)(12)), biological monitoring plan (30 CFR 250.33(b)(16)), and recommendations by the affected State(s), the Department of Defense (DOD), U.S. Fish and Wildlife Service (FWS) (for selected plans under provisions of a DOI agreement), NMFS, and/or internal MMS offices. The MMS evaluates the proposed activity for potential impacts relative to geohazards and manmade hazards (including existing pipelines), archaeological resources, endangered species, sensitive biological features, water and air quality, oil-spill response, and other uses (e.g., military operations) of the OCS.

The CER's are prepared for certain postlease activities in the WPA and CPA in accordance with 516 DM 2, Appendix 1 and 516 DM 6, Appendix 10. The eastern extent of the CPA is offshore the State of Alabama at approximately longitude 87°31' W (consult Visual No. 1 for further details). The criteria used to determine which actions are to be excluded from the NEPA process are as follows: (1) the action or group of actions would have no significant effect on the quality of the human environment and (2) the action or group of actions would not involve unresolved conflicts concerning alternative uses of available resources. The CER's serve as a vehicle for a considerable environmental analysis in cases where archaeological, air quality, and biological assessments and oil-spill response planning are necessary in early planning.

If the CER determines that the proposed action is an exception to the categorical exclusions as listed in 516 DM 2, Appendix 2, then the preparation of an EA is required. An EA may also be prepared on any action at any time in order to assist in planning and decisionmaking (516 DM 3.2.B) or under extraordinary circumstances (516 DM 2.4). The EA's are routinely prepared for selected environmentally sensitive areas (e.g., for activities proposed within the 4-mile zone of the Flower Garden Banks lease blocks) and for proposed activities considered environmentally sensitive (e.g., new or unusual technology and pipeline rights-of-way to shore).

If the EA indicates that approval of the plan would constitute a major Federal action significantly affecting the human environment, that an existing EIS addressing the matter does not exist, or that an existing EIS is not current, an EIS must be prepared. On the basis of the EA, CER, or EIS findings and the plan completeness review, the EP would be either approved or disapproved, or modification of the plan would be required of the operator. The EA would also identify appropriate mitigation of impacts of the proposal.

(b) Development and Production Plans

Pursuant to OCSLA (43 U.S.C. 1351) and 30 CFR 250.34, a development and production plan and its supporting information must be submitted for approval to MMS before an operator may begin development or production activities. Development and production plans are not required for leases in the Western Gulf pursuant to 30 CFR 250.34(d)(1). (In this designation, the Western Gulf includes all areas of the Gulf of Mexico except those that are adjacent to the State of Florida as defined previously.) However, information covering these leases is required to ensure conformance with the OCSLA, other laws, applicable regulations, and lease provisions and to enable MMS to carry out its functions and responsibilities. Therefore, before any development and production activity is conducted on a lease in the Western Gulf, the operator must prepare and submit to MMS a Development Operations Coordination Document (DOCD) and, as required, supporting environmental information, archaeological report, biological report (monitoring and/or live-bottom survey), or other environmental data determined necessary. A DOCD shall be considered a development and production plan for the purpose of any references in any law, regulation, lease provision, agreement, or other document referring to the preparation or submission of a plan. The plan describes a schedule of development activities, platforms, or other facilities including environmental monitoring features and other relevant information. Refer to Section I.B.3.d.(1)(a) for a discussion of plan revisions. The revised rule provides for submission of supporting information for MMS and State CZM evaluation as outlined in 30 CFR 250.34(b) through (u). As with EP's, MMS can require modification of a plan based on inadequate or inaccurate supporting information.

After receiving a DOCD, MMS prepares either a CER, EA, and/or EIS as discussed under EP's above (Section I.B.3.d.(1)(a)). As part of the review process, the DOCD and supporting environmental information, as required, are sent to the affected State(s) having an approved CZM plan for consistency certification review and determination. The OCSLA (43 U.S.C. 1345(a)) provides for coordination and consultation with the affected State and local governments concerning a development plan. The guidelines and environmental information requirements for lessees and operators submitting a development and production plan are addressed in NTL 86-09 and are discussed further in Section I.B.3.d.(1)(e). On the basis of the CER, EA, or EIS findings and the plan completeness review, the plan would be either approved or disapproved, or modification of the plan would be required of the operator.

After plan approval, the operator submits for approval specific applications to MMS, such as those for pipelines and platforms, to conduct activities described in the plan.

(c) Oil Spill Contingency Plans

Pursuant to 30 CFR 250.33, 30 CFR 250.34, and 30 CFR 250.42, a lessee is required to submit an Oil Spill Contingency Plan (OSCP) to MMS for approval with or prior to submitting an EP or DOCD. If an OSCP covering the area, such as a regional plan, has already been approved, it may be referred to in the plan. In order to facilitate this requirement in the Gulf of Mexico OCS Region, an operator may submit a regional plan covering all of their Gulf OCS operations. The approved regional OSCP is then referenced when EP's or DOCD's are submitted. Additionally, certain site-specific, oil-spill-response information is required to accompany a plan when a regional OSCP is referenced. An operator may elect to include or the MMS may require inclusion of a site-specific OSCP in an EP or DOCD when the approved regional OSCP does not provide adequate oil-spill protection. All regional and site-specific OSCP's are required to be reviewed and updated annually, and all modifications of an OSCP are submitted to MMS for approval. Guidelines outlined in the February 1, 1989, and September 5, 1989, LTL's were developed to aid Gulf OCS operators in the preparation of OSCP's. The OSCP must contain assurances that a full response capability exists for commitment in the event of an oil spill. Such a commitment includes specification of appropriate equipment and materials, their availability and deployment time, and provisions for varying degrees of response effort, depending on the severity of the spill. See Section IV.C.5. for additional information on oil-spill planning.

(d) Hydrogen Sulfide Contingency Plans

Pursuant to 30 CFR 250.33, 30 CFR 250.34, and 30 CFR 250.67, the operator of a lease requests that MMS make a determination regarding the presence of hydrogen sulfide (H_2S) gas. The MMS classifies an area of proposed operations as (1) a zone known to contain H_2S, (2) a zone where the presence of H_2S is unknown, or (3) a zone where the absence of H_2S has been confirmed. An H_2S Contingency Plan must be submitted for approval prior to conducting operations on a lease when the H_2S classification meets the criteria of (1) or (2) and must include contingencies for simultaneous drilling, well-completion, well-workover, and production operations. Pursuant to the LTL dated September 5, 1989, each EP or DOCD must contain a request for a determination for one of the three classifications and a discussion of the basis for the recommendation. The lessee must take all necessary and practicable precautions to protect personnel from the toxic effects of H_2S and to mitigate the adverse effects of H_2S to property and the environment.

(e) Environmental Information

Pursuant to 30 CFR 250.33 and 250.34, specific environmental information, as discussed in Sections I, II, and IV of NTL 86-09 and as prepared in accordance with guidelines in Sections II.A., II.B., or III of the enclosure to NTL 86-09, is required for leases in the Gulf of Mexico for CZM purposes. It should be noted that the term "environmental report" as used in NTL 86-09 is synonymous with the term "environmental information" required by the LTL dated October 12, 1988. Under the CZMA, each State that has an approved CZM plan has the option to require information that is different than that specifically outlined in 30 CFR 250.33 and CFR 250.34 for inclusion in the plan. Refer to Section I.B.3.d.(1)(h) for a discussion of the Gulf Region's procedures for CZM consistency. The States of Louisiana, Mississippi, Alabama, and Florida have approved CZM programs. With the exception of Florida, operators submit abbreviated environmental information for CZM purposes. Requirements for both the abbreviated format required for the States of Alabama, Louisiana, and Mississippi and the long-form format required for activity determined to affect the State of Florida are given in the LTL dated October 12, 1988 (NTL 86-09 incorporated therein by reference). The operating regulations recognize the possible significance of proposed modifications to approved plans and provide for CZM agency review of modifications.

Additional environmental information may also be required for plans/activities in the Western Gulf of Mexico for the following: (1) areas of high seismic risk or seismicity and relatively untested deep-water and remote areas; (2) areas proposed or established as a marine sanctuary and/or near the boundary of a proposed or established wildlife refuge or areas of high ecological sensitivity (e.g., East and West Flower Garden Banks); (3) areas of potentially hazardous natural bottom conditions; or (4) the use of new or unusual technology, when the additional information is required to evaluate impacts. Environmental information requirements will be determined on a case-by-case basis for plans meeting any of the four categories, with the exception of plans submitted that propose activities within the restrictive zones of the Flower Garden Banks. The Guidelines enclosure of NTL 86-09 outlines the information requirements for activities proposed within the 4-mile zone of the Flower Garden Banks. Specific information is required for structure-removal applications as outlined in LTL's dated August 19 and December 9, 1986. The submission of specific supporting information to aid in evaluating the environmental impacts of plans/activities may be required by MMS under 30 CFR 250.33(b)(21) and 30 CFR 250.34(b)(15) in areas of the Central and Western Gulf where either no environmental information is required or an abbreviated format is required for CZM purposes.

(f) Air Emissions Information

The OCSLA at 43 U.S.C. 1334(a)(8) requires the Secretary to promulgate and administer regulations to provide for compliance with the National Ambient Air Quality Standards (NAAQS) pursuant to the Clean Air Act (42 U.S.C. 7401 et seq.) to the extent that authorized activities significantly affect the air quality of any State. The Clean Air Act Amendments of 1990 state that no later than 12 months after the enactments of the amendments, USEPA's Administrator, in consultation with the Secretary of the Interior and the Commandant of the Coast Guard, will establish the requirements to control air pollution in the OCS areas of the Pacific, Atlantic, Arctic, and eastward of 87°31'W. longitude in the Gulf of Mexico. Sources located within 25 mi of the seaward boundary of those States under USEPA's jurisdiction shall be subject to requirements similar to onshore sources. For sources located in other areas, regulation is accomplished through 30 CFR 250.44, 250.45, and 250.46, and is administered by MMS as a postsale activity. It is the intent of these regulations to protect onshore ambient air quality and to ensure that no new violations of NAAQS are caused by the OCS activity. The regulated pollutants are carbon monoxide, suspended particulates, sulphur dioxide, nitrogen oxides, and volatile organic compounds. In areas where hydrogen sulfide may be present, operations are regulated by 30 CFR 250.67 and are discussed in Section I.B.3.d.(1)(d). Emissions data concerning new or modified onshore facilities (directly associated with offshore activities) are required to enable each affected State to make a determination of the effects on its air quality.

Exploration plans and DOCD's address activities that are determined by the Secretary as activities regulated under 30 CFR 250.44, 250.45, and 250.46. All new or supplemental EP's and DOCD's submitted on or after June 2, 1980, must include air emissions information sufficient to make an air quality determination. The LTL dated October 12, 1988, outlines air emissions data that must be submitted by operators. The Clean Air Act Amendments of 1990 also require that MMS conduct and complete a study of the effects of offshore air emissions in nonattainment onshore areas within 3 years after the approval of the amendments in OCS areas not under USEPA jurisdiction.

(g) Site Clearance

The MMS has established a program to ensure that any object (e.g., well heads, platforms, etc.) installed on an OCS lease is properly removed and the site cleared so as not to conflict with other uses of the OCS. The minimum requirements for site clearance and verification were addressed in NTL 90-03, which was issued on February 28, 1990. The MMS formed a site clearance committee comprised of representatives of the oil and gas and shrimping industry, the State of Louisiana, Jefferson Parish, and the MMS to address apparent inadequacies in certain site clearance procedures and verification techniques that had been reported by the shrimping industry. Based on the recommendations of the committee, interim procedures for the verification of all OCS structure removals and site clearance activities was signed as NTL 90-03 by the MMS, Gulf of Mexico Region on August 27, 1990. This interim document will allow the industry, committee, and MMS to continue monitoring various site clearance efforts and verification techniques and to continue gathering data for evaluation and consideration when formulating modifications to MMS operating regulations.

The use of explosives to cut offshore oil/gas structure legs/pilings for removal could cause injury or death to protected marine mammals and endangered sea turtles. Lessees/operators must notify MMS 30 days before a structure removal and provide information including the following: complete identification of the structure; size of the structure (number and size of legs and pilings); removal technique to be employed (if explosives are to be used, the amount and type of explosive per charge); and the number and size of well conductors to be removed and the removal technique (see LTL's dated August 19 and December 9, 1986). Structure-removal requests are reviewed on a case-by-case basis. Currently, if a structure removal involves the use of explosives, an environmental assessment is prepared and an Endangered Species Section 7 Consultation is initiated with NMFS. The NMFS issued a "standard" Biological Opinion on July 25, 1988, which covers removal operations that meet specified criteria pertaining to the size of explosive charge used, detonation depth, and number of blasts per structure grouping. The MMS, NMFS, and lessees are cooperating in an observer/monitoring program to determine the presence of marine mammals and/or sea turtles in the vicinity of the structure removals. Additional information on structure removals is found in Section IV.A.2.a.(3).

(h) Coastal Zone Management Consistency Review and Appeals for Plans

Gulf of Mexico OCS Region's Procedures for CZM Consistency

Pursuant to the CZMA, 16 U.S.C. 1451 et. seq. (Section 307), a State with an approved CZM plan reviews certain OCS activities to determine whether they will be conducted in a manner consistent with their approved plan. This review authority is applicable to activities described in detail in any plan for the exploration or development of any area that has been leased under the OCSLA and that affects any land or water use or natural resource within or outside of the State's coastal zone (16 U.S.C. 1456(c)(3)(B)). The MMS may not issue a permit for activities described in a plan unless the State concurs or is conclusively presumed to have concurred that the plan is consistent with its CZM plan (43 U.S.C. 1340(c) and 1351(d); 16 U.S.C. 1456(c)(3)).

In accordance with the requirements of 15 CFR 930.76(b), the MMS Gulf of Mexico OCS Region sends copies of an EP and DOCD--including the consistency certification and other necessary information--to the designated State CZM agency by receipted mail. See Section I.B.3.d.(1)(e) for a discussion of environmental information requirements for leases in the Gulf of Mexico submitted for CZM purposes. The Region monitors the consistency-review time period because 15 CFR 930.79(a) and (b) require that concurrence by the State agency shall be conclusively presumed in the absence of a State-agency objection when the appropriate review period expires. Similar procedures are followed for amended plans.

If a written consistency concurrence is received from the State, the Region may then approve any permit for activities described in the plan in accordance with 15 CFR 930.63(c). The Gulf Region does not impose or enforce additional State conditions when issuing permits. The MMS can require modification of a plan even if the operator has agreed to certain requirements requested by the State and agreed to by the operator.

If the Gulf Region receives a written consistency objection from the State containing all the items required in 15 CFR 930.79(c) before the expiration of the review period, the Region will not approve any permit for an activity described in the plan unless (1) the operator amends the plan to accommodate the objection in accordance with 15 CFR 930.83 and concurrence is subsequently received or conclusively presumed; (2) upon appeal, the Secretary of Commerce, in accordance with 15 CFR 930.120, finds that the plan is consistent with the objectives or purposes of the CZMA or is necessary in the interest of national security; or (3) the original objection is declared invalid by the courts.

Coastal Zone Consistency Appeals

A State determination that a proposed activity is not consistent with its approved program must be made within 6 months, and the State must notify the applicant. States often object on the grounds of insufficient information or that the proposal is inconsistent with a mandatory State program requirement. The State objection must describe (1) how the proposed activity will be inconsistent with specific elements of the management program and (2) alternative measures, if they exist, which, if adopted by the applicant, would permit the proposed activity to be conducted in a manner consistent with the management program. Further, the State must inform the applicant of the right of appeal to the Secretary of Commerce (15 CFR 930.64). The applicant has 30 days from receipt of the objection to file a notice of appeal with the Secretary. The applicant may appeal on two independent grounds. First, the applicant may state that the activity furthers the purposes or objectives of the CZMA or, second, that the activity is necessary in the interest of national security. The notice of appeal must be accompanied by a statement in support of the applicant's position, along with supporting data and information. Copies of the notice and supporting material must be sent to relevant Federal and State agencies. An Ex-Partè process applies to appeals to the Department of Commerce. The merits of an appeal cannot be discussed unless all parties are present (National Oceanic and Atmospheric Administration (NOAA), Office of Ocean and Coastal Resources Management (OCRM) exempted). The Secretary may order a public hearing on his own volition or at the request of an interested party. If the Secretary holds a hearing, the NOAA General Counsel or his designee presides as hearing officer. A *Federal Register* notice is prepared to inform the public of the hearing. The regulations covering the appeals process are found at 15 CFR 930, Subpart H.

(2) *Enforcement Measures*

(a) *Inspections*

The MMS inspection program in the Gulf of Mexico is directed by the OCS Regional Office in New Orleans, Louisiana, and six local offices that provide day-to-day review and inspection of oil and gas operations. There are 68 inspectors that go offshore every day, weather permitting. During FY 90, the Gulf of Mexico Region conducted 1,677 drilling inspections, 4,830 production inspections, 2,822 measurement inspections, and 361 pipeline inspections. The MMS also inspects the stockpiles of industry's equipment for the containment and cleanup of oil spills. Stockpiles are located at nine strategic sites along the Gulf Coast. The MMS has instituted a program to land unannounced at an operator's facility to conduct a surprise drill to test the company's ability to deal with an oil spill.

The OCSLA (43 U.S.C. 1348(c)) requires MMS to conduct onsite inspections to assure compliance with lease terms, NTL's, and approved plans and to assure that safety and pollution-prevention requirements of regulations are met. These inspections involve items of safety and environmental concern. Further information on the baseline for the inspection of lessee operations and facilities can be found in the National Potential Incident of Noncompliance (PINC) List (USDOI, MMS, 1988a). Noncompliance with checklisted requirements for specific installations or procedures is followed by prescribed enforcement actions consisting of written warnings or shut-ins of platforms, zones (wells), equipment, or pipelines. In some cases, more than one enforcement action is noted. The MMS inspector then determines the appropriate enforcement action based on an assessment of the risk of either pollution or accident, the history of the lessee, the stage of operation in progress, and the status of other systems.

If an operator is found in violation of a safety or environmental requirement, a citation is issued requiring that it be fixed within 7 days. The violation may call for the particular well component or the entire complex to be shut in.

The primary objective of initial inspections is to assure proper installation of mobile units or structures and associated equipment. After operations begin, additional announced and unannounced inspections are held. Surprise unannounced inspections are conducted to foster a climate of safe operations, to maintain an MMS presence, to focus on operators with a poor performance record, and when a critical safety feature has previously been found defective. Depending on the distance from shore and other factors such as weather and proximity to other inspections, MMS district personnel inspect from one to three different rigs or platforms per day. Aerial surveillance of additional offshore structures is conducted enroute. Annual inspections are conducted on all platforms, but more frequent inspections may be conducted on rigs and platforms. On-board inspections involve the inspection of all safety systems of a production platform. In the interest of efficient and effective utilization of inspection resources, random sampling techniques are being evaluated for the selection of specific items for inspection from the national PINC list.

The operator will normally request the use of oil-based (e.g., mineral oil or polymers) muds at the Application for Permit to Drill (APD) stage if problems are anticipated or if problems are encountered during drilling. Cuttings associated with oil-based muds are generally transported to shore for disposal. Drilling mud is usually reused because of its high cost. Inspectors try to visit operations using oil-based muds frequently or at least make an effort to "fly-by" when in the area. Of initial importance to inspectors is the presence or absence of a "visible sheen" in the waters adjacent to a rig using oil-based muds or a platform producing hydrocarbons. On-board inspection involves seeing that the muds and cuttings are being properly treated and/or disposed of. The "bucket test" involves dropping 2-3 handfuls of cuttings into a bucket of seawater to test for residual oil. The bucket test is a crude indication of the level of treatment when cuttings are treated prior to discharge offshore. The bucket test may be used to ensure that water-based muds will not cause a sheen. The presence or absence of a "visible sheen" in the bucket determines whether or not the cuttings are being properly treated prior to being dumped. This sheen test, performed by MMS inspectors, is different than the "visible sheen" test required under the U.S. Environmental Protection Agency's NPDES general permit for the Gulf of Mexico.

District personnel inspect H_2S sensors to make sure they are operational and inspect logs for timely calibration of instruments and to ensure that rig personnel have been trained in appropriate equipment handling, safety regulations, and emergency procedures. The revised rule for H_2S protection requirements and procedures has been expanded to include production, well-completion, and well-workover operations as well as drilling operations. Hydrogen sulfide presents a threat to human life and safety and to the survival of equipment.

(b) Suspension of Operations

The OCSLA, as amended (43 U.S.C. 1334(a)(1)), and regulations appearing at 30 CFR 250.10 provide for the suspension or temporary prohibition of an operation or activity when the suspension is in the national interest and when the suspension is necessary based on any of the conditions given at 30 CFR 250.10(a) through (c).

(c) Cancellation of Leases

The OCSLA (43 U.S.C. 1334(a)(2)) and regulations at 30 CFR 250.12 authorize the Secretary to cancel a lease or permit if, after opportunity and notice for a hearing, he determines (1) continued activity would probably cause serious harm or damage to life, property, the environment, or national security or defense; (2) the threat of harm or damage will not disappear or decrease to an acceptable extent within a reasonable time; (3) the advantages of cancellation outweigh the advantages of continued activity; and (4) the suspension has been in effect for at least 5 years or the termination of suspension and lease cancellation are at the request of the lessee.

(d) Remedies and Penalties

Under 43 U.S.C. 1350(b) of the OCSLA, as amended, and regulations appearing at 30 CFR 250.200-.206, civil penalties can be assessed for failure to comply with responsibilities under the law, a license, a permit, or any regulation or order issued pursuant to the Act. The Oil Pollution Act of 1990 update has changed the way MMS will address civil remedies and penalties in the future. If the violation is serious enough and is found to be a knowing and willful violation, MMS may recommend that the matter be referred to the Department of Justice for criminal prosecution (43 U.S.C. 1350(c)). The issuance and continuance in effect of any lease or of any assignment or other transfer of any lease shall be conditioned upon compliance with regulations issued under the OCSLA.

(3) Environmental Safeguards

(a) OCS Regulations

On April 1, 1988, revised regulations (30 CFR 250 and 256) that restructured and consolidated the rules governing OCS exploration, development, and production activities were published in the *Federal Register* and became effective May 31, 1988. The former Gulf of Mexico OCS Orders, which dealt with the technical aspects of OCS activities, have been incorporated into the new rules (53 FR 10596-10777).

Approvals

Pursuant to 30 CFR 250.4(a), the Director of MMS is authorized to act upon the requests, applications, and notices submitted to the agency to issue either written or oral orders to govern lease and right-of-way operations. He is also authorized to require compliance with applicable laws, regulations, and lease terms so that all operations conform to sound conservation practice and are conducted in a manner that will preserve, protect, and develop mineral resources of the OCS.

Best Available and Safest Technologies

To assure that oil and gas exploration, development, and production activities on the OCS are conducted in a safe and pollution-free manner, 43 U.S.C. 1347(b) of the OCSLA, as amended, requires that all OCS technologies and operations use the best available and safest technology (BAST) that the Secretary determines to be economically feasible. Conformance to the standards, codes, and practices referenced in 30 CFR 250 are considered to be the application of BAST. These include requirements for state-of-the-art drilling technology, production safety systems, completion of oil and gas wells, oil-spill contingency plans, pollution-control equipment, and specifications for platform/structure designs. The MMS conducts periodic offshore inspections, and the Engineering and Technology Division continuously and systematically reviews OCS technologies to ensure that the best available and safest technologies are applied to OCS operations. The BAST is not required when the Secretary determines that the incremental benefits are clearly insufficient to justify increased costs (30 CFR 250.5(b)); however, it is the responsibility of an operator on an existing operation to demonstrate why application of a new technology would not be feasible. This requirement is applicable to equipment and procedures that, if failed, would have a significant effect on safety, health, or the environment, unless benefits clearly do not justify the cost.

The BAST concept is addressed in the Gulf of Mexico OCS Region by a continuous effort to locate and evaluate the latest technologies and to report on these advances at periodic Regional Operations Technology Assessment Committee (ROTAC) Meetings. A part of the MMS staff has an ongoing function to evaluate various vendors and industry representatives' innovations and improvements in techniques, tools, equipment, procedures, and technologies applicable to oil and gas operations (drilling, producing, completion, and workover operations). This information is provided to MMS district personnel at ROTAC meetings. The requirement for the use of BAST has, for the most part, been an evolutionary process whereby advances in equipment, technologies, and procedures have been subtly integrated into OCS operations over a period of time. An awareness by both MMS inspectors and the OCS operators of the most advanced equipment and technologies has resulted in the incorporation of these advances into day-to-day operations. An example of such an equipment change that evolved over a period of time would be the upgrading of diverter systems on drilling rigs from the smaller diameter systems of the past to the large-diameter, high-capacity systems found on drilling rigs operating on the OCS today. Another example of a BAST-required equipment change would be the requirement to replace subsurface-controlled subsurface safety valves with surface-controlled, subsurface safety-valve systems, which incorporate a more positive closure design and operation. Also, a quality assurance and performance of safety and pollution-prevention equipment program regarding the surface and subsurface safety valves has been included in MMS requirements.

Pollution Prevention and Control

The MMS has promulgated regulations (30 CFR 250.40) to ensure lessees do not create conditions that will pose an unreasonable risk to public health, life, property, aquatic life, wildlife, recreation, navigation, commercial fishing, or other uses of the ocean during offshore oil and gas operations. Control and removal of pollution is the responsibility and at the expense of the lessee. Operators are required to install curbs, gutters, drip pans, and drains on platform and rig deck areas in a manner necessary to collect all contaminants and debris not authorized for discharge. The rules also explicitly prohibit the disposal of equipment, cables, chains, containers, or other materials into offshore waters. Portable equipment, spools or reels, drums, pallets, and other loose items weighing 40 lb or more must be marked in a durable manner with the owner's name prior to use or transport over offshore waters. Smaller objects must be stored in a marked container when not in use. Should equipment, material, containers, drums, or other items be lost overboard, they are to be recorded on the facility's daily report and reported to the MMS. Discussion of regulations specifically pertaining to oil-spill prevention can be found in Section IV.C.5.

(b) OCS Structures and Equipment

Wells

Prior to conducting drilling operations, the operator is required, pursuant to 30 CFR 250.64, to submit and obtain approval for an APD (Form MMS-331C). The lessee is required to take precautions to keep exploratory well drilling under control at all times. The APD is filed by the lessee/operator along with or following submission of the EP or DOCD and supporting information. The APD requires detailed information about the drilling program for evaluation with respect to operational safety and pollution-prevention measures. Approval of an APD requires an MMS-approved EP or DOCD and receipt of CZM consistency or presumptive concurrence. The approved APD constitutes the drilling permit. The APD is reviewed for conformance with the requirements of 30 CFR 250.64 and other engineering considerations. In addition, other information--including project layout at a scale of 2,000 ft to the inch, design criteria for well control and casing, blowout preventors, and a mud program--is required. The lessee must use the best available and safest technology in order to enhance the evaluation of abnormal pressure conditions and to minimize the potential for uncontrolled well flow. Specific requirements for well workovers, completions, abandonments, and sundry notices are detailed in Subparts D-G of the revised regulations. Significant deviations from an approved plan require that an environmental analysis be done in accordance with the procedures outlined in Section I.B.3.d.(1)(a).

Platforms

The lessee must design, fabricate, install, use, inspect, and maintain all platforms and structures on the OCS to assure their structural integrity for the safe conduct of operations at specific locations. Applications for platform approval are filed in accordance with 30 CFR 250.131. Design requirements are presented in detail at 30 CFR 250.134-250.139. The lessee evaluates characteristic environmental conditions associated with operational functions to be performed. Factors such as waves, wind, currents, tides, temperature, and the potential for marine growth are considered. In addition, pursuant to 30 CFR 250.132 and 250.133, a program to assure that offshore oil and gas structures are designed, fabricated, and installed using standardized procedures to prevent structural failures has been established by MMS for new platforms meeting the criteria at 30 CFR 250.130(c). The program facilitates review of these structures and utilizes third-party expertise and technical input in the verification process through the use of a Certified Verification Agent. An environmental analysis would be conducted for any proposal involving the use of new or unusual technology in accordance with the procedures outlined in Section I.B.3.d.(1)(a).

Production Facilities

Production safety equipment used on the OCS must be designed, installed, used, maintained, and tested in a manner to assure the safety and protection of the human, marine, and coastal environments. All tubing installations open to hydrocarbon-bearing zones below the surface must be equipped with safety devices that will shut off the flow from the well in the event of an emergency, unless the well is incapable of flowing. All surface production facilities, including separators, treaters, compressors, headers, and flowlines must be designed, installed, and maintained in a manner that provides for efficiency, safety of operations, and protection of the environment. Surface- and subsurface-controlled safety valves and locks must conform to the requirements of 30 CFR 250.126. Production facilities also have stringent requirements concerning electrical systems, flowlines, engines, and firefighting systems. The safety-system devices are tested by the lessee at specified intervals and must be in accordance with API RP 14 C, Appendix D, and other measures.

Pipelines

Regulatory processes and jurisdictional authority concerning pipelines on the OCS and in coastal areas are shared by several Federal agencies, including DOI, the Department of Transportation (DOT), U.S. Army Corps of Engineers (COE), the Federal Energy Regulatory Commission (FERC), and U.S. Coast Guard (USCG). Aside from pipeline regulations, these agencies have the responsibility of overseeing and regulating the following areas: the placement of structures on the OCS and pipelines in areas that affect navigation; the certification of proposed projects involving the transportation or sale of interstate natural gas, including OCS gas; the right of eminent domain exercised by pipeline companies; and wellhead pricing controls for certain gas produced on the OCS. In addition, the Office of Pipeline Safety (DOT) is responsible for promulgating and enforcing safety regulations for the transportation in or affecting interstate commerce of natural gas, liquefied natural gas (LNG), and hazardous liquids by pipeline. This includes all offshore pipelines on State lands beneath navigable waters and on the OCS. The regulations are contained in 49 CFR 191-193 and 195. In the past, MMS requested that affected States render a CZM consistency determination for offshore right-of-way pipeline applications. However, the publication of 30 CFR 250, Subpart J, on April 1, 1988, MMS has not requested such determinations from the affected States.

In a Memorandum of Understanding (MOU) between DOT and DOI dated May 6, 1976, each party's respective regulatory responsibilities are outlined. The DOT is responsible for establishing and enforcing design, construction, operation, and maintenance regulations for pipelines extending to the shore from the outlet flange of an offshore facility. The DOI's responsibility extends upstream from the outlet flange at each facility where produced hydrocarbons are first separated, dehydrated, or otherwise processed to each production well in the OCS. In addition, those pipelines necessary for the development of a lease are under DOI's exclusive jurisdiction.

The MMS pipeline permit applications are filed under Subpart J of 30 CFR 250. Detailed requirements for filing the applications are found at 30 CFR 250.157 and 30 CFR 250.160. Normally, each permit application will contain the pipeline location drawing, profile drawing, safety schematic drawing, and the pipe design data to scale. Information submitted as part of the shallow hazard survey report/analysis and/or archaeological report is used for MMS environmental evaluations. Provisions governing offshore pipelines under the revised rulemaking include expanded requirements governing design, installation, testing, safety equipment, abandonment, and reporting. A Gulf of Mexico Region LTL dated April 18, 1991, further details and interprets pipeline regulations.

In considering applications for pipeline permits, MMS approves the design and fabrication of the pipeline and prepares a CER, EA, and/or EIS in accordance with applicable policies and guidelines. The MMS prepares an EA and/or an EIS on all pipeline rights-of-way that go ashore (pursuant to 516 DM 6, Appendix 10). The FWS reviews and provides comments on applications for pipelines that are near certain sensitive biological communities. No pipeline route will be approved by MMS if any bottom-disturbing activities (the pipeline itself or the anchors of lay barges and support vessels) encroach on any biologically sensitive areas, such as stipulation-established No Activity Zones (Sections II.A.1.c.(1) and II.B.1.c.(1)). The operators are required to inspect their routes at time intervals and methods prescribed by the Regional Supervisor for any indication of pipeline leakage (30 CFR 250.155(a)). Pipelines routes in the Gulf of Mexico are inspected monthly for leakage through flyovers. In October 1990, Congress amended (through H.R. 4888) Section 3 of the Natural Gas Pipeline Safety Act of 1968 (49 U.S.C. App. 1672) relating to offshore pipeline inspection and burial. In the future, operators of offshore pipeline facilities in the Gulf and its inlets shall inspect the facility and report to the Secretary on any portion of the pipeline facility that is exposed or is a hazard to navigation. This legislation applies only to pipeline facilities between the mean high-water mark and the point where the surface is under 15 ft of water as measures from mean low water. Pipelines may be abandoned in place if they do not constitute a hazard to navigation and commercial fishing or unduly interfere with other uses of the OCS. Procedures for pipeline abandonment and pipeline reporting requirements are outlined in detail at 30 CFR 250.156 and 250.158.

(c) Lease Stipulations

Oil and gas exploration and development activities on the OCS have the potential for causing adverse environmental impacts; therefore, special stipulations may be developed before the sale (discussed in Sections II and IV) and may be attached to the lease instrument, as necessary, in the form of additional mitigating measures. Biological communities, archaeological resources, and military areas stipulations are those that have been attached most often to the leases in previous Gulf lease sales. The MMS is responsible for ensuring full compliance with stipulations appended to leases.

(d) Other MMS Environmental Safety Controls

Besides its regulations and lease stipulations, MMS has other mechanisms that may be used to control or mitigate environmental or safety problems that may arise.

Notices, Letters, and Information to Lessees and Operators

Notices to Lessees and Operators (NTL's) are formal documents that provide clarification, description, or interpretation of a regulation or OCS standard; provide guidelines on the implementation of a special lease stipulation or regional requirement; provide a better understanding of the scope and meaning of a regulation by explaining MMS interpretation of a requirement; or transmit administrative information such as current telephone listings and a change in MMS personnel or office address. A detailed listing of Gulf of Mexico NTL's was published in the *Federal Register* on May 16, 1991 (56 FR 22735-22737).

The NTL 89-01, adopted subsequent to the latest publication, concerns the Implementation of Consistent Biological Stipulation Measures in the Central and Western Gulf of Mexico.

The MMS also conveys important information by way of Letters to Lessees and Operators (LTL's) and Information to Lessees and Operators (ITL's). These documents further clarify or supplement operational guidelines. Separate Regional mailings and the EIS process have served as the vehicles for communicating previous NTL's, LTL's, and ITL's that have been issued.

Conditions of Approval

Conditions of plan approval are mechanisms used by MMS to control or mitigate potential environmental or safety problems associated with a proposal. These mechanisms represent an integration of review results from other Federal and State agencies (as applicable) and MMS technical evaluations (including geological and geophysical; royalty, Suspension of Production schedule, and competitive reservoir considerations; potentially hazardous situations involving existing or proposed pipelines; conflicts with archaeological resources and sensitive biological areas, and other uses; and NEPA compliance).

Alternatives to a proposed action are evaluated as part of the NEPA process to assess reasonable alternative activities that could result in lower adverse environmental impacts. In addition to alternatives proposed by the lessee/applicant, alternatives that consider other uses of resources that involve unresolved conflicts, as well as alternatives or mitigation that are not part of the proposal that may be needed to minimize environmental effects, are given full consideration. Mitigating measures have addressed resource-use concerns such as endangered/threatened species, geologic and manmade hazards, military warning and ordnance disposal areas, oil-spill contingency planning, chemosynthetic communities, operations in H_2S prone areas, and shunting of drill effluents in the vicinity of biologically sensitive features.

Conditions that may be necessary to provide environmental protection may be applied to any OCS plan, permit, right of use of easement, or pipeline right-of-way grant.

Personnel Training and Education

An important factor in ensuring that offshore oil and gas operations are carried out in a manner that emphasizes operational safety and minimizes the risk of environmental damage is the proper training of personnel. Under 30 CFR 250.43(a), all operators must have trained personnel to operate oil-spill cleanup equipment or must have retained a trained contractor(s) that will operate the equipment for them. The Drilling Well-Control Training Program, now incorporated under 30 CFR 250.211, was instituted by MMS in 1979. In 1982 and 1983, an additional training program--the Safety Device Training Program--was developed and put into effect. The Safety Device Training Program, incorporated under 30 CFR 250.212(a), ensures that personnel involved in installing, inspecting, testing, and maintaining safety devices are qualified.

(e) Prevention and Control Regulations for Spills and Discharges

There are a number of important acts under which regulations have been promulgated to minimize pollution incidents and the potential environmental and economic damage caused by the release of pollutants from various sources into Gulf waters. These acts include the Clean Water Act; OCSLA, as amended (Section I.B.3.a.); the Ports and Waterways Safety Act (Section I.B.4.a.); Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), or "Superfund," as amended by the Superfund Amendments and Reauthorizations Act of 1986 (SARA) (Section I.B.3.d.(3)(f); and the Oil Pollution Act of 1990, signed into law on August 18, 1990. There are also a number of international regulations, which the U.S. is a signatory to, that prevent or limit water pollution.

Also, the USCG has promulgated regulations on oil pollution prevention for vessel transfer facilities (USCG regulations do not apply to pipelines) (33 CFR 154), requirements for the reporting of oil discharges (33 CFR 153), and regulations relating to discharges from ships (33 CFR 155).

Federal Water Pollution Control Act (Clean Water Act)

The Federal Water Pollution Control Act (FWPCA) of 1972 (33 U.S.C. 1251 et seq.), as amended, and commonly called the Clean Water Act (CWA), provides a major tool to the Federal Government to ensure that the chemical, physical, and biological integrity of the Nation's waters are maintained. The Clean Water Act of 1987 expanded and strengthened the FWPCA by building on progress already made in water quality and by addressing new and remaining problems.

Section 311 of FWPCA, provides the authority for the Federal government's oil spill program. The Oil Pollution Act of 1990 (OPA) contained significant modifications to many of the provisions of Section 311 of the Clean Water Act. Major provisions of Section 311 authorizes the Federal Government to

(1) establish reporting criteria for notifying the Federal Government of discharges of oil and hazardous substance into U.S. waters;

(2) respond to oil and hazardous substances discharges, including directing certain cleanups by responsible parties;

(3) assess civil and criminal penalties;

(4) establish regulations requiring procedures, methods, and equipment to prevent discharges;

(5) republish the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), incorporating OPA changes;

(6) establish area committees to prepare area contingency plans;

(7) promulgate regulations requiring a facility owner or operator to prepare a plan for responding to a worst-case discharge and to a substantial threat of such a discharge.

Responsibility for implementing Section 311 is divided between USEPA and the DOT by Executive Order 11735. In general, DOT is responsible for regulations governing vessels and pipelines, while USEPA is responsible for fixed facilities. Within DOT, the U.S. Coast Guard and the Office of Pipeline Safety have responsibility for implementing Section 311.

Recently, USEPA proposed revisions in the Oil Pollution Prevention regulations (40 CFR 112) promulgated under Section 311 (j)(1)(C) of the CWA, as amended by OPA. This proposed rule establishes requirements for Spill Prevention, Control, and Countermeasures (SPCC) Plans to prevent spills of oil by nontransportation-related onshore and offshore facilities into the waters of the U.S. and adjoining shorelines. If finalized, these regulations would apply to OCS onshore oil storage areas. The USEPA proposes to exempt offshore production or exploration facilities subject to MMS regulations.

Title III of the FWPCA requires the USEPA to establish national effluent limitation standards for point sources of wastewater discharges. Title IV of the Act establishes requirements for Federal permits and licenses to conduct an activity (including construction or operation of facilities) that may result in any discharges into waters, called the National Pollutant Discharge Elimination System (NPDES). Section 402 of the Act confers authority upon USEPA to issue permits for the discharge of pollutants into territorial seas and oceans only when the discharges are in compliance with the ocean discharge criteria guidelines established under the authority of Section 403(c) of the Act.

Operational Wastes Disposal and Storage Regulations

The disposal of oil and gas operational wastes are managed by USEPA through regulations established under three Federal Acts. The Resource Conservation and Recovery Act (RCRA), as amended (42 USC 6901, et seq.), provides a framework for the safe disposal of discarded materials, regulating the management of solid and hazardous wastes. The USEPA has exempted many oil and gas wastes from coverage under hazardous wastes regulations under Subtitle C of RCRA. If covered, such wastes would be more stringently regulated under hazardous waste rules, i.e., industry would be responsible for the wastes from their generation to their final disposal. Exempt wastes include those generally coming from an activity directly associated with the drilling, production, or processing of a hydrocarbon product. Nonexempt oil and gas wastes include those not unique to the oil and gas industry and used in the maintenance of equipment.

The direct disposal of operational wastes into offshore waters are limited by USEPA under the authority of the Clean Water Act, as amended. A general National Pollution Discharge Elimination System (NPDES) Permit, based on effluent limitation guidelines, is required for all such discharges. On July 9, 1986, the USEPA issued an NPDES general permit for discharges from offshore oil and gas facilities conducting exploration, development, and production operations on the OCS (51 FR 24897). This general permit established effluent limitations, prohibitions, reporting requirements, and other conditions. The USEPA has revised the general permit for the Gulf waters excluding the area off Florida, and the proposed permit was published on April 16, 1991. The USEPA is in the process of responding to comments and expects the final permit to be issued by the end of the year. The USEPA, Region IV, which is responsible for the Eastern Gulf, is beginning work on their general permit. No dates are available.

Proposed new offshore effluent guidelines, which the general permit is based upon, have been published in the *Federal Register* (55 FR 49094, November 26, 1990) for comment. New proposed effluent limitation guidelines and standards for drilling muds and cuttings, produced waters, well treatment fluids, produced sands, and domestic and sanitary wastes discharges are being considered at this time by USEPA. These new effluent limitation regulations will take into account industry's best available control technology, best conventional pollutant control technology, and new source performance standards. Considering that existing effluent limitations have only considered best practicable control technologies, the new discharge limitations and standards are expected to significantly alter some existing discharge practices. Promulgation of these effluent limitations will occur on June 19, 1992.

When injected underground, oil and gas operational wastes are regulated by USEPA's third program, the Underground Injection Control program, established by Part C of the Safe Drinking Water Act (P.L. 93-523, as amended by P.L. 99-339 on June 19, 1986).

Section 404

Section 404 of the Federal Water Pollution Control Act has had a substantial effect on areas adjacent to navigable waters. This section requires a Corps of Engineers permit for the disposal or emplacement for development purposes of dredge or fill material, and for the building of structures in all the waters of the United States. Section 404 requires Corps of Engineers approval, with consultation from other Federal and State agencies, for the dredging of pipeline canals and navigation routes that service OCS production and activities in the coastal areas of the Gulf of Mexico.

Air Emissions Regulatory Framework

The Clean Air Act (CAA) (42 U.S.C. 7401-7642) has been an evolving law, beginning with the Clean Air Legislation of 1955, to the 1963 Clean Air Act, and through various amendments in 1967, 1970, 1977, and finally 1990. At each step, the CAA gave the Federal government more control over air pollution issues, and finally, the amendments in 1977 authorized USEPA to provide for air pollution prevention and control activities. The 1990 amendments give the USEPA jurisdiction of OCS air emissions in the Pacific, Arctic, Atlantic, and east of 87°30' W. longitude in the Gulf of Mexico. The 1990 CAA amendments instruct MMS to conduct and complete a study within 3 years of the date of CAA Reauthorization or the effects of offshore air emissions on onshore air quality in nonattainment areas for O_3 and NO_x. These areas must be located in OCS areas under MMS jurisdiction.

The goals of the CAA are specifically (1) to protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population; (2) to initiate and accelerate a national research and development program to achieve the prevention and control of air pollution; (3) to provide technical and financial assistance to State and local governments in connection with development and execution of their air-pollution prevention and control programs; and (4) to encourage and assist the development and operation of regional air pollution controls programs. Other important contributions of the CAA are the introduction and development of NAAQS; use of the regional approach and introduction of the prevention of significant deterioration concepts to air quality control; emissions standards for new or modified sources and hazardous pollutants; Federal authority to deal with interstate and intrastate air pollution problems; and the regulatory power to deal with O_3-destroying chemicals.

The USEPA established ambient air quality standards and regulations. These standards are the primary and secondary air quality standards used to establish the air quality control of each State. The USEPA has also developed air quality standards for hazardous pollutants. The primary standards are designed to protect public health; secondary standards are designed to protect the public welfare. Other amendments established deadlines for establishing the air quality status and for achieving the reduction and controls necessary of the air quality regions.

The Act requires that Federal departments or agencies having jurisdiction over any property, facility, or engaged in any activity resulting in the discharge of air pollutants comply with all Federal, State, interstate, or local requirements in the control and abatement of air pollution. The Act is referred to in Section 5(a)(8) of the OSCLA, which describes DOI's authority to regulate air emissions from OCS oil and gas facilities. The MMS has established 30 CFR 250.44, 250.45, and 250.46 to comply with the Clean Air Act. The MMS also established 30 CFR 250.67 to regulate activities in hydrogen sulfide prone areas. These regulations allow the collection of information about potential sources of pollution for the purpose of preventing accidents and air quality deterioration.

Regulations for the Prevention of Pollution by Solid Wastes from Ships

The Marine Pollution Research and Control Act of 1987 (Title II of P.L. 100-200) implements Annex V of the International Convention for the Prevention of Pollution from Ships. Most of the law's regulatory provisions became effective on December 31, 1988. Under provisions of the law, all ships and watercraft, including all commercial and recreational fishing vessels, are prohibited from dumping plastics at sea. The law also severely restricts the legality of dumping other vessel-generated garbage and solid waste items both at sea and in U.S. navigable waters. The USCG is responsible for enforcing the provisions of this law and has developed final rules for its implementation (55 FR 171, September 4, 1990), calling for adequate trash reception facilities at all ports, docks, marinas, and boat launching facilities.

Interim final rules published May 2, 1990 (55 FR 85, pages 18578-18581) explicitly stated that fixed and floating platforms or all drilling rigs, manned production platforms, and support vessels operating under a Federal oil and gas lease (33 CFR 151.73) are required to develop Waste Management Plans (33 CFR 151.57) and to post placards reflecting MARPOL, Annex V dumping restrictions (33 CFR 151.59). Waste Management Plans will require oil and gas operators to describe procedures for collecting, processing, storing, and discharging garbage and to designate the person who is in charge of carrying out the plan. These rules also apply to all oceangoing ships of 40 ft of more in length that are documented under the laws of the U.S. or numbered by a State and that are equipped with a galley and berthing. Placards noting discharge limitations and restrictions, as well as penalties for noncompliance, apply to all boats and ships 26 ft or more in length. Furthermore, the Shore Protection Act of 1988 (FR 22546; May 24, 1989) requires ships transporting garbage and refuse to assure that the garbage and refuse is properly contained on board so that it will not be lost in the water from inclement wind or water conditions.

Occupational Safety and Health Act

The Occupational Safety and Health Act of 1970 (29 U.S.C. 651-678) was enacted to assure, to the extent possible, every working man and woman in the Nation safe and healthful working conditions and to preserve our human resources. The Act encourages employers and employees in their efforts to reduce occupational safety and health hazards in their places of employment and stimulates the institution of new programs and the perfection of existing programs for providing safe and healthful working conditions. The Act establishes a National Institute for Occupational Safety and Health, which is authorized to develop and establish occupational safety and health standards. Likewise, the Act establishes a National Advisory Committee on Occupational Safety and Health consisting of members appointed by the Secretaries of Labor and Health and

Human Services. This committee advises, consults, and makes recommendations to the Secretaries on matters of the Act's administration.

The Act empowers the Secretary of Labor or his representative to enter any factory, plant, establishment, workplace, or environment where work is performed by employees and to inspect and investigate during regular working hours and at other reasonable times any such place of employment and all pertinent conditions and equipment therein. If, upon inspection, the Secretary or authorized representative believes that an employer has violated provisions of the Act, the employer shall be issued a citation and given 15 days to contest the citation or proposed assessment of penalty. If the Secretary has reason to believe that an employer has failed to correct a violation for which a citation has been issued, the employer shall be notified of such failure and of the penalty proposed to be assessed. In addition, the Act provides for any representatives of employees who believe that a violation of a safety or health standard exists that threatens physical harm, or that imminent danger exists, may request an inspection by giving notice to the Secretary or his authorized representative of such a violation or danger.

Oil Pollution Act of 1990

The Oil Pollution Act of 1990, enacted in August 1990, is comprehensive legislation that includes, in part, provisions to (1) improve oil-spill prevention, preparedness, and response capability; (2) establish limitations on liability for damages resulting from oil pollution; and (3) implement a fund for the payment of compensation for such damages.

The Oil Pollution Act of 1990 amends portions of the Intervention on the High Seas Act, the Federal Water Pollution Control Act, the Deepwater Port Act, and the Outer Continental Shelf Lands Act Amendments of 1978. Amendments to these Acts provide that all monies remaining in the pollution funds established by these Acts and any amounts received through the oil discharge-related provisions of the Federal Water Pollution Control Act shall be deposited into the Oil Spill Liability Trust Fund implemented under the Oil Pollution Act of 1990. In return, the Oil Spill Liability Trust Fund assumes all liability incurred by the Offshore Oil Pollution Compensation Fund, the Deepwater Port Liability Fund, and the revolving Fund set up under the Federal Water Pollution Control Act.

Amounts in the Oil Spill Liability Trust Fund shall also be available for (1) the payment of removal costs and other costs as outlined in Section 1012 of the Oil Pollution Act of 1990; (2) carrying out the sections relating to oil pollution or the substantial threat of oil pollution in the Intervention on High Seas Act (Sections 5 and 7); and (3) carrying out subsections (b), (c), (d), (j), and (l) of Section 311 of the Federal Water Pollution Control Act with respect to oil discharge-related prevention, removal, and enforcement. The $1 billion National Oil Spill Liability Trust Fund will be established from a five-cent-per-barrel tax on all oil. The Fund can provide up to $1 billion per incident for cleanup costs and can compensate oil-spill victims when liability limits have been reached or if a spiller and an injured party cannot reach an agreement on a settlement within 60 days. The limit established under the Fund for natural resource damage restoration or replacement is $500 million.

The Act specifies that cargo owners are not liable for spills and raises the liability limits from $150 per gross ton to $1,200 per gross ton for vessels. Liability for offshore facilities is set at $75 million plus unlimited removal costs, while liability for onshore facilities or a deepwater port is set at $350 million. Willful misconduct, violation of any Federal operating or safety standard, failure to report an incident, or refusal to participate in a cleanup subjects the spiller to unlimited liability under provisions of the Act.

Pursuant to the Act, double hulls are required on all newly constructed tankers. Double hulls or double containment systems are required on all tank vessels less than 5,000 gross tons (i.e., barges). Beginning in 1995, existing single-hull tankers will be phased out based on size and age. All single-hull tankers will be banned after the year 2010.

If a discharge or substantial threat of a discharge of oil or a hazardous substance from a vessel, offshore facility, or onshore facility is considered to be of such a size or character to be a substantial threat to the public health or welfare of the U.S., under provisions of the Act, the President (through the USCG) now has the authority to direct all Federal, State, and private actions to remove a discharge or to mitigate or prevent the threat of the discharge. Potential impacts from discharges of oil or a hazardous substance to fish, shellfish, wildlife, other natural resources, or the public and private beaches of the U.S. would be an example of the degree or type of threat considered to be of such a size or character to be a substantial threat to the U.S. public health or welfare. In addition, the USCG's authority to investigate marine accidents involving foreign tankers has been expanded to include accidents in the Exclusive Economic Zone. The Act also establishes USCG oil-spill response groups (to include equipment and personnel) in each of the 10 USCG districts, with a national response unit to be located at Elizabeth City, North Carolina.

The Oil Pollution Act of 1990 requires that contingency plans address the response to a "worst case" oil spill or a substantial threat of such a discharge. It also requires that vessels and both onshore and offshore facilities have response plans approved by the President. These plans adhere to specified requirements, including the demonstration that they have contracted with private parties to provide the personnel and equipment necessary to respond to or mitigate a "worst case" spill. In addition, the Act provides increased penalties for violations of statutes related to oil spills, including payment of triple costs by persons who fail to follow contingency plan requirements.

Within 180 days of the enactment of the Act, an Interagency Coordinating Committee on Oil Pollution Research, established by the provisions of the Act, will submit a plan for the implementation of an oil-pollution research, development, and demonstration program to Congress. This program will address, in part, an identification of significant oil-pollution research gaps, an establishment of research priorities and goals, and an estimate of the resources and timetables necessary to accomplish the identified research tasks. The program is required to provide for (1) research, development, and demonstration of new and improved technologies that are effective in preventing or mitigating oil discharges and that will protect the environment; (2) oil-pollution prevention and mitigation technology evaluation; and (3) a research program to monitor and evaluate the environmental effects of oil discharges.

(f) Federal Compensation for Damages or Pollution

The Oil Liability Trust Fund

Title III of the Outer Continental Shelf Lands Act Amendments of 1978 has been repealed. Any amounts remaining in the Offshore Oil Pollution Compensation Fund established under Section 302 of that title and any amounts remaining in the revolving fund established under subsection (k) of the Federal Water Pollution Control Act shall be deposited in the Oil Spill Liability Trust Fund pursuant to the Oil Pollution Act of 1990. In addition, any amounts received through the oil discharge-related provisions of the Federal Water Pollution Control Act shall also be deposited into the Oil Spill Liability Trust Fund. In return, the Oil Spill Liability Trust Fund shall assume all liability incurred by the Offshore Oil Pollution Compensation Fund and the revolving Fund set up under the Federal Water Pollution Control Act. Liability incurred by the Deepwater Port Liability Fund will also be assumed by the Oil Spill Liability Trust Fund.

In addition to the liability incurred by the Fund, amounts in the Oil Spill Liability Trust Fund shall also be available for (1) the payment of removal costs and other costs as outlined in Section 1012 of the Oil Pollution Act of 1990; (2) carrying out the sections relating to oil pollution or the substantial threat of oil pollution in the Intervention on High Seas Act (Sections 5 and 7); and (3) carrying out subsections (b), (c), (d), (j), and (l) of Section 311 of the Federal Water Pollution Control Act with respect to oil discharge-related prevention, removal, and enforcement.

Section 1012 of the Oil Pollution Act of 1990 indicates that the Fund will generally be available to the President for the payment of the following:

(1) removal costs, including the costs of monitoring removal costs, determined by the President to be consistent with the National Contingency Plan;

(2) costs incurred for assessing natural resource damages and for developing and implementing plans for the restoration, rehabilitation, replacement, or acquisition of damaged resources;

(3) removal costs as a result of, and damages resulting from, a discharge, or a substantial threat of a discharge, of oil from a foreign offshore unit;

(4) uncompensated removal costs; and

(5) Federal administrative, operational, and personnel costs and expenses for the implementation, administration, and enforcement of the Act.

Fishermen's Contingency Fund

Final regulations for the implementation of Title IV of the OCSLA, as amended (43 U.S.C. 1841-1846), were published in the *Federal Register* on January 24, 1980 (50 CFR 296). The OCSLA, as amended, established the Fishermen's Contingency Fund (not to exceed $2 million) to compensate commercial fishermen for actual and consequential damages including loss of profit due to damage or loss of fishing gear by various materials and items associated with oil and gas exploration, development, or production on the OCS. This Fund, administered by the Financial Services Division of NMFS, mitigates most losses suffered by commercial fishermen due to OCS oil and gas activities.

As required in the OCSLA, nine area accounts have been established--five in the Gulf of Mexico, one in the Pacific, one in Alaska, and two in the Atlantic. The five Gulf accounts cover the same areas as the five MMS Gulf OCS Districts. Each area account is initially funded at $100,000 and cannot exceed this amount. The accounts are initiated and maintained by assessing holders of leases, pipeline rights-of-way and easements, and exploration permits. These assessments cannot exceed $5,000 per operator in any calendar year.

The claims eligible for compensation are generally contingent upon the following: (1) damages or losses must be suffered by a commercial fisherman; and (2) any actual or consequential damages, including loss of profit, must be due to damages or losses of fishing gear by items or obstructions related to OCS oil and gas activities. Damages or losses that occur in non-OCS waters may be eligible for compensation if the item(s) causing damages or losses are associated with OCS oil and gas activities.

Ineligible claims for compensation are generally (1) damages or losses caused by items that are attributable to a financially responsible party; (2) damages or losses caused by negligence or fault of the commercial fishermen; (3) occurrences before September 18, 1978; (4) claims of damages to, or losses of, fishing gear exceeding the replacement value of the fishing gear; (5) claims for loss of profits in excess of 6 months, unless supported by records of the claimant's profits during the previous 12 months; (6) claims or any portions of damages or losses claimed that will be compensated by insurance; (7) claims not filed within 60 days of the event of the damages or losses; and (8) damages or losses caused by natural obstructions or obstructions unrelated to OCS oil and gas activities.

There are several requirements for filing claims, including one that a report, stating among other things the location of the obstruction, must be made within 5 days after the event of the damages or losses; this 5-day report is required to gain presumption of causation. A detailed claim form must be filed within 60 days of the event of the damages or losses. The specifics of this claim are contained in 50 CFR 296. The claimant has the burden of establishing all the facts demonstrating eligibility for compensation, including the identity or nature of the item that caused the damages or losses and its association with OCS oil and gas activity.

Damages or losses are presumed to be caused by items associated with OCS oil and gas activities provided the claimant establishes that (1) the commercial fishing vessel was being used for commercial fishing and was located in an area affected by OCS oil and gas activities; (2) the 5-day report was filed; (3) there is no record in the most recent NOAA/NOS nautical charts or weekly USCG Notice to Mariners of an obstruction in the immediate vicinity; and (4) no proper surface marker or lighted buoy marked the obstruction. Damages or losses occurring within a one-quarter-mile radius of obstructions recorded on charts, listed in the Notice to Mariners, or properly marked are presumed to involve the recorded obstruction.

National Resource Damage Assessment Regulations

Section 301(c) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (42 U.S.C. 9601 et seq.), modified by the 1986 Superfund Amendments and Reauthorization Act (SARA) and Section 1006 of the Oil Pollution Act of 1990, requires the promulgation of rules for the assessment of damages for, injury to, destruction of, or loss of natural resources resulting from a discharge of oil or a release of a hazardous substance. These assessments are specified for hazardous substance releases in Sections 107(a) and 111(a) and (b) of CERCLA and for a discharge of oil into or upon navigable waters, or upon adjoining shorelines or the exclusive economic zone in Sections 311 (f)(4) and (5) of the Clean Water Act (Section I.B.3.d.(3)(e)) and Section 1006 of OPA. The natural resource damage assessment requirements provide a process for determining proper compensation to the public for injury to natural resources. Section 301(c) of CERCLA specified two types of procedures to be developed: type "A" procedures for simplified assessments requiring minimal field observations and type "B" procedures for individual cases. On August 1, 1986, the U.S. Department of the Interior issued final regulations (51 FR 27674) establishing procedures for assessing damages to natural resources to be used by authorized Federal and State officials referred to as "trustees." Type "A" procedures were codified for coastal and marine environments on March 20, 1987 (52 FR 9042). On February 22, 1988 (53 FR 5166), the regulations were modified to conform with amendments to CERCLA brought about by the 1986 Superfund Amendments and Reauthorization Act (SARA). Finally, on September 22, 1989, the Department of the Interior announced that it intends to revise the type "A" natural resource damage assessment procedures in response to recent court rulings (54 FR 39013). On December 28, 1990, NOAA published an advanced notice of proposed rulemaking to establish its own procedures for natural resource damage assessment under OPA.

4. Interrelationship with Other Federal Policies Governing OCS Environmental Resources

a. Ports and Waterways Safety Act

The Ports and Waterways Safety Act (33 U.S.C. 1221-1232) promotes the safety of ports, harbors, waterfront areas, and navigable waters of the United States. The Act was amended by the Ports and Tanker Safety Act (92 Stat. 1471) in 1978 to expand the authority of the Act to the protection of navigation and vessel safety and to the protection of the marine environment.

The Act authorizes increased supervision of vessel and port operations to reduce vessel or cargo loss; to prevent damage to life, property, or the marine environment; and to prevent damage to structures in, on, or immediately adjacent to navigable waters of the United States or the resources within such waters. It also requires that the Secretary of Transportation ensure that vessels operating in U.S. navigable waters comply with all applicable standards and requirements for vessel construction, equipment, manning and operational procedures, and that the handling of dangerous articles and substances within navigable waters be conducted within established standards and requirements.

The Act authorizes the Coast Guard to designate necessary safety fairways and traffic separation schemes (TSS's) to allow vessels unobstructed, safe access to U.S. ports. Safety fairways are areas in which no fixed structures are permitted and, therefore, may inhibit exploration and exploitation of mineral resources in the designated areas. Fairways may be viewed as a necessary compromise between convenient mineral exploitation and concern for navigation safety. The TSS's are designed to increase navigation safety by separating opposing lanes of vessel traffic. In order to ensure that the interests of all affected parties are considered, the Act mandates that a port access route study be conducted when new fairway areas or TSS's are contemplated. Publication of a study notice advises all bidders in future lease sales within the study area that occupancy rights may be restricted by a routing system developed as a result of the study. The USCG must also consult with DOI to reconcile the need for safe access routes with the needs of all other reasonable uses of the area involved. Lessees are advised that the USCG may designate necessary fairways through leased blocks.

b. Archaeological Resources Legislation

The Federal Government's involvement in archaeological resource management and protection on the OCS is based on the requirements of the National Historic Preservation Act of 1966, as amended. This Act states, in effect, that any Federal agency, before approving federally permitted or federally funded undertakings, must take into consideration the effect of that undertaking on any property listed on, or eligible for, the National Register of Historic Places. Implied in this legislation and Executive Order 11593 is that an effort be made to locate such sites before development of an area. Section 101(b)(4) of NEPA states that it is the continuing responsibility of the Federal Government to preserve important historic and cultural aspects of our natural heritage. In addition, Section 11(g)(3) of the OCSLA, as amended, states that "such exploration (oil and gas) will not . . . disturb any site, structure, or object of historical or archaeological significance."

c. Endangered Species Act of 1973

The Endangered Species Act of 1973 (16 U.S.C. 1531-1543), as amended, establishes a national policy designed to protect and conserve threatened and endangered species and the ecosystem upon which they depend. The Act is administered by FWS and NMFS. Section 7 of the Act governs interagency cooperation and consultation. The MMS formally consults with NMFS and FWS because there is a possibility that activities in support of a proposed action may constitute a take as defined under the Endangered Species Act. The agencies, FWS and NMFS, must determine and ensure that proposed actions are unlikely to jeopardize the continued existence of a threatened or endangered species and/or to result in adverse modification or destruction of their critical habitat. The results of these determinations are presented as Biological Opinions (Appendix B). If it is determined that taking has occurred, a reinitiation of formal consultation could be required.

The FWS makes recommendations on the modification of oil and gas operations to minimize adverse impacts. The MMS has enacted the following FWS recommendations:

(1) require adequate oil spill contingency plans for all activities; and

(2) urge aircraft supporting offshore facilities to maintain an altitude of 2,000 ft or more above national parks, seashores, and wildlife refuges.

The MMS Studies Program complies with the Act's intent of conserving endangered or threatened species by contracting research on marine turtles and cetaceans. Data derived from these studies supplement information in the biological opinions and identify potential conflicts with oil and gas development.

d. Marine Mammal Protection Act of 1972

The Marine Mammal Protection Act (MMPA) of 1972 (16 U.S.C. 1361 et seq.), as amended, establishes a national policy designed to protect and conserve marine mammals and their habitats. This policy is established so as not to diminish such species or population stocks beyond the point at which they cease to be a significant, functioning element in the ecosystem, nor to diminish such species below their optimum sustainable population. The Secretaries of Commerce and the Interior have delegated authority for administering the Act to NMFS, which is responsible for all cetacean and pinnipeds (except walruses), and to FWS, which is responsible for walruses, sea otters, manatees, and dugongs.

The Marine Mammal Commission and its delegated administrators are responsible for reviewing and advising Federal agencies for the protection and conservation of marine mammals because activities under the authority of Federal agencies may constitute a take as defined under the MMPA. If it is ascertained that taking may occur, an exemption to or waiver of the Act's moratorium on taking would be required from the responsible parties. The Act provides particular exemptions to the taking of marine mammals by Alaskan natives under certain conditions. The Act authorizes the Commission to make recommendations on the prohibition of the taking and importation of marine mammals and marine mammal products, except as expressly provided for by an international treaty, convention, or agreement to which the United States is a party.

In late March 1991, The American Petroleum Institute (API), representing all operators in the Gulf of Mexico, requested a rulemaking from NMFS concerning "a small take of spotted and bottlenose dolphins incidental to the removal of oil and gas drilling and production structures in state and on the Outer Continental Shelf in the Gulf of Mexico (GOM) over the next five years." The API estimated that 134 structures per year will be removed from the Gulf of Mexico during the next 5 years and that 5,500 structures will be removed by the year 2026. About 80 percent of wells and platform legs are expected to be severed using explosives. Since 1986, MMS, the U.S. Army Corp of Engineers, and removal operators have been following strict NMFS recommendations to avoid adverse impacts to endangered marine turtles and cetaceans. These recommendations have also been followed to avoid the incidental taking of marine mammals, endangered or not. In their request for rulemaking, API stated that the most likely form of incidental take of dolphinids as a result of structure removals is harassment from low-level sound and pressure waves.

Pursuant to 50 CFR 228, NMFS asked for comments, information, and suggestions concerning API's request and concerning the structure and content of their (NMFS) forthcoming regulations to allow the incidental taking of dolphinids during platform removals. This input has been received and NMFS must now develop an environmental assessment. If, in the environmental assessment, the Secretary of Commerce finds that the total taking will have a "negligible impact" on the species or stock and not have an "unmitigable adverse impact" on the availability of the species or stock for subsistence use, then, upon request, the incidental taking of small numbers of dolphinids will be allowed during platform removals. The Secretary's permission for this incidental take may be granted for periods of 5 years or less. After these final regulations are established, Letters of Authorization must be requested from and issued to individual applicants (operators) to conduct the activities (platform removals) pursuant to the regulations.

The MMS commented to NMFS on the request and sent an advanced copy of excerpts from an MMS-funded research effort titled *Underwater Blast Effects from Explosive Severance of Platform Legs and Well Conductors* (Connor, 1990). The research was performed by the Naval Surface Warfare Center (NAVSWC). The *in situ* data strongly indicate that any negative pressure events occurring as a result of explosive severance activities present a much lower risk than originally anticipated. The potential energy released to the open-water environment is greatly attenuated by the structures being severed and from the location of detonation below the mudline. The NAVSWC research used an explosive called pentolite, which is not used in the Gulf of Mexico because it is a slow velocity explosive and does not have the cutting power needed to severe most Gulf of Mexico platform legs. However, a slow velocity explosive such as pentolite has a greater adverse effect upon marine mammals, turtles, and fish than the explosives (Composition B and Composition 4) used in the Gulf of Mexico during platform removals (Connor, 1990; Crawford, personal comm., 1991).

A provision of the Marine Mammal Protection Act (under Section 101 (a) (3), 16 U.S.C. 1371 et seq.) directs the Secretary of Commerce to allow, on request, those engaged in oil and gas activities from the "taking" prohibitions stated within the Act when the taking is unintentional, involves small numbers of individuals, and has negligible effects, provided that satisfactory provisions have been made to monitor and report the taking. To ensure that OCS activities adhere to regulations stated within Section 101 (a) (3), MMS must actively seek to gain information concerning local species of marine mammals in relation to impacts from OCS activities. Likewise, a requirement of the Outer Continental Shelf Lands Act (Section 20) states that the Secretary shall conduct studies subsequent to the leasing and development of any area or region to establish environmental monitoring information designed to provide time-series and data trend information that can be used for comparison with existing historical data for the purpose of identifying significant changes, if any, in such issues as the distribution, abundance, breeding habits, and times and lines of migratory movements of marine mammals. Consequently, the MMS Outer Continental Shelf Environmental Studies Program has recently (1991) funded a series of studies through Texas A&M University on the distribution and abundance of marine mammals in the north-central and Western Gulf of Mexico designed to produce a first-step estimate of the potential effects of deep-water exploration and production on these species. The studies include systematic aerial and shipboard surveys, behavioral observations, and the tagging and subsequent tracking of a limited number of sperm whales using satellite telemetry. Data acquired from both shipboard surveys and remote sensing will be used to characterize preferred habitats of cetaceans in the study area, whereas data acquired from behavioral observations will be used to determine preferred geographic areas and temporal patterns of critical activities such as feeding, breeding, and mating.

e. Magnuson Fishery Conservation and Management Act of 1976

The Magnuson Fishery Conservation and Management Act of 1976 (MFCMA) (16 U.S.C. 1801-1882) established a fisheries conservation zone for the United States and its possessions and delineates an area from the States' seaward boundary out 200 nmi. The Act created eight Regional Fishery Management Councils (FMC's) and mandated a continuing planning program for marine fisheries management by the Councils. The Act, as amended, requires that a Fishery Management Plan (FMP) based upon the best available scientific and economic data be prepared for each commercial species (or related group of species) of fish that is in need of conservation and management within each respective region.

Based on Congressional direction, the MFCMA must be reauthorized every few years. At the time of reauthorization, Congress also considers amendments to the Act that will update and improve the fishery management system. The individual FMC's also take part in the process by recommending changes to the Act that they believe are necessary to improve the fishery management system. During the 1989 consideration of reauthorization, the Gulf of Mexico FMC recommended 14 amendments, many of which addressed budgeting, funding, administrative, and data-gathering concerns. The important fishery recommendations from the Gulf of Mexico FMC were amendments to include tuna, billfish, and sharks under the MFCMA. Tuna were excluded under Section 102 because they are a highly migratory species; however, landings for tuna have increased exponentially in the Gulf during the past 5 years. The Gulf of Mexico FMC believes tuna are in need of a management plan but cannot manage the species until it is included under the Act.

To date, nine FMP's have been implemented. The FMP for shrimp was implemented in 1981; for stone crab, in 1982; for spiny lobster, in 1982; for coastal pelagic fish, in 1983; for coral, in 1984; for reef fish, in 1984; for swordfish, in 1985; for red drum, in 1987; and for sharks, in 1991. The FMP's are amended and updated as new information from studies and public input is received and assessed.

Congress has reauthorized the MFCMA with some changes. Tuna, swordfish, sharks, and billfish are now included for protection under the MFCMA. Responsibility for their management and conservation has been given to the appropriate FMC's through the NMFS.

f. National Fishing Enhancement Act of 1984

Title II of Public Law 98-623, also known as the Artificial Reef Act, establishes broad artificial-reef development standards and a National policy of the United States to encourage the development of artificial reefs that will enhance fishery resources and commercial and recreational fishing. The Secretary of Commerce provided leadership in developing a National Artificial Reef Plan that identifies design, construction, siting, and maintenance criteria for artificial reefs and that provides a synopsis of existing information and future research needs. The Secretary of the Army issues permits to responsible applicants for reef development projects in accordance with the National Plan, as well as regional, State, and local criteria and plans. The law also limits the liability of reef developers complying with permit requirements and amends the Reefs for Marine Life Conservation Law to include the availability of all surplus Federal ships for consideration as reef development materials. Although the Act mentions no specific materials other than ships for use in reef development projects, the Secretary of the Interior cooperated with the Secretary of Commerce in developing the National Plan, which identifies oil and gas structures as acceptable materials of opportunity for artificial-reef development. The MMS adopted a Rigs-to-Reefs policy in 1985 in response to this Act and to broaden interest in the use of petroleum platforms as artificial reefs.

g. Executive Order 11990 (May 24, 1977), Protection of Wetlands

This Executive Order is pertinent to the proposed actions as it states in part:

> Each agency shall provide leadership and shall take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for: (1) acquiring, managing, and disposing of Federal lands and facilities; (2) providing federally undertaken, financed, or assisted construction and improvements; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

h. Marine and Estuarine Sanctuaries Legislation

The National Marine Sanctuary and National Estuarine Research Reserve programs are administered by the Sanctuaries and Reserves Division, National Ocean Service, National Oceanic and Atmospheric Administration of the U.S. Department of Commerce. The marine sanctuary program was established by the Marine Protection, Research, and Sanctuaries Act of 1972 (33 U.S.C. 1401-1445), and the estuarine research reserve program was established by the Coastal Zone Management Act of 1972.

Marine sanctuaries and estuarine research reserves are designed and managed to meet the following goals, among others:

(1) enhance resource protection through the implementation of a comprehensive, long-term management plan tailored to the specific resources;

(2) promote and coordinate research to expand scientific knowledge of significant marine resources and improve management decisionmaking;

(3) enhance public awareness, understanding, and wise use of the marine environment through public interpretive and recreational programs; and

(4) provide for optimum compatible public and private use of special marine areas.

Marine Sanctuaries

Title III of the Marine Protection Research and Sanctuaries Act pertains to national marine sanctuaries. Only sites with special national significance are selected for marine sanctuary status. Sites selected for consideration are evaluated on the merits of resource and human-use values and on the public benefits to be derived from sanctuary status.

One national marine sanctuary has been established in the Gulf of Mexico by a recent act (H.R. 5909; P.L. 101-605) of Congress: the Florida Keys National Marine Sanctuary. Another, the Flower Garden Banks National Marine Sanctuary was designated in December 1991 and become effective in early 1992.

Florida Keys National Marine Sanctuary: Just offshore the Florida Keys land mass are, to quote H.R. 5909, "... spectacular, unique, and nationally significant marine environments, including seagrass meadows, mangrove islands, and extensive living coral reefs ... These marine environments support rich biological communities possessing extensive conservation, recreational, commercial, ecological, historical, research, educational, and esthetic values which give this area special national significance... These environments... support high levels of biological diversity, are fragile and easily susceptible to damage from human activities, and possess high value to human beings if properly conserved ... (and) are subject to damage and loss of their ecological integrity from a variety of sources of disturbance ... (including) vessel groundings ... Action is necessary to provide comprehensive protection for these marine environments ... by restricting vessel traffic ... and by requiring promulgation of a management plan and regulations to protect sanctuary resources."

This new law is designated to protect the resources of the area, to educate and interpret the environment, and to manage human uses within the Sanctuary. The area of the Sanctuary would include essentially all submerged lands and waters, including living marine and other resources, from the mean high-water mark of the Keys out to the 300-ft isobath, excluding Fort Jefferson National Monument.

The following two uses of the area are specifically prohibited by the law: (1) operation of a tank vessel or a vessel greater than 50 m in length, except for public vessels; and (2) leasing, exploration, development, or production of minerals or hydrocarbons.

An advisory council has also been established to assist in the development of a comprehensive management plan and in the implementation of regulations. The Secretary of Commerce is directed to consult with other Federal agencies and the appropriate State and local governments in managing the Sanctuary. The Sanctuary incorporates the existing Looe Key and Key Largo National Marine Sanctuaries on the Atlantic side of the Keys. An EIS will be prepared, as has been done in all previous sanctuary designations. Sombrero Key and Alligator Reef, both of which had previously been mandated for study as marine sanctuaries by Congress, will also be included in the comprehensive management plan.

Flower Garden Banks National Marine Sanctuary: One site is well along the road to sanctuary designation. The Flower Garden Banks were named an Active Candidate for designation as a national marine sanctuary (49 FR 30988-30991) on August 2, 1984, and was designated a sanctuary in December 1991 (56 FR 63634-63648). This site, located 177 km (110 mi) offshore, represents the northernmost coral reef community in the Western Gulf of Mexico. The proposed borders of the sanctuary encompass a total of 114 km^2 (44 mi^2). The area is a valuable representation of a tropical coral reef community dominated by hermatypic coral (*Montastrea annularis*, *M. cavernosa*, *Porites asteroides*, and *Diploria strigosa*) and associated reef fishes and invertebrates. The DOI has protected the biological resources of the Flower Garden Banks from possible damage due to oil and gas exploration and development activities by the establishment of a "No Activity Zone" and by operational restrictions as described in the Topographic Features Stipulation (Section IV.D.2.a.(2)(b)). The DOI cannot, however, protect these reefs from damage due to activities outside DOI's permitting process. The Gulf of Mexico Fishery Management Council, in its proposed FMP for corals, has designated the area within the 50-fathom (91.4-m) isobath at the Flower Garden Banks as a Habitat Area of Particular Concern (HAPC) (50 CFR 638), but even with such designation the Council may be unable to regulate "nonfishing" activities such as anchoring of ships. Designation of the reefs as a marine sanctuary may be the only way to protect the reefs from non-oil- and gas-related activities, such as anchoring (which has been shown to be the most destructive of man's activities in the area), the use of heavy trawls (such as roller trawls), and the taking of corals and reef fishes. The following activities, while not necessarily proposed to be regulated initially, may be regulated by NOAA under the terms of designation at some future time:

(1) anchoring or otherwise mooring within the Sanctuary;

(2) discharging or depositing, from within the boundaries of the Sanctuary, any material or other matter;

(3) discharging or depositing, from beyond the boundaries of the Sanctuary, any material or other matter;

(4) drilling into, dredging, or otherwise altering the seabed of the Sanctuary, or constructing, placing, or abandoning any structure, material, or other matter on the seabed of the Sanctuary;

(5) exploring for, developing, or producing oil, gas, or minerals within the Sanctuary;

(6) taking, removing, catching, collecting, harvesting, feeding, injuring, destroying, or causing the loss of, or attempting to take, remove, catch, collect, harvest, feed, injure, destroy, or cause the loss of a Sanctuary resource;

(7) possessing within the Sanctuary a Sanctuary resource or any other resource, regardless of where taken, removed, caught, collected, or harvested, that, if it had been found within the Sanctuary, would be a Sanctuary resource;

(8) possessing or using within the Sanctuary any fishing gear, device, equipment, or means;

(9) possessing or using explosives or air guns or releasing electrical charges within the Sanctuary; and

(10) interfering with, obstructing, delaying, or preventing an investigation, search, seizure, or disposition of seized property in connection with enforcement of Sanctuary regulations or permits.

It should be noted that oil and gas activities regulated by MMS in those small areas of the Sanctuary that are outside the MMS No Activity Zones are specifically excluded from Sanctuary restrictions on oil and gas industry activities.

Three additional sites in the Gulf are on the Site Evaluation List (SEL), which potentially leads to an area being designated as an Active Candidate. These sites are Shoalwater Bay--Chandeleur Sound (Louisiana)--the Big Bend Seagrass Beds off Florida, and Baffin Bay (Texas). Areas on the SEL are given additional study for potential designation as an Active Candidate; such designation will then result in even further evaluation for possible designation as a national marine sanctuary. No schedule has been established for these studies and possible designations.

Estuarine Research Reserves

Three estuarine research reserves have been established in the Gulf of Mexico: Rookery Bay National Estuarine Research Reserve and Apalachicola National Estuarine Research Reserve in Florida, and Weeks Bay National Estuarine Research Reserve in Alabama.

Rookery Bay National Estuarine Research Reserve, at more than 3,440 ha (8,500 ac), preserves a large mangrove-filled bay and two creeks, along with their drainage corridors. Management of the sanctuary is performed by the Florida Department of Natural Resources, The Conservancy, and the National Audubon Society. This unique management structure was created when the two private organizations granted a dollar-per-year, 99-year lease of the land to the State. Federal and State funds will add additional key acreage to the existing core area. The diversity of the area's fauna can be recognized by the porpoises that feed there and the bald eagles and whitetailed deer that make Rookery Bay their permanent residence. Within the Sanctuary is a marine laboratory, which, even before the establishment of the sanctuary, provided data used in important coastal management decisions--a primary objective of Congress in establishing the estuarine research-reserve program.

At more than 76,890 ha (190,000 ac), the Apalachicola National Estuarine Research Reserve is one of the largest remaining naturally functioning ecosystems in the nation, and it is also the first sanctuary on the mouth of a major navigable river. Because of this, its establishment served to promote improved cooperation concerning river navigation among the States of Florida, Alabama, and Georgia. The major business activity of Apalachicola, which is adjacent to the sanctuary, centers around the oyster industry, and it is expected that the sanctuary will benefit this and other fishing industries by protecting the environment and by providing research information that will help assure the continued productivity of the bay/river ecosystem. A FWS refuge and a State park, which represents a unique cooperative effort at ecosystem protection, exists with the boundaries of the reserve.

Weeks Bay National Estuarine Research Reserve constitutes a small estuary of approximately 1,225 ha (3,028 ac), comprising open shallow waters with an average depth of less than 1.5 m (5 ft) and extensive vegetated wetlands areas. It receives waters from the spring-fed Fish and Magnolia Rivers and connects through a narrow opening with Mobile Bay, the principal element of coastal Alabama.

There are no additional sites proposed as National Estuarine Research Reserves in the Gulf of Mexico.

Title I of the Marine Protection, Research, and Sanctuaries Act is administered by USEPA. Section 102 of the Act provides that USEPA may issue permits, after public notices and hearings, for the transportation of material for the purpose of dumping into ocean waters, after a determination that such dumping will not unreasonably degrade or endanger human health, welfare, or the marine environment.

The National Estuary Program

In 1987 the National Estuary Program was established by an amendment, known as the Water Quality Act (P.L. 100-4, which, among other things, created Section 320), to the Clean Water Act. The purpose of the Program is to identify nationally significant estuaries, to protect and improve their water quality, and to enhance their living resources. Under the Program, which is administered by the USEPA, comprehensive management plans are generated to protect and enhance environmental resources. The governor of a state may nominate an estuary for the Program and request that a Comprehensive Conservation and Management Plan be developed for an estuary. Representatives from Federal, State, and interstate agencies, academic and scientific institutions, and industry and citizen groups work during a 5-year period to define objectives for protecting the estuary, to select the chief problems to be addressed in the Plan, and to ratify a pollution control and resource management strategy to meet each objective. Strong public support and subsequent political commitments are needed to accomplish the actions called for in the Plan, hence the 5-year time period to develop the strategies. A total of 17 estuaries have been selected for the Program, 4 of which are in the Gulf: Sarasota Bay and Tampa Bay in Florida, the Barataria-Terrebonne Estuarine Complex in Louisiana, and Galveston Bay in Texas. Brief descriptions of these four areas are given below.

Sarasota Bay is a small estuary on the southwest coast of Florida. Although generally regarded as a "clean" bay, it is threatened by overuse and growth pressure. Stormwater runoff and habitat loss have been identified as primary issues of concern in the restoration and enhancement of the estuary. Seven goals have been identified as targets upon which to focus the attention of all interested parties. Demonstration projects to begin the restoration of native, productive habitat to the bay system have been started, and these and others will be an integral part of the final comprehensive plan for the bay.

Tampa Bay is the largest open-water estuary in Florida and supports a myriad of uses, such as commercial and recreational fishing, shipping, sanitary and electrical services, waterfront development, tourism, and recreation. The water quality is good to excellent in much of the lower and middle Bay, declining in old Tampa Bay, and undesirable in the Hillsborough area. A number of causes of degradation have been identified, and goals have been established to improve the situation.

The Barataria-Terrebonne Estuarine Complex consists of an extensive array of estuarine wetlands and bodies of water containing more coastal wetlands than any other estuarine system in the United States. At least 19 percent of the nation's estuary-dependent commercial fisheries is sustained by the Complex. It is also used for recreation by boaters, fishermen, and hunters, supporting important elements of the local economy and culture. As much as half of the national loss of coastal wetlands may have occurred in the Complex. Problems have been identified, and goals have been established to improve the situation.

The Galveston Bay system is the seventh largest estuary in the U.S. and the largest in Texas. The bay system provides 1,554 km^2 (600 mi^2) of very shallow water, averaging less than 3 m (10 ft) in depth. On the average, precipitation in the bay area watershed equals or exceeds what is lost through evaporation, and nearly 10 million ac-ft of freshwater enter the bay annually. The resulting low salinity in the bay is the key to its productivity, providing ideal conditions for the growth of fish, crabs, shrimps, and oysters. In addition, the bay is surrounded by 526 km^2 (203 mi^2) of estuarine marsh, 36 km^2 (14 mi^2) of forested wetlands, and 158 km^2 (61 mi^2) of freshwater ponds and lakes. These ecological resources filter runoff to the bay system and provide a rich source of nutrients that enhance biological productivity, as well as providing valuable habitat for many economically important species. The committees set up under the program will identify the critical issues facing Galveston Bay and then develop specific action plans and commitments to solve the problems identified.

i. Ocean Dumping

All ocean dumping is regulated by the Marine Protection, Research, and Sanctuaries Act of 1972, as amended (33 U.S.C. 1401 et seq.). Regulations (40 CFR 220 et seq.) implementing the Act require a USEPA permit for all ocean dumping of industrial wastes and municipal sludge materials. The termination of ocean dumping of sewage sludge and industrial wastes by December 31, 1981, was mandated by 33 U.S.C. 1412a. The designated ocean areas where wastes may be disposed are listed in 40 CFR 228. Further, USEPA has published an annual report entitled *Ocean Dumping in the United States*. This report includes information on permit holders, types of waste approved for disposal under the permit, and yearly waste volumes disposed. The USEPA had one designated deep-water disposal area in the Gulf of Mexico. The site was designated for the incineration of hazardous wastes, but the disposal area was officially de-designated on February 27, 1991 (56 FR 8133-8135).

The current interim-designated Dredged Material Disposal Sites are now being converted by the USEPA into formally-designated sites. These sites, used for the disposal of dredged material from the U.S. Army Corps of Engineers channel dredging programs, have, in most cases, been used for this purpose for as long as 25 years.

j. Rivers and Harbors Act of 1899

Section 10 of the Rivers and Harbors Act of 1899 prohibits the unauthorized obstruction or alteration of any navigable water of the United States. The construction of any structure in or over any navigable water of the United States, the excavating from or depositing of material in such waters, or the accomplishment of any other work affecting the course, location, condition, or capacity of such waters is unlawful without prior approval from the Corps of Engineers. The authority of this legislation to prevent obstructions to navigation in navigable water was extended to installations and devices located on the seabed to the seaward limit of the OCS by Section 4(e) of the Outer Continental Shelf Lands Act of 1953, as amended.

k. Coastal Barrier Resources Act of 1982

The Coastal Barriers Resources Act (CBRA) was the culmination of several years of study by the Congress and the Department of the Interior of the effects of Federal programs on coastal barriers. The Act established 186 coastal barrier units that were included in a Coastal Barrier Resource System (CBRS).

The CBRA prohibited all new Federal expenditures and financial assistance within the CBRS, with certain specific exceptions including energy development. The purpose of this legislation was to end the Federal Government's encouragement for development on barrier islands by withholding Federal flood insurance for new construction of or substantial improvements to structures on undeveloped coastal barriers.

l. National Ocean Pollution Planning Act of 1978

The National Ocean Pollution Act of 1978 (33 U.S.C. 1701-1709) calls for the establishment of a comprehensive, coordinated, and effective ocean pollution research, development, and monitoring program. The Act requires that the Department of Commerce's National Oceanic and Atmospheric Administration, in consultation with other agencies, prepare a comprehensive 5-year *Federal Plan for Ocean Pollution Research Development, and Monitoring* every three years. The Plan contains major elements that consider an assessment and prioritization of National needs and problems, existing Federal capabilities, policy recommendations, and a budget review.

m. Coastal Zone Management Act of 1972

The Coastal Zone Management Act (CZMA) (16 U.S.C. 1451 et seq.) was enacted by Congress in 1972 to improve the nation's management of coastal resources, which were being irretrievably damaged or lost due to poorly planned development. Specific concerns were the loss of living marine resources and wildlife habitat, decreasing open space for public use, and shoreline erosion. Congress also recognized the need to resolve conflicts between various uses that were competing for coastal lands and waters (USDOC, NOAA, 1988a).

The basic goal of the CZMA is to encourage and assist coastal states to voluntarily develop comprehensive management programs. The CZMA establishes a State-Federal partnership in which the States take the lead in managing their coastal resources, while the Federal Government provides financial and technical assistance and agrees to act in a manner consistent with the federally-approved State management programs. The law also establishes a National Estuarine Reserve Research System with specific estuarine sites designated across the nation. The CZMA is implemented by the Office of Ocean and Coastal Resource Management (OCRM), within NOAA's National Ocean Service.

The Coastal Zone Reauthorization Amendments of 1990 amended the Federal consistency provisions to counter the Supreme Court's 1984 decision in *Secretary of the Interior v. California*. This clarified that *all* Federal agency activities, whether in or outside of the coastal zone, are subject to the consistency requirements of Section 307(c)(1) of the CZMA if the activities affect natural resources, land uses, or water uses in the coastal zone. The purpose of the reauthorization was to strengthen and revitalize the CZMA, particularly in the area of water quality.

The Coastal Zone Reauthorization Amendments of 1990 established a Coastal Zone Management Fund consisting of Coastal Energy Impact Program (CEIP) loan repayments from which the Secretary shall pay for the Federal administrative costs of the program and for funding special projects, emergency State assistance, and other discretionary coastal zone management activities.

The Act also reinstated program development grants by authorizing the Secretary of Commerce to provide assistance and management-oriented research to a State for the development and implementation of a CZM program.

The new provisions encourage each State, under a Coastal Zone Enhancement Grants Program at Section 309, to improve continually its CZM program in one or more of eight identified national priority areas: coastal wetlands management and protection, natural hazards management (including potential sea and Great Lakes level rise), public access improvements, reduction of marine debris, assessment of cumulative and secondary impacts of coastal growth and development, special area management planning, ocean resource planning, and siting of coastal energy and Government facilities. Three new program approval requirements were also added at Section 306(d)(14), (15), and (16), dealing with public participation in permitting processes; consistency determinations, providing a mechanism to ensure that all State agencies will adhere to the program; and requiring enforceable policies and mechanisms to implement the applicable requirements of the new Coastal Nonpoint Pollution Control Programs, respectively.

The provisions also authorize the Secretary to make annual "Walter B. Jones" achievement awards to recognize individuals, local governments, and graduate students for outstanding accomplishments in the field of coastal zone management; and the provisions authorize appropriations for five years at increased levels.

In addition, the subtitle establishes a Coastal Nonpoint Pollution Control Program at Section 306. This program will require each coastal state to develop a program that will protect coastal waters from nonpoint pollution from adjacent coastal land uses and will be implemented through the Coastal Zone Management Act and Section 319 of the Clean Water Act by NOAA and USEPA. The NOAA is not proposing to issue regulations on the CZM fund, the technical assistance program, the CZM achievement awards, or the Federal consistency regulations at this time. Changes to the Federal consistency provisions resulting from CZMA Reauthorization, except for overturning the Supreme Court's decision on OCS oil and gas lease sales, merely codify NOAA's existing regulations (USDOC, NOAA, 1991). Because of the substantial scope of CZMA changes, NOAA will undertake phased rulemaking for Coastal Zone Enhancement Grants, nonpoint pollution control programs, new program approval requirements in Section 306, and changes to the National Estuarine Research Reserve System (Section 315 of CZMA). On October 18, 1991, the first phase of proposed rulemaking was published in the *Federal Register* (56 FR 52220-52230) to implement the new Coastal Zone Enhancement Grants Program (new Section 309), revised procedures for conducting reviews of performance under Section 312, and new authority for interim sanctions under Section 312(c).

5. Gulf of Mexico Regional Environmental Studies Program

The MMS supports and administers a large, multidisciplinary studies program to develop information needed for assessment and mitigation of impacts to human, marine, and coastal environments that may be affected by OCS oil and gas activities. This program was initiated in 1973 by the Bureau of Land Management (BLM), which then had responsibility for OCS leasing. Since program initiation, more than 150 studies projects, at a cumulative funding level in excess of $102 million, have been awarded to support leasing and regulatory functions of the Minerals Management Service's OCS Program within the Gulf of Mexico OCS Region.

The MMS Environmental Studies Program (ESP) is authorized by the OCS Lands Act Amendments of 1978. Section 20 of the Act mandates the program and provides three general goals: (a) to establish information needed for assessment and management of environmental impacts on the human, marine, and coastal environments of the OCS and the potentially affected coastal areas; (b) to predict impacts on the marine biota, which may result from chronic low-level pollution or large spills associated with OCS production, from muds and cuttings discharges, pipeline emplacement, and impacts of onshore development; and (c) to monitor human, marine, and coastal environments to provide time-series and data-trend information for identification of significant changes in the quality and productivity of these environments, for detection of change trends, and for identification of the causes of these changes.

Appendix E of the Final EIS for Sales 131, 135, and 137 (USDOI, MMS, 1990a) provides detailed information on the history and accomplishments of the ESP as well as a discussion of how the program is administered.

SECTION II

ALTERNATIVES INCLUDING THE PROPOSED ACTIONS

II

II. ALTERNATIVES INCLUDING THE PROPOSED ACTIONS

A. PROPOSED CENTRAL GULF SALE 142

1. Alternative A - The Proposed Action

a. Description

Proposed Central Gulf Sale 142 is scheduled to be held in March 1993 and will offer all unleased blocks within the CPA. It is estimated that the proposal could result in the discovery and production of 0.14 BBO and 1.40 tcf of gas during the time period 1993-2027. There are no areas deferred from the CPA, but there are alternatives to the proposed action. The alternatives are to delete biologically sensitive areas near topographic features and offer the remaining acreage or to take no action (cancel the sale). For more information describing the proposed action and alternatives, see Section I.B.2.

The analyses of impacts summarized below and described in detail in Section IV.D.1. are based on a development scenario (Base Case) formulated to provide a set of assumptions and estimates on the amounts, locations, and timing for OCS exploration, development, and production operations and facilities, both offshore and onshore. These are estimates only and not predictions of what will happen as a result of holding the proposed sale. A detailed discussion, with tables, of the development scenario and major related impact-producing factors is included in Section IV.A. The following are the estimates of major activities and associated impact-producing factors assumed for proposed Sale 142 (Base Case). These estimates and factors were utilized in the impact analyses.

(1) During the exploration phase, 1994-2004, there will be 340 wells drilled, resulting in the following:

- the generation of 2.42 MMbbl of drilling mud and 0.63 MMbbl of drill cutting wastes, 18 percent of which will be disposed of onshore;
- offshore air emissions from well drilling operations of 330 tons of total suspended particulate matter, 95 tons of total hydrocarbons, 384 tons of sulphur oxides, 877 tons of carbon monoxide, and 3,288 tons of nitric oxides;
- 6,600 service vessel trips and 23,000 helicopter landings;
- disturbance from rig emplacements of 144 ha of ocean bottom; and
- the likelihood of 1 blowout (Section IV.A.2.d.(8)).

(2) During the development phase, 1995-2017, there will be 130 oil wells and 120 gas wells drilled, resulting in the following:

- the generation of 1.69 MMbbl of drilling mud and 0.358 MMbbl of drilling cutting wastes, a small amount of which will be disposed of onshore;
- offshore air emissions from well drilling operations of 162 tons of total suspended particulate matter, 47 tons of total hydrocarbons, 189 tons of sulphur oxides, 430 tons of carbon monoxide, and 1,611 tons of nitric oxides;
- 4,800 service vessel trips and 17,000 helicopter landings;

- the disturbance from fixed structure emplacements of 48 ha of ocean bottom; and

- the likelihood of 1 blowout (Section IV.A.2.d.(8)).

(3) During the production phase, 1995-2026, 0.14 BBO of oil and 1.40 tcf of gas will be produced from 29 platform complexes and one floating production system, resulting in the following:

- the open-water discharge of 283 MMbbl of produced water;

- the onshore disposal of 34 MMbbl of produced waters and 69,000 bbl of produced sands that were generated offshore;

- air emissions of 124 tons of total suspended particulate matter, 19,175 tons of total hydrocarbons, 88 tons of sulphur oxides, 6,590 tons of carbon monoxide, and 50,592 tons of nitric oxides;

- 6,300 service vessel trips and 328,000 helicopter trips;

- the removal of 120 ha of commercial fishing area (peak year estimate); and

- the likelihood of 2 blowouts (Section IV.A.2.d.(8)).

(4) During platform removal operations, which will occur the year after production ceases, 20 platforms will be removed using explosives. The remaining platforms will be removed by non-explosive methods.

(5) The transportation of gas and oil will require the following:

- the construction of 240 km of gathering pipelines that will connect with existing trunklines prior to landfall, resulting in the disturbance of 77 ha of bottom and the displacement of 320,000 m^3 of sediment;

- 77 barge trips carrying oil to 8 existing shore terminals along the Texas and Louisiana coasts; and

- 2 shuttle tanker trips carrying oil to Mississippi River terminals.

(6) Support activity will result in the following:

- No new major onshore support or processing facility construction is expected; existing OCS-related facilities will be used, with sale-related activities utilizing about 3 percent, on the average, of the capacities of the onshore infrastructure.

- the use of 18 navigation channels, 7 major channels in Louisiana will be maintenance dredged periodically and one deepened to support vessel traffic;

- 56 million liters of bilge water will be discharged in coastal waters from service vessels traveling to 28 existing bases;

- 206,000 helicopter coastal crossings to reach 27 helicopter hubs; and

- air emissions from service vessels and helicopters of 680 tons of total suspended particulate matter, 495 tons of total hydrocarbons, 177 tons of sulphur oxides, 1,466 tons of carbon monoxide, and 9,264 tons of nitric oxides.

(7) Twenty-one crude oil spills greater than 1 and less than or equal to 50 bbl, one spill between 50 and 1,000 bbl, and one spill of 1,000 bbl or greater are assumed to occur. The large spill is projected to be 6,500 bbl and has a 16 percent chance of land contact.

(8) Fewer than 10 crude oil spills greater than one and less than 50 bbl are assumed to occur from onshore support activities.

(9) Total employment from all activities associated with the exploration, development, and production of oil and gas generated as a result of Sale 142 is 58,500 personnel, 45 percent of which will be directly employed.

b. Summary of Impacts

The following summarizes the detailed impact analyses of Section IV.D.1.a. It should be emphasized that these are impact summaries and that the reader should refer to Section IV.D.1.a. for detailed information regarding particular resources. Note that these summaries are limited to the impact of the proposed action (Base Case). The impacts under the Cumulative Analysis are assessed in Section IV.D.1.d. and are not summarized here. Table S-3 compares the impacts of Alternatives A-C and the cumulative impacts on each resource category estimated as a result of the various scenarios.

The following impact analyses are for the proposed action and include the following potential stipulations as part of the proposed action: the Topographic Features Stipulation, the Live Bottom Stipulation, the Archaeological Resources Stipulation, and the Military Stipulation. The analyses to follow presume full compliance with the proposed stipulations.

To facilitate the analyses, the Federal offshore area is divided into subareas. The CPA is comprised of four subareas (C-1, C-2, C-3, and C-4) and the coastal region is divided into four coastal subareas (C-1, C-2, C-3, and C-4). These subareas are delineated on Figure IV-1.

Sensitive Coastal Environments

Coastal Barrier Beaches (Section IV.D.1.a.(1)(a))

Oil-spill contact to a barrier island could result in erosional changes in the barrier if cleanup operations removed large quantities of sand. Because of the very low probability of occurrence and contact from either an offshore or onshore spill of greater than 50 bbl, however, it is assumed that no contact from such a spill will occur. Several spills less than 50 bbl are assumed to contact coastal areas of the CPA under the Base Case scenario from barge and pipeline accidents and from offshore sources. These spills will contact mainly the landward side of barrier islands, will affect only a short stretch of beach, and will be cleaned within a week with no effects on beach morphology.

Impacts from onshore and nearshore construction of OCS-related infrastructure (pipeline landfalls, navigation channels, service bases, platform yards, etc.) are not expected to occur because no new infrastructure construction is anticipated as a result of the proposed action. Although some maintenance dredging is expected to occur, this activity has not been shown to have a negative impact on barriers, and the need for dredging cannot be attributed to the small percentage of vessel traffic in these channels accounted for by Base Case activities.

It follows from the above that activities resulting from the proposed action will not have a significant impact on coastal barriers.

Conclusion

The Proposed Action is not expected to result in permanent alterations of barrier beach configurations, except in localized areas downdrift from navigation channels that have been dredged and deepened. The contribution to this localized erosion is expected to be less than 1 percent.

Wetlands (Section IV.D.1.a.(1)(b))

No oil spills of 1,000 bbl or greater offshore or inshore sources are expected to occur and contact coastal wetlands under the Base Case scenario. Although several spills greater than 1 and less than or equal to 50 bbl are expected to contact wetlands from inshore barge and pipeline accidents in coastal Louisiana, only small areas (several hectares) of wetlands will be contacted by high-enough concentrations of oil to result in the conversion of wetlands to open water habitat. Seagrass beds will be contacted by such low concentrations of oil from these spills that no impacts are expected.

No new dredging projects for pipelines or navigation channels are projected. Few to no impacts from maintenance dredging are expected given the small contribution of OCS vessel traffic to navigational usage of the channels. Furthermore, alternative dredge material disposal methods that could be used to enhance coastal wetland growth exist.

Erosion of wetlands from OCS vessel wakes is not expected to result in more than 5.5 ha of wetlands loss during the 35-year life of the proposed action.

Conclusion

The proposed action is expected to result in dieback and mortality of 10 to 15 ha of wetlands vegetation as a result of contacts from onshore oil spills. All but 2 ha of these wetlands will recover within 10 years; the remaining 2 ha will be converted to open water. About 5.5 ha of wetlands are projected to be eroded along channel margins as a result of OCS vessel wake erosion, and 3.5 ha of wetlands are projected to be created as a result of beneficial disposal of dredged material from channel-deepening projects.

Sensitive Offshore Resources

Live Bottoms (Pinnacle Trend) (Section IV.D.1.a.(2)(a))

Activities resulting from the proposed action are not expected to have a high level of impact on the pinnacle trend environment, since these activities would be restrained by the implementation of the Live Bottom Stipulation. The impact to the pinnacle trend area as a whole is expected to be slight because no community-wide impacts are expected. The inclusion of the potential Live Bottom Stipulation would preclude the occurrence of the most potentially damaging of these activities. The action is judged to be infrequent because of the limited operations in the vicinity of the pinnacles and the small size of many of the features. Potential impact levels from large oil spills, blowouts, pipeline emplacement, muds and cuttings discharges, and structure removals would be very low because of the effectiveness of the proposed Live Bottom Stipulation. The frequency of impacts to the pinnacles is rare, and the severity is judged to be slight because of the widespread nature of the features.

Conclusion

The impact of the Base Case of the proposed action on the pinnacle trend region in the Gulf of Mexico is expected to be such that any changes in the regional physical integrity, species diversity, or biological productivity of the hard-bottom region would recover to pre-impact conditions in less than 2 years, more probably on the order of 2-4 months.

Deep-water Benthic Communities (Section IV.D.1.a.(2)(b))

The only impact-producing factor threatening the chemosynthetic communities is physical disturbance of the bottom, which would destroy the organisms comprising these communities. Such disturbance would come from those OCS-related activities associated with pipelaying, anchoring, structure emplacement, and seafloor blowouts. Only structure emplacement is considered to be a threat, and then only to the high-density (Bush Hill-type) communities; the widely distributed low-density communities would not be at risk. The provisions of NTL 88-11 (currently in effect), requiring surveys and avoidance prior to drilling, will greatly reduce, but not completely eliminate, the risk.

Conclusion

The proposed action is expected to cause little damage to the physical integrity, species diversity, or biological productivity of either the widespread, low-density chemosynthetic communities or the rarer, widely scattered, high-density Bush Hill-type chemosynthetic communities. Recovery from any damage is expected to take less than two years.

Topographic Features (Section IV.D.1.a.(2)(c))

Several impact-producing factors (anchoring, structure emplacement, effluent discharges, blowouts, oil spills, and structure removals) may threaten the communities of the topographic features. Because of the effectiveness of the proposed Topographic Features Stipulation, operational discharges (drilling muds and cuttings, produced waters) would have little impact on the biota of the banks. Recovery from any impact would be rapid.

Blowouts may similarly cause damage to benthic biota, but due to the application of the proposed Topographic Features Stipulation, they would have little impact on the biota of the banks. Recovery from any impact would be rapid.

Oil spills (there is an estimated 6% chance of an oil spill greater than or equal to 1,000 bbl occurring in the Central Gulf as a result of this proposed action) will cause damage to benthic organisms if the oil contacts the organisms; such contact is likely only from spills from blowouts, which, because of the proposed Topographic Features Stipulation, would not occur very near to the biota of the banks.

Conclusion

The proposed action is expected to cause little to no damage to the physical integrity, species diversity, or biological productivity of the habitats of the topographic features of the Gulf of Mexico. Small areas of 5-10 m^2 would be impacted, and recovery from this damage to pre-impact condition is expected to take less than 2 years, probably on the order of 2-4 weeks.

Water Quality (Section IV.D.1.a.(3))

Coastal and Estuarine Waters

All existing onshore infrastructure and associated coastal activities occurring in support of proposed Sale 142 will contribute to the degradation of regional coastal and nearshore water quality to a minor extent because each provides a low measure of continuous contamination and because discharge locations are widespread. Process, cooling, boiler, and sewage water effluents will be discharged due to the use of the existing infrastructure and facilities. Because of the new Louisiana regulations banning the discharge of produced waters into State waters, the onshore separation, treatment, and disposal of up to 34 MMbbl of OCS produced water is not expected to impact coastal and nearshore water quality. Based on the new regulations, it is expected that these waters will be reinjected onshore, separated/treated onshore, and then transported offshore for disposal or discharged into the Mississippi River. Based on the new regulations, it is expected that these waters will be reinjected onshore, separated/treated onshore and then transported offshore for disposal, or discharged into the Mississippi River. The OCS-related vessel traffic is likely to impact water quality through routine releases of bilge and ballast waters, chronic fuel and tank spills, trash, and low-level releases of the contaminants in antifouling paints. The improper storage and disposal of oilfield wastes and contaminated oilfield equipment would adversely impact surface and ground waters in proximity to disposal facilities, cleaning sites, and scrap yards.

Marine Waters

Based on projected sale-related support activities, offshore Subarea C-1 would receive the greatest portion of pipeline burial activities, whereas, offshore Subareas C-3 and C-4 would receive the largest amounts of operational discharges. Immediate effects would be brought about by increased drilling, construction and pipelaying activities, causing increased water column turbidity (lasting for several hours with mud discharges and several weeks with dredging-pipelaying activities). Proposed produced water and drilling fluid discharges will encounter rapid dispersion in marine waters and be rapidly diluted within the immediate vicinity of the discharge source. Drilling fluid (mud) plumes will be diluted to background levels within a period of hours and/or within several hundred meters of the discharge source. Significant increases in water concentrations of dissolved and particulate hydrocarbons and trace metals are not expected outside the initial mixing zone or immediate vicinity of the discharge source. Higher concentrations of trace metals, salinity, temperature, organic compounds, and radionuclides, and lower dissolved oxygen may be present near the discharge source.

Program-related spills will introduce oil into coastal and offshore waters and create elevated hydrocarbon levels (up to 100+ μg/l) within affected waters. Much of the oil will be dispersed throughout the water column over several days to weeks. Little effect to water use is anticipated from these spills and then only in an area near the source and slick.

Conclusion

An identifiable change to the ambient concentration of one or more water quality parameters will be evident up to several hundred to 1,000 m from the source for periods lasting up to several weeks in duration in marine and coastal waters. Chronic, low-level pollution related to the proposal will occur throughout the life of the proposed action.

Air Quality (Section IV.D.1.a.(4))

Emissions of pollutants into the atmosphere from the activities associated with the proposed action are likely to have a low impact on offshore air quality because of the prevailing atmospheric conditions, emission heights, and pollutant concentrations. Onshore impact on air quality from emissions from the OCS activities are estimated to be low because of the atmospheric regime, the emission rates, and distance of these emissions from the coastline. Section IV.D.1.a.(4) is based on average conditions; however, there will be days of low mixing heights and wind speeds which could increase impact levels. These conditions are characterized by fog formation, which in the Gulf occurs about 35 days a year mostly during winter. Impact from these conditions is reduced in winter because the onshore winds have the smallest frequency and rain removal is greatest.

Conclusion

Emissions of pollutants into the atmosphere are expected to have concentrations that would not change onshore air quality classifications. Increase in onshore concentrations of air pollutants are estimated to be about 1 μgm^{-3} (box model steady concentrations). This concentration will have minimal impacts during winter because onshore winds occur only about 37 percent of the time and maximum impacts in summer when onshore winds occur 61 percent of the time.

Coastal and Marine Mammals

Marine Mammals (Section IV.D.1.a.(5)(a))

Nonendangered and Nonthreatened Species

Activities resulting from the proposed action have a potential to cause detrimental effects on nonendangered cetaceans. These marine mammals could be impacted by operational discharges, helicopter and vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills, and oil-spill response activities. The effects of the majority of these activities are estimated to be sublethal. Potential lethal effects are estimated only from oil spills greater than or equal to 1,000 bbl (one 6,500-bbl spill is assumed). Sale-related oil spills of any size are expected to seldom contact nonendangered and nonthreatened marine mammals.

Conclusion

The impact of the Base Case scenario on nonendangered and nonthreatened marine mammals within the potentially affected area is expected to result in sublethal effects that are chronic and could result in persistent physiological or behavioral changes, as well as some degree of avoidance of the impacted area(s).

Endangered and Threatened Species

Activities resulting from the proposed action have a potential to cause detrimental effects on endangered marine mammals. These cetaceans could be impacted by operational discharges, helicopter and vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills, and oil-spill response activities. The effects of the majority of these activities are estimated to be sublethal. Potential lethal effects are estimated only from oil spills greater or equal to 1,000 bbl (one 6,500-bbl spill is assumed). Sale-related oil spills of any size are expected to seldom contact endangered and threatened marine mammals.

Conclusion

The impact of the Base Case scenario on endangered and threatened marine mammals within the potentially affected area is expected to result in sublethal effects that are chronic and could result in persistent physiological or behavioral changes, as well as some degree of avoidance of the impacted area(s).

Alabama, Choctawhatchee, and Perdido Key Beach Mice (Section IV.D.1.a.(5)(b))

Activities resulting from the proposed action have a potential to cause detrimental effects on Alabama and Perdido Key beach mice. Beach mice could be impacted by oil spills and oil-spill response activities. It is expected that there will seldom be interaction between these events and beach mice or their habitats, as well as some degree of avoidance of the impacted area(s).

Conclusion

The impact of the Base Case scenario on Alabama, Choctawhatchee, and Perdido Key beach mice within the potentially affected area is expected to result in sublethal effects that seldom occur and may cause short-term physiological or behavioral changes.

Marine Turtles (Section IV.D.1.a.(6))

Activities resulting from the proposed action have a potential to cause detrimental effects on marine turtles. Marine turtles could be impacted by structure installation, pipeline placement, dredging, operational discharges, OCS-related trash and debris, vessel traffic, explosive platform removals, oil-spill response activities, and oil spills. The effects of the majority of these activities are estimated to be sublethal. Potential lethal effects are estimated only from oil spills greater than or equal to 1,000 bbl (one 6,500-bbl spill is assumed). Sale-related oil spills of any size are expected to seldom contact marine turtles.

Conclusion

The impact of the Base Case scenario on marine turtles within the potentially affected area is estimated to result in sublethal effects which are chronic and could result in persistent physiological or behavioral changes.

Coastal and Marine Birds

Nonendangered and Nonthreatened Species (Section IV.D.1.a.(7)(a))

Activities resulting from the proposed action have the potential to cause detrimental effects on Central Gulf coastal and marine birds. Coastal and marine birds may be impacted by helicopter and service-vessel traffic, onshore pipeline landfalls, entanglement in and ingestion of offshore oil- and gas-related plastic debris, and oil spills. It is estimated that the effects from the major impact-producing factors on coastal and marine birds are negligible and of nominal occurrence. As a result there will be no perceivable disturbance to Gulf coastal and marine birds.

Conclusion

The impact of the Base Case scenario on nonendangered and nonthreatened coastal and marine birds within the potentially affected area is expected to result in no discernible decline in a population or species and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to pre-disturbance condition in less than one generation.

Endangered and Threatened Species (Section IV.D.1.a.(7)(b))

The brown pelican, Arctic peregrine falcon, bald eagle, and piping plover may be impacted by helicopter and service vessel traffic, onshore pipeline landfalls, entanglement in and ingestion of offshore oil- and gas-related plastic debris, and oil spills. The effects of these activities are estimated to be sublethal. Potential lethal effects are estimated only from oil spills greater than or equal to 1,000 bbl (one 6,500-bbl spill is assumed). Sale-related oil spills of any size are estimated to be extraordinary events that will rarely contact endangered and threatened birds or their critical feeding, resting, or breeding habitats.

Conclusion

The impact of the Base Case scenario on endangered and threatened birds within the potentially affected area is expected to result in no discernible decline in a population or species and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to pre-disturbance condition in less than one generation.

Gulf Sturgeon (Section IV.D.1.a.(8))

The Gulf sturgeon can be impacted by oil spills resulting from the proposed action. The impact of this scenario on Gulf sturgeon is estimated to be inconsequential.

Conclusion

The impact of the Base Case scenario on the Gulf sturgeon within the potentially affected area is expected to result in sublethal effects and cause short-term physiological or behavioral changes.

Commercial Fisheries (Section IV.D.1.a.(9))

Activities resulting from the proposed action have the potential to cause detrimental effects to Central Gulf commercial fisheries. It is estimated that the effects from the major impact-producing factors on commercial fisheries in the CPA are inconsequential and of nominal occurrence. As a result, there will be little discernible disturbance to Gulf commercial fisheries.

Conclusion

The impact of the Base Case scenario on commercial fisheries within the potentially affected area is expected to result in a short-term decrease in a portion of a population of commercial importance, in an essential habitat, or in commercial fisheries on a local scale. Any affected population is expected to recover to pre-disturbance condition in one generation.

Recreational Resources and Activities

Beach Use (Section IV.D.1.a.(10)(a))

A few oil spills of greater than 1 and less than or equal to 50 bbl are likely to affect portions of CPA beaches, with little disruption of recreational activities. Marine debris will be lost from time to time from OCS operations associated with drilling 590 new wells and producing oil and gas from 30 new platform complexes throughout the CPA over the next 35 years. Intermittent oiling and wash up of debris will detract from enjoyment of recreational beaches. A drilling rig and production platform in the nearshore area off Louisiana and Mississippi could impact the natural seascape viewed from some wilderness beaches in coastal Subarea C-3. Helicopter and vessel traffic will add periodic offsite noise pollution affecting wilderness beach users.

Conclusion

The proposed action is expected to result in minor pollution events and nearshore operations that may adversely affect the enjoyment of some beach users on Louisiana and Texas beaches.

Marine Fishing (Section IV.D.1.a.(10)(b))

The proposed action is expected to result in up to 16 new platform complexes that will attract fishermen and improve fishing success in the nearshore waters (within 30 miles) of the CPA over the next 5-35 years.

Conclusion

Platforms installed within 30 mi of shore attract fishermen and improve fishing for a period of about 20 years, but they are unlikely to affect offshore fishing patterns in general unless the platforms are installed in nearshore locations where no platforms currently exist.

Archaeological Resources

Historic (Section IV.D.1.a.(11)(a))

The greatest potential impact to an historic archaeological resource as a result of the proposed action would result from a contact between an OCS offshore activity (platform installation, drilling rig emplacement, dredging, or pipeline project) and an historic shipwreck. The areas of the northern Gulf of Mexico, which are considered to have a high probability for historic period shipwrecks, have recently been redefined as a result of an MMS-funded study (Garrison et al., 1989). The redefinition of the high-probability areas has reduced the total number of lease blocks with a high probability for shipwrecks from 3,410 to 2,263. A new NTL for archaeological surveys in the Gulf of Mexico Region (NTL 91-02) has increased the survey linespacing density for historic shipwreck surveys from 150 m to 50 m.

Most other activities associated with the proposed action are expected to have very low impacts on historic archaeological resources. No new onshore infrastructure construction or pipeline landfalls are expected as a result of the proposed action. Historic cultural resources, therefore, will not be affected by these activities. The chance of contact from an oil spill associated with the proposed action is very low. Furthermore, the major impact from an oil-spill contact on an historic coastal site, such as a fort or lighthouse, would be visual due to oil contamination. These impacts would be temporary and reversible. Impacts from dredging are expected to be low.

The OCS activity could contact a shipwreck because of incomplete knowledge on the location of shipwrecks in the Gulf. Although this occurrence is not probable, such an event would result in the disturbance or destruction of important historic archaeological information. Other factors associated with the proposed action are not expected to affect historic archaeological resources.

Conclusion

There is a very small possibility of an impact between OCS oil and gas activities and a historic shipwreck or site. Should such an impact occur, unique or significant historic archaeological information could be lost.

Prehistoric (Section IV.D.1.a.(11)(b))

Several impact-producing factors may threaten the prehistoric archaeological resources of the Central Gulf. An impact could result from a contact between an OCS activity (pipeline and platform installations, drilling rig emplacement and operation, dredging, and anchoring activities) and a prehistoric site located on the continental shelf. The archaeological surveys and archaeological clearance of sites that are required prior to an operator beginning oil and gas activities in a lease block are estimated to be 90 percent effective at identifying possible prehistoric sites. The survey and clearance provide a significant reduction in the potential for a damaging interaction between an impact-producing factor and a prehistoric site. There is a very small possibility of an OCS activity contacting a prehistoric site. Should such contact occur, there could be damage to or loss of significant or unique archaeological information.

Onshore development as a result of the proposed action could result in the direct physical disturbance from new facility construction, pipeline trenching, and new navigation canal dredging. None of these activities is expected to occur under the Base Case. The impact level from these factors is considered to be very low.

Should an oil spill contact a coastal prehistoric site, the potential for dating the site using radiocarbon methods could be destroyed. Oil-spill cleanup operations could physically impact coastal prehistoric sites. Previously unrecorded sites could also experience an impact from oil-spill cleanup operations on beaches. The probability of a spill of 1,000 bbl or greater (one 6,500-bbl spill is assumed) occurring and contacting a coastal prehistoric site within 10 days is very low (1%), and it is assumed that no contact will occur. A few spills greater than 1 and less than or equal to 50 bbl are assumed to contact the coast, but these small spills would probably not cover an exposed site, such as a shell midden, with enough oil to contaminate all the datable organic remains. The impact level from oil-spill contact is expected to be very low.

Conclusion

There is a very small possibility of an impact between OCS oil and gas activities and a prehistoric site. Should such an impact occur, there could be damage or loss of significant or unique prehistoric archaeological information.

Socioeconomic Conditions

Population, Labor, and Employment (Section IV.D.1.a.(12)(a))

Peak annual changes in the population, labor, and employment of all coastal subareas in the Central and Western Gulf resulting from the proposed action in the Central Gulf represent less than 1 percent of the levels expected in the absence of the proposed action in the Central Gulf. Only 2 percent of the total employment resulting from the proposed action is expected to affect the coastal subareas of the Western Gulf. Employment resulting from oil-spill clean-up activities due to the proposed action is negligible. It is expected that employment demands in support of the proposed action will be met with the existing population and available labor force.

Conclusion

The Base Case impact of the proposed action in the Central Gulf on the population, labor, and employment of the counties and parishes of the Central and Western Gulf coastal impact area is expected to be less than 1 percent of the levels expected in the absence of the proposal.

Public Services and Infrastructure (Section IV.D.1.a.(12)(b))

Impacts to public services and infrastructure would be related to dramatic increases or decreases in population. Specific impact-producing factors examined in this analysis include fluctuations in work force, migration into or out of the coastal subareas, and the relatively high wages made by personnel involved in the oil and gas industry. An analysis of historical trends indicates that population impacts of greater than 1 percent involve positive net migration into a given area. Under the Base Case, population impacts are not expected to exceed the peak year impact of 0.24 percent. No positive net migration into the coastal subareas of the Central and Western Gulf of Mexico is expected to occur as a result of the proposed action. It is expected that employment will occur from those currently employed in the oil and gas industry, as well as unemployed, underemployed, and new employees already living in the area. In addition, jobs created by the proposal would likely reduce the amount of migration out of the coastal subareas when compared to scenarios without the proposal. It is expected that employees leaving public service and infrastructure related jobs could be replaced from the existing labor pool.

Conclusion

Population and employment impacts that result from the proposed action under the Base Case scenario will not result in disruptions to community infrastructure and public services beyond what is anticipated by in-place planning and development agencies.

Social Patterns (Section IV.D.1.a.(12)(c))

Impacts to social patterns would be related to dramatic changes in population and the disruption of environmental resources, as well as conditions inherent to OCS-related employment (i.e., work scheduling and rate of pay). Specific impact-producing factors examined in this analysis include fluctuations in the workforce, migration into or out of the coastal subareas, work scheduling, displacement from traditional occupations, and relative income. An analysis of historical trends indicates that population impacts of greater than 1 percent typically involve positive net migration into a given area. Under the Base Case, population impacts are not expected to exceed the peak year impact of 0.25 percent. No positive net migration into coastal subareas of the Central and Western Gulf of Mexico is expected to occur as a result of the proposal. It is expected that employment will occur from those currently employed in the oil and gas industry, as well as unemployed, underemployed, and new employees already living in the area. It is expected that jobs created by the proposal would likely reduce the amount of out-migration when compared to scenarios without the proposal. It is expected that minor displacement from traditional occupations will occur as a result of the proposed action. This displacement will be mitigated, to some extent, by the extended work schedule associated with OCS-related employment. The extended work schedule is expected to have some deleterious effects on family life in pertinent, individual cases. Impacts caused by the displacement of traditional occupations and relative wages are expected to occur to a minimal extent.

Conclusion

It is expected that no net migration will occur as a result of the proposed action. Deleterious impacts to social patterns are expected to occur in some individual cases as a result of extended work schedules, displacement from traditional occupations, and relative wages.

c. Mitigating Measures

Measures have been developed to mitigate possible impacts of OCS activities on envirorimental resources and non-OCS activities. The four stipulations presented below have been applied to appropriate OCS leases for many years. These stipulations, while proven effective, are considered as potential mitigating measures in this EIS. The Secretary will make a decision prior to Sale 142 on whether or not to apply these measures to appropriate leases resulting from the sale. The analyses in this EIS of the impacts to the resources to which these stipulations apply assume that the measures will be in place. However, the analyses also contain a description of possible impacts without the protection afforded by the stipulations.

(1) Topographic Features Stipulation

The Topographic Features Stipulation was formulated based on consultation with various Federal agencies and comments solicited from State, industry, environmental organizations, and academic representatives. The stipulation wording is based on years of scientific information collected since the inception of the stipulation. This information includes various Bureau of Land Management/MMS-funded studies on the topographic highs in the Central Gulf, numerous stipulation-imposed, industry-funded monitoring reports, and the National Research Council (NRC) report entitled *Drilling Discharges in the Marine Environment* (1983).

The requirements in the stipulation are based on the following facts:

(a) Shunting of the drilling effluent to the nepheloid layer confines the effluent to a level deeper than that of the living reef of a high-relief topographic feature. Shunting is therefore an effective measure for protecting the biota of high relief topographic features (Bright and Rezak, 1978; Rezak and Bright, 1981; NRC, 1983).

(b) The biological effect on the benthos from the deposition of nonshunted discharge are mostly limited to within 1,000 m of the discharge (NRC, 1983).

(c) The biota of topographic features can be categorized into depth-related zones defined by degree of reef-building activity (Rezak and Bright, 1981; Rezak et al., 1983 and 1985).

The stipulation establishes No Activity Zones at the topographic features. The zone is defined by the 85-m isobath because, generally, the biota shallower than 85 m are more typical of the Caribbean reef biota, while the biota deeper than 85 m are similar to soft-bottom organisms found throughout the Gulf. Where a bank is in water depths less than 85 m, the deepest closing isobath defines the No Activity Zone for that bank. Within the No Activity Zone, no operations, anchoring, or structures are allowed. Outside the No Activity Zones, additional restrictive zones are established within which oil and gas operations could occur, but within which drilling discharges would be shunted.

The stipulation requires that all effluents within 1,000 m of those banks with the antipatharian-transitional zone be shunted to within 10 m of the seafloor. Banks containing the more sensitive and productive algal-sponge zone require a shunt zone extending 1 nmi and an additional 3-nmi shunt zone for development. (The reported algal-sponge zone at Sackett Bank is mostly dead; Sackett Bank is, therefore, not accompanied by this restriction.) Because Sweet Bank in the Central Gulf is small and surrounded by very deep water (the depth drops very quickly to greater than 200 m around the bank), it does not require the protection of the shunt zones; therefore, only a "No Activity Zone" is established there.

The banks and corresponding blocks to which this stipulation may be applied in the Central Gulf are as follows:

Bank Name	Isobath (meters)	Bank Name	Isobath (meters)
McGrail Bank	85	Parker Bank	85
Bouma Bank	85	Fishnet Bank[2]	76
Rezak Bank	85	Jakkula Bank	85
Sidner Bank	85	Sweet Bank[1]	85
Sonnier Bank	55	Rankin Bank	85
Sackett Bank[2]	85	29 Fathom Bank	64
Ewing Bank	85	Bright Bank	85
Diaphus Bank[2]	85	Geyer Bank[3]	85
Alderdice Bank	80	MacNeil Bank[3]	82

[1]Only paragraph (a) of the stipulation applies.
[2]Only paragraphs (a) and (b) apply.
[3]Western Gulf of Mexico bank with a portion of its "3 Mile Zone" in the Central Gulf of Mexico.

The stipulation reads as follows:

Topographic Features Stipulation
(Central Planning Area)

(a) No activity including structures, drilling rigs, pipelines, or anchoring will be allowed within the listed isobath ("No Activity Zone") of the banks as listed above.

(b) Operations within the area shown as "1,000 Meter Zone" shall be restricted by shunting all drill cuttings and drilling fluids to the bottom through a downpipe that terminates an appropriate distance, but no more than ten meters, from the bottom.

(c) Operations within the area shown as "1 Mile Zone" shall be restricted by shunting all drill cuttings and drilling fluids to the bottom through a downpipe that terminates an appropriate distance, but no more than ten meters, from the bottom. (Where there is a "1 Mile Zone" designated, the "1,000 Meter Zone" in paragraph (b) is not designated.)

(d) Operations within the area shown as "3 Mile Zone" shall be restricted by shunting all drill cuttings and drilling fluids from development operations to the bottom through a downpipe that terminates an appropriate distance, but no more than ten meters, from the bottom.

Effectiveness of the Lease Stipulation

The coral and associated communities at the crest and on the upper flanks of the topographic features would be severely and adversely impacted (i.e., have an expected impact level of very high) by oil and gas activities resulting from the proposed action if such activities took place on or near these communities without the Topographic Features Stipulation. The USDOI has recognized this problem for some years, and since 1974 stipulations have been made a part of leases on blocks on or near these biotic communities so that impacts from nearby oil and gas activities were mitigated to the greatest extent possible. This stipulation does not prevent the recovery of oil and gas resources, but it does serve to protect valuable and sensitive biological resources.

The analyses of the proposed actions in the Final EIS for Sales 131, 135, and 137 (USDOI, MMS, 1990a) were done without the stipulations in place. A thorough analysis of the impacts of oil and gas activities as they relate to topographic features is presented there. The following is a summary of that analysis, which is hereby incorporated by reference.

The purpose of the stipulation is to protect the biota of the topographic features from adverse effects due to routine oil and gas activities. Several impact-producing factors may threaten the communities of the topographic features. Anchoring of vessels and structure emplacement result in physical disturbance of the benthic environment and are the most likely activities to cause permanent or long-lasting impacts to sensitive offshore habitats. Recovery from damage caused by such activities may take 10 or more years. Operational discharges (drilling muds and cuttings, produced waters) may impact the biota of the banks due to turbidity and sedimentation, resulting in death to benthic organisms in large areas. Recovery from such damage may take 10 or more years. Blowouts may similarly cause damage to benthic biota by resuspending sediments, causing turbidity and sedimentation, resulting in death to benthic organisms. Recovery from such damage may take up to 10 years. Fortunately, blowouts seldom occur in the Gulf. Oil spills will cause damage to benthic organisms if the oil contacts the organisms; such contact is likely only from spills from blowouts. Structure removal using explosives (as is generally the case) results in water turbidity, sediment deposition, and potential explosive shock-wave impacts. Such effects include physical damage from anchoring and rig emplacement and potential toxic and smothering effects from muds and cuttings discharges. Severe damage to benthic organisms could result. Recovery from such damage could take more than 10 years. The above activities resulting from this proposal, especially bottom-disturbing activities, have a potential for causing very high impacts to the biota of the topographic features. While some of the activities are expected to result in lower impacts, those having the greatest impacts are also those most likely to occur. The proposed action, without benefit of the Topographic Features Stipulation or comparable mitigation, is expected to have a very high impact on the sensitive offshore habitats of the topographic features.

The Topographic Features Stipulation has been used on leases since 1974, and this experience shows conclusively that the stipulation effectively prevents damage to the biota of these banks from routine oil and gas activities. Anchoring on the sensitive portions of the features by the oil and gas industry has been prevented. Monitoring studies conducted, as required by the stipulation have demonstrated that the shunting requirements are effective in preventing the muds and cuttings from impacting the biota of the banks. The stipulation, if adopted for this proposed action, would continue to protect the biota of the banks, specifically as discussed below. Mechanical damage resulting from oil and gas operations is probably the single most severe impact to benthic areas. The "No Activity Zone" designation would completely eliminate this threat from leasing activities. The sensitive biota within the zones will thus be protected.

The stipulation requires that all effluents within 1,000 m of Sackett, Fishnet, and Diaphus Banks, categorized by Rezak and Bright (1981) as Category C banks, be shunted into the nepheloid layer.

The categories of Rezak and Bright (1981) and their definitions are as follows:

Category A: zone of major reef-building activity; maximum environmental protection recommended;

Category B: zone of minor reef-building activity; environmental protection recommended;

Category C: zone of negligible reef-building activity, but crustose algae present; environmental protection recommended; and

Category D: zone of no reef-building or crustose algae; additional protection not necessary.

The biota of the antipatharian zone located at these banks will thus be protected from impact from drilling discharges within the 1,000-m zone because the potentially harmful materials (in drilling muds) will be trapped in the bottom boundary layer and will not move up the bank where the biota of concern are located. Surface drilling discharge at distances greater than 1,000 m from the bank is not expected to impact the biota since effects from drilling discharge are limited to 1,000 m.

The stipulation protects the remaining Category A and B banks with greater restrictions. Surface discharge will not be allowed within 1 nmi of these more sensitive banks. Thus, the stipulation prevents impacts to the biota of these sensitive banks from drilling discharges within 1 nmi. Surface discharges outside of 1 nmi are not expected to impact the biota of the banks, as effects from surface discharge are limited to 1,000 m. However, it is possible that because multiple wells from a single platform (surface location) are typically drilled during development operations, extremely small amounts of muds discharged more than 1 nmi from the bank may reach the bank. In order to eliminate the possible cumulative effect of muds discharged during development drilling outside of 1 nmi, the stipulation imposes a "3 Mile Zone" in which shunting of development well effluent will be required.

The stipulation will prevent damage to the biota of the banks from routine oil and gas activities resulting from the proposed action. Furthermore, oil and gas resources present near such areas could be recovered. However, the stipulation will not protect the banks from the adverse effects of an accident such as a large blowout on a nearby oil or gas operation.

(2) Live Bottom (Pinnacle Trend) Stipulation

A small portion of the northeastern CPA is characterized by a pinnacle trend, which is classified as a live bottom under the definition in the stipulation. The pinnacles in the region could be impacted from physical damage of unrestricted oil and gas activities, as noted in Section IV.D.1.a.(2)(a). The Live Bottom Stipulation is intended to protect the pinnacle trend and the associated hard-bottom communities from damage and, at the same time, provide for recovery of potential oil and gas resources.

The stipulation reads as follows:

Live Bottom (Pinnacle Trend) Stipulation
(Central Planning Area)

(To be included only on leases in the following blocks: Main Pass Area, South and East Addition Blocks 190, 194, 198, 219-226, 244-266, 276-290; Viosca Knoll Blocks 473-476, 521, 522, 564, 565, 566, 609, 610, 654, 692-698, 734, 778.)

For the purpose of this stipulation, "live bottom areas" are defined as seagrass communities; or those areas which contain biological assemblages consisting of such sessile invertebrates as sea fans, sea whips, hydroids, anemones, ascidians, sponges, bryozoans, or corals living upon and attached to naturally occurring hard or rocky formations with rough, broken, or smooth topography; or areas whose lithotope favors the accumulation of turtles, fishes, and other fauna.

Prior to any drilling activities or the construction or placement of any structure for exploration or development on this lease, including, but not limited to, anchoring, well drilling, and pipeline and platform placement, the lessee will submit to the Regional Director (RD) a live bottom survey report containing a bathymetry map prepared utilizing remote sensing techniques. The bathymetry map shall be prepared for the purpose of determining the presence or absence of live bottoms which could be impacted by the proposed activity. This map shall encompass such an area of the seafloor where surface disturbing activities, including anchoring, may occur.

If it is determined that the live bottoms might be adversely impacted by the proposed activity, the RD will require the lessee to undertake any measure deemed economically, environmentally, and technically feasible to protect the pinnacle area. These measures may include, but are not limited to, the following:

(a) the relocation of operations; and

(b) the monitoring to assess the impact of the activity on the live bottoms.

Effectiveness of the Lease Stipulation

The sessile and pelagic communities associated with the crest and flanks of the pinnacle and hard-bottom features would be adversely impacted (i.e., have an expected impact level of low) by oil and gas activities resulting from the proposed action if such activities took place on or near these communities without the Live Bottom Stipulation. The low impact level from the proposed action without the stipulation is partly due to the widespread nature of the features in the pinnacle region and the comparatively low level of activity. The USDOI has recognized this problem for some years, and stipulations have been made a part of leases on blocks on or near these biotic communities so that impacts from nearby oil and gas activities were mitigated to the greatest extent possible. This stipulation does not prevent the recovery of oil and gas resources, but it does serve to protect valuable and sensitive biological resources.

The analyses of the proposed actions in the Final EIS for Sales 131, 135, and 137 (USDOI, MMS, 1990a) were done without the stipulations in place. A thorough analysis of the impacts of oil and gas activities as they relate to the pinnacle region is presented there. The following is a summary of that analysis, which is hereby incorporated by reference.

Activities resulting from the proposed action, particularly anchor damage to localized pinnacle areas, are expected to have a high level of impact on some individuals at portions of the pinnacle trend environment, since these activities have the potential to destroy some of the biological communities and damage one or several individual pinnacles. The range of impacts that may potentially occur at the pinnacle region is low to very low. The most potentially damaging of these are the impacts associated with mechanical damages that may result from anchors. However, the action is judged to be infrequent because of the limited operations in the vicinity of the pinnacles and the small size of many of the features. Potential impact levels from large oil spills, blowouts, pipeline emplacement, muds and cuttings discharges, and structure removals are very low. The frequency of impacts to the pinnacles is rare, and the severity is judged to be slight because of the widespread nature of the features. The proposed action, without the benefit of the Live Bottom Stipulation, is expected to have a low impact on the pinnacle region.

The pinnacle trend is known to exist as patchy regions within the general area of the eastern portion of the CPA (Ludwick and Walton, 1957; Vittor and Associates, Inc., 1985; Brooks et. al., 1989). The stipulation would force the operators to locate the individual pinnacles and associated communities that may be present in the block. The stipulation requires that a survey be done to encompass the potential area of proposed surface disturbance and that a bathymetry map be made from this survey. The bathymetry map depicts any pinnacles in the vicinity of the proposed activity. (Since it is the pinnacles themselves and the habitat they provide for various species that are sensitive to impacts from oil and gas activities, photo-documentation of the identified pinnacles is not warranted.) The RD, through consultation with FWS, could then decide if pinnacles in the trend would be potentially impacted and, if so, require any appropriate mitigative measures.

By identifying the individual pinnacles present at the activity site, the lessee would be directed to avoid placement of the drilling rig and anchors on the sensitive areas. Thus, mechanical damage to the pinnacles is eliminated when measures required by the stipulation are imposed. The stipulation does not address the discharge of effluents near the pinnacles because the pinnacle trend is subjected to heavy natural sedimentation and is at considerable depths. The rapid dilution of drill cuttings and muds will minimize the potential of significant concentration of effluents on the pinnacles.

(3) Archaeological Resource Stipulation

The Archaeological Resource Stipulation has been placed on leases issued in the Gulf of Mexico Region since 1974. The stipulation provides protection for prehistoric and historic archaeological resources by requiring remote sensing surveys in areas designated to have a high probability for archaeological resources and by requiring protection of archaeological resources discovered outside of the designated high probability zones. The stipulation is included in the analysis of this proposed action.

(a) "Archaeological resource" means any prehistoric or historic district, site, building, structure, or object (including shipwrecks); such term includes artifacts, records, and remains which are related to such a district, site, building, structure, or object (16 U.S.C. 470w(5)). "Operations" means any drilling, mining, or construction or placement of any structure for exploration, development, or production of the lease.

(b) If the Regional Director (RD) believes an archaeological resource may exist in the lease area, the RD will notify the lessee in writing. The lessee shall then comply with subparagraphs (1) through (3).

(1) Prior to commencing any operations, the lessee shall prepare a report, as specified by the RD, to determine the potential existence of any archaeological

resource that may be affected by operations. The report, prepared by an archaeologist and geophysicist, shall be based on an assessment of data from remote-sensing surveys and of other pertinent archaeological and environmental information. The lessee shall submit this report to the RD for review.

(2) If the evidence suggests that an archaeological resource may be present, the lessee shall either:

(i) Locate the site of any operation so as not to adversely affect the area where the archaeological resource may be; or

(ii) Establish to the satisfaction of the RD that an archaeological resource does not exist or will not be adversely affected by operations. This shall be done by further archaeological investigation, conducted by an archaeologist and a geophysicist, using survey equipment and techniques deemed necessary by the RD. A report on the investigation shall be submitted to the RD for review.

(3) If the RD determines that an archaeological resource is likely to be present in the lease area and may be adversely affected by operations, he will notify the lessee immediately. The lessee shall take no action that may adversely affect the archaeological resource until the RD has told the lessee how to protect it.

(c) If the lessee discovers any archaeological resource while conducting operations on the lease area, the lessee shall report the discovery immediately to the RD. The lessee shall make every reasonable effort to preserve the archaeological resource until the RD has told the lessee how to protect it.

Effectiveness of the Lease Stipulation

Prehistoric archaeological resources would be slightly affected by oil and gas activities resulting from the proposed action if such activities took place within the zone of high probability for prehistoric resources. Historic archaeological resources would be adversely affected by oil and gas industry activities resulting from the proposed action if such activities took place within the zone of high probability for historic resources. The DOI has recognized its legal responsibilities for protection of archaeological resources on the Gulf of Mexico OCS, and since 1974 stipulations have been made a part of leases on blocks within the Gulf of Mexico Region. The stipulation does not prevent the recovery of oil and gas resources, but it does provide a mechanism to protect our Nation's prehistoric and historic OCS archaeological resources.

The Archaeological Resource Stipulation shall assure MMS compliance with Federal laws and regulations requiring protection of archaeological resources. The National Historic Preservation Act of 1966, as amended, requires each Federal agency to establish a program to locate, inventory, and nominate to the Secretary all properties under the agency's ownership or control that appear to qualify for inclusion on the National Register. Section 2(a) of Executive Order 11593 provides that Federal agencies shall locate, inventory, and nominate to the Secretary of the Interior all sites, buildings, districts, and objects under their jurisdiction or control that appear to qualify for listing on the National Register of Historic Places. Section 11(g)(3) of the OCSLA, as amended, states that "such exploration (oil and gas) will not . . . disturb any site, structure, or object of historical or archaeological significance." Because of these laws and regulations, the withdrawal of the Archaeological Resource Stipulation would not relieve the MMS of its legal responsibility to protect OCS archaeological resources.

The analyses of the proposed actions in the Final EIS for Sales 131, 135, and 137 (USDOI, MMS,1990a) were presented without the stipulations in place. A thorough analysis of the impacts of oil and gas activities as they relate to archaeological resources is presented there. The following is a summary of that analysis, which is incorporated by reference.

The purpose of the stipulation is to provide a mechanism to protect OCS archaeological resources from adverse effects due to oil and gas exploration and development. Several impact-producing factors may threaten prehistoric and/or historic archaeological resources. The placement of drilling rigs, production platforms, pipelines, and anchoring could destroy artifacts or disrupt the provenience and stratigraphic context of artifacts, sediments, and paleoindicators from which the scientific value of the archaeological resource is derived. Oil spills could destroy the ability to date prehistoric sites by radiocarbon dating techniques. Dredging new channels and maintaining current channels could impact a historic shipwreck. Ferromagnetic debris associated with OCS oil and gas activities would tend to mask magnetic signatures of significant historic archaeological resources.

The stipulation is the agency's effort to comply with existing Federal laws and regulations. It provides a mechanism for the protection of the Nation's OCS archaeological resources. Remote-sensing surveys mandated in the stipulation will serve to protect archaeological resources from oil and gas activities resulting from the proposed action by identifying the location of the resources. Without the stipulation in place, the agency would still be responsible for protecting the Nation's OCS archaeological resources. Remote-sensing surveys would still be required to ensure compliance with existing laws and regulations.

(4) Military Areas Stipulation

The proposed Military Areas Stipulation has been applied to blocks in military warning and water test areas in past lease sales in the Central Gulf and may be included, at the option of the Secretary, in all leases resulting from this proposed action. The military has recommended utilizing the stipulation on all leasing operations within their warning areas.

The stipulation reads as follows:

Military Areas Stipulation No. 1

Hold and Save Harmless

Whether compensation for such damage or injury might be due under a theory of strict or absolute liability or otherwise, the lessee assumes all risks of damage or injury to persons or property, which occur in, on, or above the Outer Continental Shelf (OCS), to any persons or to any property of any person or persons who are agents, employees, or invitees of the lessee, its agents, independent contractors, or subcontractors doing business with the lessee in connection with any activities being performed by the lessee in, on, or above the OCS, if such injury or damage to such person or property occurs by reason of the activities of any Agency of the United States Government, its contractors or subcontractors, or any of its officers, agents or employees, being conducted as a part of, or in connection with, the programs and activities of the command headquarters listed in Table II-1.

Notwithstanding any limitation of the lessee's liability in Section 14 of the lease, the lessee assumes this risk whether such injury or damage is caused in whole or in part by any act or omission, regardless of negligence or fault, of the United States, its contractors or subcontractors, or any of its officers, agents, or employees. The lessee further agrees to indemnify and save harmless the United States against all claims for loss, damage, or injury sustained by the lessee, or to indemnify and save harmless the United States against all claims for loss, damage, or injury sustained by the agents, employees, or invitees of the lessee, its agents, or any independent contractors or subcontractors doing business with the lessee in connection with the programs and activities of the aforementioned military installation, whether the same be caused in whole or in part by the negligence or fault of the United States, its contractors, or subcontractors, or any of its officers, agents, or employees and whether such claims might be sustained under a theory of strict or absolute liability or otherwise.

Table II-1

Military Contacts

Central Gulf of Mexico

Warning Areas	Command Headquarters
*W-155A and W-155B (for operational control)	Fleet Area Control & Surveillance Facility (FACSFAC) Naval Air Station Pensacola, Florida 32508 Telephone: (904) 452-2735/4671
W-92	Naval Air Station Air Operations Department Air Traffic Division/Code 52 New Orleans, Louisiana 70146-5000 Telephone: (504) 393-3100/3101
W-453	159th Tactical Fighter Group (ANG) NAS NOLA New Orleans, Louisiana 70143 Telephone: (504) 391-8612/8621
Eglin Water Test Areas 1-5	Air Force Development Test Center 3246th Test Wing/CCU Eglin AFB, Florida 32542 Telephone: (904) 882-8963

Western Gulf of Mexico

Warning Areas	Command Headquarters
W-228	Chief, Naval Air Training Naval Air Station Corpus Christi, Texas 78419-5100 Telephone: (512) 939-3927/3902
W-602	Headquarters SAC/DONO Deputy Chief of Staff Operations Headquarters Strategic Air Command Offutt AFB, Nebraska 68113-5001 Telephone: (402) 294-3103/3450 or Scheduling: (402) 294-2334
*W-155A and W-155B (for agreement)	Chief, Naval Air Training Naval Air Station Corpus Christi, Texas 78419-5100 Telephone (512) 939-3927/3862

Electromagnetic Emissions

The lessee agrees to control its own electromagnetic emissions and those of its agents, employees, invitees, independent contractors or subcontractors emanating from individual designated defense warning areas in accordance with requirements specified by the commander of the command headquarters listed in Table II-1 to the degree necessary to prevent damage to, or unacceptable interference with Department of Defense flight, testing, or operational activities, conducted within individual designated warning areas. Necessary monitoring control, and coordination with the lessee, its agents, employees, invitees, independent contractors or subcontractors, will be affected by the commander of the appropriate onshore military installation conducting operations in the particular warning area; provided, however, that control of such electromagnetic emissions shall in no instance prohibit all manner of electromagnetic communication during any period of time between a lessee, its agents, employees, invitees, independent contractors or subcontractors and onshore facilities.

Operational

The lessee, when operating or causing to be operated on its behalf, boat, ship, or aircraft traffic into the individual designated warning areas, shall enter into an agreement with the commander of the individual command headquarters listed in Table II-1, upon utilizing an individual designated warning area prior to commencing such traffic. Such an agreement will provide for positive control of boats, ships, and aircraft operating into the warning areas at all times.

Effectiveness of the Lease Stipulation

The hold harmless section of the proposed Military Areas Stipulation serves to protect the U.S. Government from liability in the event of an accident involving the lessee and military activities. The actual operations of the military and the lessee and its agents will not be affected. The electromagnetic emissions section of the proposed stipulation requires the lessee and its agents to reduce and curtail the use of radio, CB, or other equipment emitting electromagnetic energy within some areas. This serves to reduce the impact of oil and gas activity on the communications of military missions and reduces the possible effects of electromagnetic energy transmissions on missile testing, tracking, and detonation.

The operational section requires notification to the military of oil and gas activity to take place within a military use area. This allows the base commander to plan military missions and maneuvers that will avoid the areas where oil and gas activities are taking place or to schedule around these activities. Prior notification helps reduce the potential impacts associated with vessels and helicopters traveling unannounced through areas where military activities are underway.

The proposed Military Areas Stipulation reduces potential impacts, particularly in regards to safety, but does not reduce or eliminate the actual physical presence of oil and gas operations in areas where military operations are conducted. The reduction in potential impacts resulting from this stipulation would make multiple-use conflicts most unlikely. Without the stipulation, some potential conflict is likely. The best indicator of the overall effectiveness of the stipulation may be that there has never been an accident involving a conflict between military operations and oil and gas activities.

(5) Notices to Lessees and Letters to Lessees

Notices to Lessees and Operators (NTL's) are formal documents that provide clarification, description, or interpretation of a regulation or OCS standard; provide guidelines on the implementation of a special lease stipulation or regional requirement; provide a better understanding of the scope and meaning of a regulation by explaining MMS interpretation of a requirement; or transmit administrative information such as current telephone listings and a change in MMS personnel or office address. A detailed listing of current and effective Gulf of Mexico NTL's was published in the *Federal Register* on May 16, 1991 (56 FR 22735-22737. The MMS publishes an updated NTL listing annually in the *Federal Register.*

The MMS also conveys important information by way of Letters to Lessees and Operators (LTL's) and Information to Lessees and Operators (ITL's). These documents further clarify or supplement operational guidelines. Separate Regional mailings and the EIS process have served as the vehicles for communicating previously issued NTL's, LTL's, and ITL's.

2. Alternative B - The Proposed Action Excluding the Blocks Near Biologically Sensitive Topographic Features

This alternative, offered for the Secretary's consideration, would protect valuable offshore biological resources. It affects the biologically sensitive banks (topographic features) of the Central Gulf.

All of the blocks included in the deletion alternative are also the blocks that are covered by the proposed Topographic Features Stipulation (discussed in Section II.A.1.c.(1)). The Secretary may choose to adopt only a part of this alternative in order to promote the environmental protection policies of the Department.

a. Description

This alternative would offer all the blocks offered by the proposal except the 62 unleased blocks (Figures II-1 and II-2) of the total 167 blocks (these blocks are listed in Appendix A) affected by the proposed Topographic Features Stipulation. These blocks are on or near enough to biologically sensitive areas of the topographic features of the CPA so that activities resulting from the proposed action could have a high probability of impacting these biota. These blocks represent about 1.2 percent of the 5,194 blocks to be offered in the Central Gulf. It is estimated that the proposal could result in the discovery and production of 0.14 BBO and 1.40 tcf of gas during the time period 1993-2027. There are no areas deferred from the CPA. For more information describing the proposed action and alternatives, see Section I.B.2.

The analyses of impacts summarized below and described in detail in Section IV.D.1.b. are based on a development scenario (Base Case) formulated to provide a set of assumptions and estimates on the amounts, locations, and timing for OCS exploration, development, and production operations and facilities, both offshore and onshore. These are estimates only and not predictions of what will happen as a result of holding the proposed sale. A detailed discussion, with tables, of the development scenario and major related impact-producing factors is included in Section IV.A. The following are the major estimates of activities and associated impact-producing factors assumed for proposed Sale 142 (Base Case). These estimates and factors were utilized in the impact analyses.

(1) During the exploration phase, 1994-2004, there will be 340 wells drilled, resulting in the following:

- the generation of 2.42 MMbbl of drilling mud and 0.63 MMbbl of drill cutting wastes, 18 percent of which will be disposed of onshore;
- offshore air emissions from well drilling operations of 330 tons of total suspended particulate matter, 95 tons of total hydrocarbons, 384 tons of sulphur oxides, 877 tons of carbon monoxide, and 3,288 tons of nitric oxides;
- 6,600 service vessel trips and 23,000 helicopter landings;
- disturbance from rig emplacements of 144 ha of ocean bottom; and
- the likelihood of 1 blowout (Section IV.A..d.(8)).

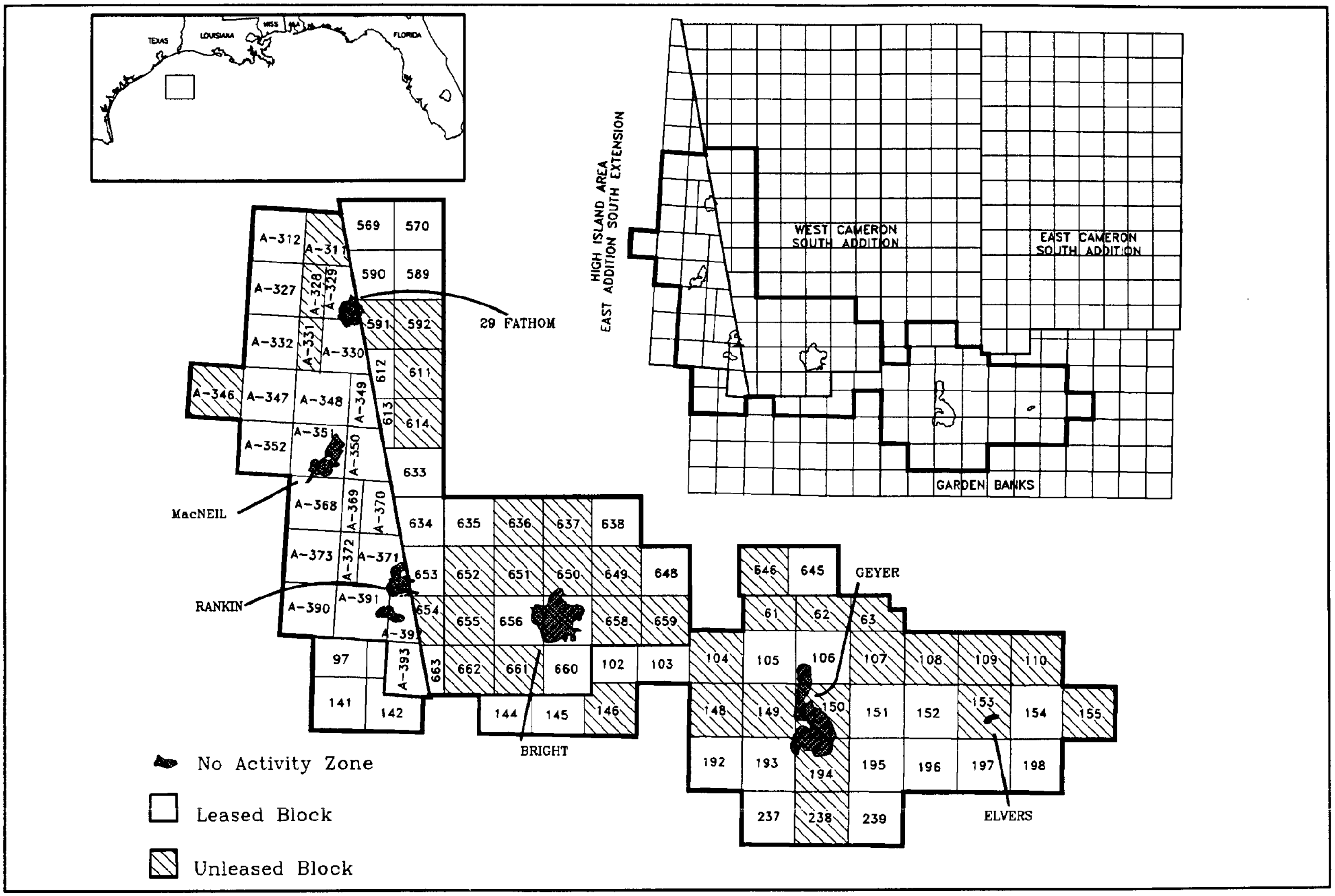


Figure II-1. Location and Lease Status of Blocks Affected by Alternative B (West Louisiana).

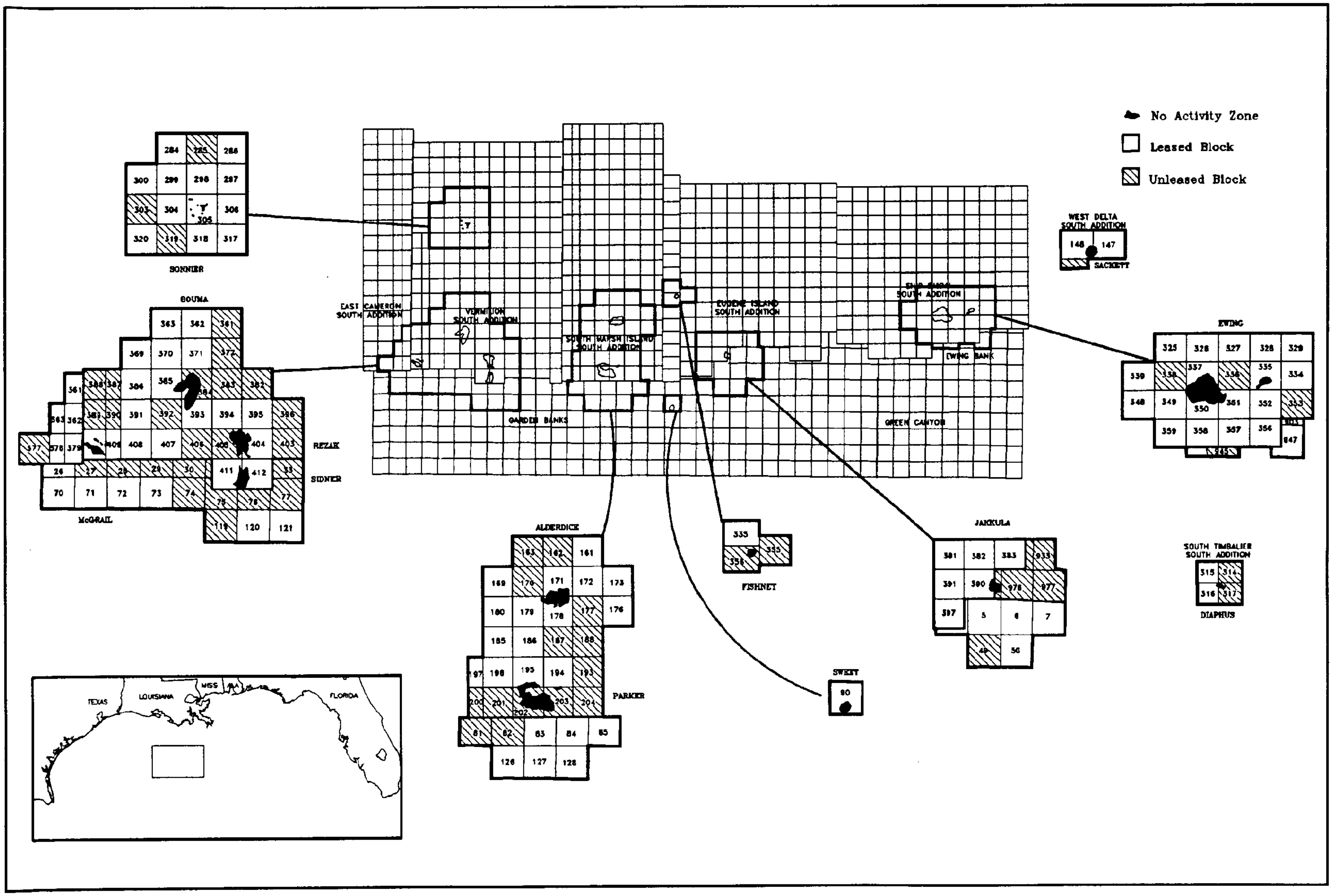


Figure II-2. Location and Lease Status of Blocks Affected by Alternative B (East Louisiana).

(2) During the development phase, 1995-2017, there will be 130 oil wells and 120 gas wells drilled, resulting in the following:

- the generation of 1.69 MMbbl of drilling mud and 0.358 MMbbl of drilling cutting wastes, a small amount of which will be disposed of onshore;

- offshore air emissions from well drilling operations of 162 tons of total suspended particulate matter, 47 tons of total hydrocarbons, 189 tons of sulphur oxides, 430 tons of carbon monoxide, and 1,611 tons of nitric oxides;

- 4,800 service vessel trips and 17,000 helicopter landings;

- the disturbance from fixed structure emplacements of 48 ha of ocean bottom; and

- the likelihood of 1 blowout (Section IV.A.2.d.(8)).

(3) During the production phase, 1995-2026, 0.14 BBO of oil and 1.40 tcf of gas will be produced from 29 platform complexes and one floating production system, resulting in the following:

- the open-water discharge of 283 MMbbl of produced water;

- the onshore disposal of 34 MMbbl of produced waters and 69,000 bbl of produced sands that were generated offshore;

- air emissions of 124 tons of total suspended particulate matter, 19,175 tons of total hydrocarbons, 88 tons of sulphur oxides, 6,590 tons of carbon monoxide, and 50,592 tons of nitric oxides;

- 6,300 service vessel trips and 328,000 helicopter trips;

- the removal of 120 ha of commercial fishing area (peak year estimate); and

- the likelihood of 2 blowouts (Section IV.A.2.d.(8)).

(4) During platform removal operations, which will occur the year after production ceases, 20 platforms will be removed using explosives.

(5) The transportation of gas and oil will require the following:

- the construction of 240 km of gathering pipelines that will connect with existing trunklines prior to landfall, resulting in the disturbance of 77 ha of bottom and the displacement of 320,000 m^3 of sediment;

- 77 barge trips carrying oil to 8 existing shore terminals along the Texas and Louisiana coasts; and

- 2 shuttle tanker trips carrying oil to Mississippi River terminals.

(6) Support activity will result in the following:

- No new major onshore support or processing facility construction is expected; existing OCS-related facilities will be used, with sale-related activities utilizing about 3 percent, on the average, of the capacities of the onshore infrastructure.

- the use of 18 navigation channels, 7 major channels in Louisiana will be maintenance dredged periodically and one deepened to support vessel traffic;

- 56 million liters of bilge water discharged in coastal waters from service vessels traveling to 28 existing bases;

- 206,000 helicopter coastal crossings to reach 27 helicopter hubs; and

- air emissions from service vessels and helicopters of 680 tons of total suspended particulate matter, 495 tons of total hydrocarbons, 177 tons of sulphur oxides, 1,466 tons of carbon monoxide, and 9,264 tons of nitric oxides.

(7) Twenty-one crude oil spills greater than 1 and less than or equal to 50 bbl, one spill between 50 and 1,000 bbl, and one spill of 1,000 bbl or greater are assumed to occur. The large spill is projected to be 6,500 bbl and has a 16 percent chance of land contact.

(8) Fewer than 10 crude oil spills greater than one and less than 50 bbl are assumed to occur from onshore support activities.

(9) Total employment from all activities associated with the exploration, development, and production of oil and gas generated as a result of Sale 142 is 58,500 personnel, 45 percent of which will be directly employed.

It should be noted that the assumptions and estimates for Alternative B are the same as in the Base Case of Alternative A. Alternative B is essentially Alternative A minus 58 widely scattered blocks (representing about 1.1 percent of the blocks to be offered under Alternative A). Due to the scattered nature of the blocks that would not be offered by this alternative, resource estimates for Alternative B do not differ from those estimated for Alternative A. To the extent that adoption of Alternative B, by reducing the blocks available for leasing, reduces the activities resulting from the leasing, these assumptions and estimates will be similarly reduced. For instance, it may be reasonable to assume that one oil or gas field may be present in one or more of the blocks not offered under Alternative B. As discussed in Section IV.A., not conducting exploration or development activities on that field (because the blocks are not part of the sale area under this alternative) could possibly result in the following activities not happening (which might otherwise occur under Alternative A): 2-4 exploration wells with the disturbance of 1.5 ha of seafloor per well; 1 platform with the disturbance of 2 ha of seafloor (4 ha in water deeper than 1,500 ft); 12 development wells from that platform; 8 km of gathering pipeline for that platform; no anchoring, pipeline burial, or sediment disturbance will occur in the block; no use of service vessels or helicopters to and from that block will be required; no discharges of drilling muds (7,134 bbl per exploration well, 6,749 bbl per development well), drill cuttings (1,853 bbl per exploration well, 1,430 bbl per development well); no discharge of produced waters (450 bbl per oil well per day; 68 bbl per gas well per day); no air emissions; and no chance for oil and gas industry-related accidents.

The primary difference between Alternative A (with the proposed Topographic Features Stipulation) and Alternative B (which excludes the blocks affected by that stipulation) is that under Alternative B oil and gas activities would be completely excluded from taking place within the blocks which, under Alternative A, activities could take place (although with certain restrictions in certain portions of the blocks). Figure III-5 shows a topographic feature with its attendant proposed No Activity Zone, 1 Mile Zone, and 3 Mile Zone. Under Alternative A, all those blocks containing any of those zones could be leased, although no oil and gas activities would be permitted in the No Activity Zone and activities would be restricted in the 1 and 3 Mile

Zones. Under Alternative B, none of those blocks containing any of those zones would be leased, thus precluding any oil and gas activities anywhere in those blocks.

b. Summary of Impacts

The following summarizes the detailed impact analyses of Section IV.D.1.b. It should be emphasized that these are impact summaries and that the reader should refer to Section IV.D.1.b. for detailed information regarding particular resources. Table S-3 compares the impacts of Alternatives A-C and the cumulative impacts on each resource category estimated as a result of the various scenarios.

To facilitate the analyses, the Federal offshore area is divided into subareas. The CPA is comprised of four subareas (C-1, C-2, C-3, and C-4) and the coastal region is divided into four coastal subareas (C-1, C-2, C-3, and C-4). These subareas are delineated on Figure IV-1.

This alternative is offered for the Secretary's consideration to protect valuable offshore biological resources. It affects the biologically sensitive banks (topographic features) of the Central Gulf.

Given the size of the area available for lease under Alternative A, it is reasonable to assume that the removal of 1.2 percent of the area probably will not significantly change the projected level of activity (i.e., numbers of wells, platforms, vessel trips, etc. (Table IV-1)) projected under that alternative. The only differences are that under Alternative B no activity will take place in the deletion areas. The assumption that the levels of activity for Alternative B are virtually identical to those projected for Alternative A indicates that the impacts expected to result will be very similar to those described under Alternative A (Section IV.D.1.a). The areas that would not be offered under Alternative B make up only a small portion of the CPA, and with the exception of topographic features, only contain comparatively small amounts, if any, of the resources analyzed in this document. Therefore, the regional impact levels for all resources are estimated to be identical to those described under Alternative A. However, there are some localized changes in the impacts as described below.

Coastal Resources

Coastal resources include beaches, seagrass beds, salt and fresh marshes, and estuaries. The beaches serve as recreational sites in addition to storm protection and erosion control areas. The marshes and estuaries support numerous commercially and recreationally important fish and wildlife species. The primary impact-producing factors of concern for these environmental resources are contact by oil spills and disturbance from the emplacement of pipelines or the dredging of channels.

The areas that would be deleted from the proposed sale with the selection of Alternative B are scattered across the CPA shelf far from the coastline. All of the areas available for deletion, with one exception, are located over 115 km (70 mi) from shore (Sackett Bank with a 2 1/4 block deletion area is located about 30 km (18 mi) from the mouth of the Mississippi River). Considering the assumption that the estimated level of activity will not change from that projected for Alternative A and the substantial distances from the deletion areas to coastal resources, it is extremely unlikely that selection of Alternative B would have any influence on the impacts estimated for Alternative A.

Conclusion

The impacts on the following coastal resources are estimated to be the same as those estimated under Alternative A: coastal barriers; wetlands; coastal and estuarine water quality; air quality; Alabama, Choctawhatchee, and Perdido Key beach mice; nonendangered and nonthreatened coastal and marine birds; endangered and threatened marine birds; recreational beach use; and population, labor, and employment.

Offshore Resources

Deletion of this area would preclude drilling operations and associated activities from occurring within the 62 affected blocks. It would further eliminate the threat of damage from drilling discharges, anchoring, or platform/pipeline emplacement and removal related to the exploration and development of this area. The following analyses deal specifically with the sensitive resources that may exist in the deletion area and for which there might be a change in impacts with the selection of Alternative B. Live-bottom areas (Pinnacle Trend), deep-water benthic communities, and archaeological resources are not located in or near the area, so there would be no change in the impact level projected under Alternative A. Commercial fisheries and recreational marine fishing would also remain as under Alternative A.

Topographic Features

Essentially, oil and gas operations within the blocks that fall within 3 nmi of the 85-m isobath of the 16 banks of the Central Gulf (and 2 banks of the Western Gulf that are within 3 nmi of the Central Gulf) are considered potential sources of impact to biota of those banks that could be harmed by oil and gas activities. The biological resources of the topographic features are considered very sensitive to potential impacts due to oil and gas operations; however, topographic features in the Central Gulf are usually the surface expressions of salt domes, which are often associated with oil and gas reserves. The recovery of such reserves, the extent of which is unknown at this time, would be prevented by the adoption of this alternative. It is noted that 105 of the 167 blocks affected are already leased. This deletion alternative is presented in order to fully protect the biological resources inhabiting the crests of the topographic features.

This alternative, if adopted, would prevent any oil and gas activity whatsoever in the affected blocks (except for pipeline construction, which would be regulated through the normal pipeline permitting procedures); thus, it would eliminate any impacts to the biota of the area from oil and gas activities, which otherwise would be conducted within the blocks. However, because of the operation of the proposed Topographic Features Stipulation, which is included in the analysis of Alternative A (Section II.A.1.c.(1)), the impact levels to the topographic features will be essentially the same for both Alternative A and Alternative B.

Conclusion

The activities assumed for Alternative B are expected to cause little to no damage to the physical integrity, species diversity, or biological productivity of the habitat of the topographic features of the Gulf of Mexico. Small areas of 5-10 m^2 would be impacted, and recovery from this damage to pre-impact conditions is expected to take less than 2 years, probably on the order of 2-4 weeks. Selection of Alternative B would preclude oil and gas operations in the unleased blocks (62 of 167) affected by the proposed Topographic Features Stipulation.

Marine Water Quality

The impact-producing factors leading to water quality degradation resulting from offshore OCS oil and gas operations include the resuspension of bottom sediments through exploration and development activities, pipeline construction, and platform removal operations; the discharge of deck drainage, sanitary and domestic wastes, formation waters (produced waters), and drilling fluids (muds and cuttings); and accidental hydrocarbon discharges due to spills, blowouts, or pipeline leaks. Routine operational discharges may degrade water quality with high impacts occurring within a few meters to tens of meters from the source. These impacts decrease to very low with distance (500-1,000 m) from the source. Accidental oil spills may degrade water quality somewhat, changing the measurements from background levels only in a very limited area close to the source. Adoption of this alternative would preclude impacts associated with routine exploration and production activities in the area not offered. It would not eliminate the threat of degradation from those OCS activities occurring outside the area not offered. However, because the area not offered is a small portion of the entire area offered for leasing under either Alternative A or Alternative B, the regional impact level will be reduced by only that small amount, assuming that oil and gas activities would be reduced proportionally.

Conclusion

Selection of Alternative B would eliminate potential impacts on very localized areas contained in the deletion area, but this would not be significant enough to change the regional impact level on marine water quality as projected under Alternative A.

Marine Mammals, Marine Turtles, and the Gulf Sturgeon

As benthic feeders, adult loggerhead, green, hawksbill, and Kemp's ridley sea turtles are unlikely to occur in the proposed deletion area because the topographic features in the CPA and WPA are at depths in excess of 300 m, which is the lower limit of the feeding habitat for these species. However, the pelagic stages of all sea turtles could occur in the vicinity of any of these areas. Sperm whales have been sighted near topographic features in the CPA and several of the more common small marine mammals--*Stenella, Kogia,* and *Grampus*--could be expected in the vicinity of topographic features because of the presence of prey species. Sea turtles and marine mammals could be impacted by oil and gas activities in this area by contact with or ingestion of oil, collision with vessels, entanglement in or ingestion of debris generated from platforms, or physical/acoustic disturbances (drilling, and structure placement and removal). Not offering this area would eliminate all impacts to sea turtles and marine mammals that would otherwise occur from proposed action-related oil and gas operations within the blocks not offered. If the area is not offered, impacts to marine mammals and sea turtles will not change from those of the proposed action because of the comparatively low level of oil and gas activity proposed in the area.

Conclusion

Selection of Alternative B would eliminate potential impacts on endangered species and marine mammals in or near the area that would not be offered under this alternative. This slightly smaller number of blocks to be offered is not substantial enough to change the regional impacts on these resources as projected under Alternative A. These impacts are as follows: marine mammals and marine turtles - sublethal effects that are chronic and could result in persistent physiological or behavioral changes; the Gulf sturgeon - sublethal effects that could cause short-term physiological or behavioral changes.

3. Alternative C - No Action

a. Description

The alternative is equivalent to cancellation of a sale scheduled for a specific timeframe on the approved 5-year OCS Oil and Gas Leasing Schedule. Sales in the Central Gulf are scheduled on an annual basis. By canceling the proposed sale, the opportunity is postponed or foregone for development of the estimated 0.14 BBO and 1.40 tcf of gas that could have resulted from proposed Sale 142 in the Central Gulf.

b. Summary of Impacts

If Alternative C is selected, all impacts, positive and negative, associated with the proposed action would be canceled. This alternative would therefore result in no effect on the sensitive resources and activities discussed in Section IV.D.1.a. The incremental contribution of the proposed action to cumulative effects would also be foregone, but such effects from other activities, including other OCS sales, would remain. One contribution to impacts that could increase is oil spill risk due to the importation of foreign oil to replace the resources lost through cancellation of the proposed action.

Alternative energy strategies that could provide replacement resources for lost domestic OCS oil and gas production include energy conservation; conventional oil and gas supplies; coal; nuclear power; oil shale; tar sands; hydroelectric power; solar and geothermal energy; and imports of oil, natural gas, and LNG. These are discussed in some detail in Appendix D. The energy equivalents that may be required from several alternative energy sources, should this lease sale be permanently canceled, are shown on Table D-8 and are based on the resources estimated by MMS to be produced as a result of the proposed action. For the purpose of clarity, this table has separately identified each potential alternative source of energy regarding substitution requirements. It is unlikely, however, that there would be a single choice between these alternative sources, but instead, some combined effort to explore and develop further many or all of these forms as a substitute for OCS oil and gas production.

4. Comparison of Alternatives

Table S-3 provides a comparison and summary of the impacts of the proposed action (Alternative A), the proposed action excluding the blocks near biologically sensitive topographic features (Alternative B), no action (Alternative C), and the cumulative analyses for proposed Sale 142.

B. PROPOSED WESTERN GULF SALE 143

1. Alternative A - The Proposed Action

a. Description

Proposed Western Gulf Sale 143 is scheduled to be held in August 1993 and will offer all unleased blocks within the WPA, except for two biologically sensitive blocks. The blocks deferred from the proposed action, because of the environmentally sensitive nature of the biological communities located on these blocks, are High Island Area, East Addition, South Extension Block A-375 (East Flower Garden Bank) and High Island Area, East Addition, South Extension Block A-398 (West Flower Garden Bank). It is estimated that the proposal could result in the discovery and production of 0.05 BBO and 0.74 tcf of gas during the time period 1993-2027. There are three alternatives to the proposed action. The alternatives are to delete biologically sensitive areas near topographic features and offer the remaining acreage, delete a 340-block naval operations area off Corpus Christi, Texas, and offer the remaining acreage, or to take no action (cancel the sale). For more information describing the proposed action and alternatives, see Section I.

The analyses of impacts summarized in this section and presented in detail in Section IV.D.2. are based on a development scenario (Base Case) formulated to provide a set of assumptions and estimates on the amounts, locations, and timing for OCS exploration, development, and production operations and facilities, both offshore and onshore. These are estimates only and not predictions of what will happen as a result of holding the proposed sale. A detailed discussion, with tables, of the development scenario and major related impact-producing factors is included in Section IV.A. The following are the major estimates of activities and associated impact-producing factors assumed for proposed Sale 143 (Base Case). These estimates and factors were utilized in the impact analyses.

(1) During the exploration phase, 1994-2004, there will be 210 wells drilled, resulting in the following:

- the generation of 1.50 MMbbl of drilling mud and 0.39 MMbbl of drill cutting wastes, about 18 percent of which will be disposed of onshore;

- offshore air emissions from well drilling operations of 204 tons of total suspended particulate matter, 59 tons of total hydrocarbons, 237 tons of sulphur oxides, 542 tons of carbon monoxide, and 2,031 tons of nitric oxides;

- 4, 050 service vessel trips and 14,200 helicopter landings;
- disturbance from rig emplacements of 83 ha of ocean bottom; and
- the likelihood of 1 blowout.

(2) During the development phase, 1995-2016, there will be 50 oil wells and 60 gas wells drilled, resulting in the following:

- the generation of 0.74 MMbbl of drilling mud and 0.157 MMbbl of drilling cutting wastes, a small amount of which will be disposed of onshore;
- offshore air emissions from well drilling operations of 94 tons of total suspended particulate matter, 27 tons of total hydrocarbons, 109 tons of sulphur oxides, 248 tons of carbon monoxide, and 9,31 tons of nitric oxides;
- 2,120 service vessel trips and 7,425 helicopter landings;
- the disturbance from fixed structure emplacements of 10 ha of ocean bottom; and

(3) During the production phase, 1995-2026, 0.05 BBO of oil and 0.74 tcf of gas will be produced from 8 platform complexes and two floating production systems, resulting in the following:

- the open-water discharge of 126 MMbbl of produced water;
- 24,000 bbl of produced sands disposed of onshore;
- offshore air emissions from platforms of 42 tons of total suspended particulate matter, 6,500 tons of total hydrocarbons, 30 tons of sulphur oxides, 2,234 tons of carbon monoxide, and 17,150 tons of nitric oxides;
- 2,086 service vessel trips and 109,000 helicopter landings;
- the removal of 15 ha of commercial fishing area (peak year estimate); and
- the likelihood of 1 blowout.

(4) During platform removal operations, which will occur the year after production ceases 3 platforms will be removed using explosives.

(5) The transportation of gas and oil will require the following:

- the construction of 80 km of gathering pipelines that will connect with existing trunklines prior to landfall, resulting in the disturbance of 26 ha of bottom and the displacement of 40,000 m^3 of sediment;
- 9 barge trips carrying oil to 3 existing shore terminals; and
- 66 shuttle tanker trips carrying oil to four Texas and two Louisiana terminals.

(6) Support activity will result in the following:

- No new major onshore support or processing facility construction is expected; existing OCS-related facilities will be used, with sale-related activities utilizing about 3 percent, on the average, of the capacities of the onshore infrastructure.
- the use of 15 navigation channels (less than 1 percent), that will be maintenance dredged periodically and one deepened to support vessel traffic;
- 26 million liters of bilge water discharged in coastal waters from service vessel traffic to 27 existing bases;
- 73,000 helicopter coastal crossings to reach 20 helicopter hubs; and
- air emissions from service vessels and helicopters of 211 tons of total suspended particulate matter, 154 tons of total hydrocarbons, 56 tons of sulphur oxides, 470 tons of carbon monoxide, and 2,857 tons of nitric oxides.

(7) Eight crude oil spills greater than 1 and less than or equal to 50 bbl are projected to occur, but none will reach land.

(8) Fewer than 10 crude oil spills greater than one and less than 50 bbl are assumed to occur from onshore support activities.

(9) Total employment from all activities associated with the exploration, development, and production of oil and gas generated as a result of Sale 143 is 24,000 personnel, 45 percent of which will be directly employed.

b. Summary of Impacts

The following summarizes the detailed impact analyses of Section IV.D.2.a. It should be emphasized that these are impact summaries and that the reader should refer to Section IV.D.2.a. for detailed information regarding particular resources. Note that these summaries are limited to the impact of the proposed action (Base Case). The impacts under the Cumulative Analysis are assessed in Section IV.D.2.d. and are not summarized here. Table S-4 compares the impacts of Alternatives A-D and the cumulative impacts on each resource category estimated as a result of the various scenarios.

The following impact analyses are for the proposed action and include the following potential stipulations as part of the proposed action: the Topographic Features Stipulation, the Live Bottom Stipulation, the Archaeological Resource Stipulation, and the Military Areas Stipulation. The analyses to follow presume full compliance with the proposed stipulations.

To facilitate the analyses, the Federal offshore area is divided into subareas. The WPA is comprised of three subareas (W-1, W-2, and W-3) and the coastal region is divided into two coastal subareas (W-1, and W-2). These subareas are delineated on Figure IV-1.

Sensitive Coastal Environments

Coastal Barrier Beaches (Section IV.D.2.a.(1)(a))

Oil-spill contact to a barrier island could result in erosional changes in the barrier if cleanup operations removed large quantities of sand. Because of the very low probability of occurrence of and contact from either an offshore or onshore spill of 1,000 bbl or greater, however, it is assumed that no contact from a spill will occur. Although several spills greater than 1 and equal to or less than 50 bbl are assumed to occur in coastal areas of the WPA and contact barrier landforms, these spills will result in only a light oiling of a small stretch of backbarrier beach. The spilled oil will be cleaned manually within a week with no effects on beach morphology. The impacts to coastal barriers from spills are expected to be very low.

Impacts from onshore and nearshore construction of OCS-related infrastructure (pipeline landfalls, navigation channels, service bases, platform yards, etc.) are not expected to occur, because no new infrastructure construction is anticipated as a result of the proposed action. Although some maintenance dredging is expected to occur, this activity has not been shown to have a negative impact on barriers, and the need for dredging cannot be attributed to the small percentage of vessel traffic in these channels accounted for by Base Case activities.

Conclusion

The proposed action is not expected to result in permanent alterations of barrier beach configurations, except in localized areas downdrift from channels that have been dredged and deepened. The contribution to this localized erosion is expected to be less than 1 percent.

Wetlands (Section IV.D.2.a.(1)(b))

No oil spills from offshore sources are expected to occur and contact coastal wetlands under the Base Case scenario. Although several spills between 1 and 50 bbl are expected to contact wetlands from inshore barge accidents in the WPA, the concentrations of oil that contact wetlands will have only short-term die-back effects on small areas of vegetation. Complete recovery of the affected vegetation is expected within a growing season. None of these spills will contact seagrass beds because of the location of beds in an area that does not include OCS-related oil terminals and barge traffic.

No new dredging projects for pipelines or navigation channels are projected under the Base Case scenario. Few to no impacts from maintenance dredging are expected, given the small contribution of OCS vessel traffic under the Base Case to navigational usage of the channels.

Erosion of wetlands from OCS vessel wakes is not expected to result in significant erosion of wetland shorelines because of the location of navigation channels in open water areas along much of the vessel route to an onshore facility.

Conclusion

The proposed action is expected to result in no permanent alterations of wetland habitat, except for the erosion of less than 1 ha of wetlands along navigation channel margins. These losses could be offset or even exceeded by wetland gains from the beneficial disposal of dredged material generated during channel maintenance and deepening operations.

Sensitive Offshore Resources

Deep-water Benthic Communities (Section IV.D.2.a.(2)(a))

The only impact-producing factor threatening the deep-water benthic communities is physical disturbance of the bottom, which would destroy the organisms comprising these communities. Such disturbance would come from those OCS-related activities associated with pipelaying, anchoring, structure emplacement, and seafloor blowouts. Only structure emplacement is considered to be a threat, and then only to the high-density (Bush Hill-type) communities; the widely distributed low-density communities would not be at risk. The provisions of NTL 88-11 (currently in effect), requiring surveys and avoidance prior to drilling, will greatly duce, but not completely eliminate, the risk and potential effects.

Conclusion

The proposed action is expected to cause little damage to the physical integrity, species diversity, or biological productivity of either the widespread, low-density chemosynthetic communities or the rarer, widely scattered, high-density Bush Hill-type chemosynthetic communities. Recovery from any damage is expected to take less than 2 years.

Topographic Features (Section IV.D.2.a.(2)(b))

Several impact-producing factors (anchoring, structure emplacement, effluent discharge, blowouts, oil spills, and structure removals) may threaten the communities of the topographic features.

Because the analysis of impacts includes the application of the proposed Topographic Features Stipulation, operational discharges (drilling muds and cuttings, produced waters) would have little impact on the biota of the banks. Recovery from any impact would be rapid.

Blowouts may similarly cause damage to benthic biota, but due to the application of the proposed Topographic Features Stipulation for this analysis, they would have little impact on the biota of the banks. Recovery from any impact would be rapid.

Oil spills (there is an estimated 6 percent chance of an oil spill greater than or equal to 1,000 bbl occurring in the Western Gulf as a result of this proposed action and no spill greater than 1,000 bbl is assumed) will cause damage to benthic organisms if the oil contacts the organisms; such contact is likely only from spills from blowouts, which, because of the proposed Topographic Features Stipulation, will not occur very near to the biota of the banks.

Conclusion

The proposed action is expected to cause little to no damage to the physical integrity, species diversity, or biological productivity of the habitats of the topographic features of the Gulf of Mexico. Small areas of 5-10m^2 would be impacted, and recovery from this damage to pre-impact conditions is expected to take less than 2 years, probably on the order of 2-4 weeks.

Water Quality (Section IV.D.2.a.(3))

Coastal and Estuarine Waters

All existing onshore infrastructure and associated coastal activities occurring in support of proposed Sale 143 will contribute to the degradation of regional coastal and nearshore water quality to a minor extent because each provides a low measure of continuous contamination. No onshore OCS produced water discharges are assumed for the proposed sale. Wastes and contaminated equipment from offshore will be brought ashore for disposal and storage. Adverse impacts could occur to surface and groundwater in proximity to improperly designed and maintained disposal sites and facilities. OCS-related vessel traffic is likely to impact water quality through routine releases of bilge and ballast waters, chronic fuel and tank spills, trash, and low-level releases of the contaminants in antifouling paints. The improper storage and disposal of oilfield wastes and contaminated oilfield equipment would adversely impact surface and ground waters in proximity to disposal facilities, cleaning sites, and scrap yards.

Marine Waters

Based on projected sale-related support activities, offshore Subarea W-1 would receive the greatest portion of pipeline burial activities, whereas, offshore Subarea W-3 would receive the largest amounts of operational discharges. Immediate effects would be brought about by increased drilling, construction and pipelaying activities, causing an increase in water column turbidity (lasting for several hours with mud discharges and several weeks with dredging-pipelaying activities). Proposed produced water and drilling fluid discharges will encounter rapid dispersion in marine waters and be rapidly diluted within the immediate vicinity of the discharge source. Drilling fluid (mud) discharge plumes will be diluted to background levels within a period of hours and/or within several hundred meters of the discharge source. Significant increases in water concentrations of dissolved and particulate hydrocarbons and trace metals are not expected outside the initial mixing zone or immediate vicinity of the discharge source. Higher concentrations of trace metals, salinity, temperature, organic compounds, and radionuclides, and lower dissolved oxygen may be present near the discharge source.

Program-related spills will introduce oil into coastal and offshore waters and create elevated hydrocarbon levels (up to 100+ $\mu g/l$) within affected waters. Much of the oil will be dispersed throughout the water column over several days to weeks. Little effect to water use is anticipated from these spills and then only in an area near the source and slick.

Conclusion

An identifiable change to the ambient concentration of one or more water quality parameters will be evident up to several hundred to 1,000 m from the source for periods lasting up to several weeks in duration in marine and coastal waters. Chronic, low-level pollution related to the proposal will occur throughout the life of the proposed action.

Air Quality (Section IV.D.2.a.(4))

Emissions of pollutants into the atmosphere from the activities associated with the proposed action are likely to have a low impact on offshore air quality because of the prevailing atmospheric conditions, emission heights, and pollutant concentrations. Onshore impact on air quality from emissions from the OCS Activities are estimated to be low because of the atmospheric regime, the emission rates, and distance of these emissions from the coastline. Section IV.D.2.a.(4) is based on average conditions; however, there will be days of low mixing heights and wind speeds which could increase impact levels. These conditions are characterized by fog formation which in the Gulf occurs about 35 days a year mostly during winter. Impact from these conditions is reduced in winter because the onshore winds have the smallest frequency and rain removal is greatest.

Conclusion

Emissions of pollutants into the atmosphere from activities for the Proposed Action are expected to have concentrations that would not change onshore air quality classifications. Increase in onshore concentrations of air pollutants are estimated to be about 1 μgm^{-3} (box model steady concentrations). This concentration will have minimal impacts during winter because onshore winds occur only about 34 percent of the time and maximum impacts in summer when onshore winds occur 85 percent of the time.

Marine Mammals

Nonendangered and Nonthreatened Species (Section IV.D.2.a.(5)(a))

Activities resulting from the proposed action have a potential to cause detrimental effects on nonendangered marine mammals. These marine mammals could be impacted by operational discharges, helicopter and vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills, and oil-spill response activities. The effects of the majority of these activities are estimated to be sublethal. Potential lethal effects are estimated only from oil spills greater than or equal to 1,000 bbl. Sale-related oil spills of any size are estimated to seldom contact nonendangered and nonthreatened marine mammals.

Conclusion

The impact of the Base Case scenario on nonendangered and nonthreatened marine mammals within the potentially affected area is expected to result in sublethal effects that occur periodically and result in short-term physiological or behavioral changes, as well as some degree of avoidance of the impacted area(s).

Endangered and Threatened Species (Section IV.D.2.a.(5)(b))

Activities resulting from the proposed action have a potential to cause detrimental effects on endangered marine mammals. These marine mammals could be impacted by operational discharges, helicopter and vessel traffic, platform noise, explosive platform removals, seismic surveys, oil spills, and oil-spill response activities. The effects of the majority of these activities are estimated to be sublethal. Potential lethal effects are estimated only from oil spills greater than or equal to 1,000 bbl. Sale-related oil spills of any size are estimated to seldom contact endangered and threatened marine mammals.

Conclusion

The impact of the Base Case scenario on endangered and threatened marine mammals within the potentially affected area is expected to result in sublethal effects that occur periodically and result in short-term physiological or behavioral changes, as well as some degree of avoidance of the impacted areas.

Marine Turtles (Section IV.D.2.a.(6))

Activities resulting from the proposed action have a potential to cause detrimental effects on marine turtles. Marine turtles could be impacted by structure installation, pipeline placement, dredging, operational discharges, OCS-related trash and debris, vessel traffic, explosive platform removals, oil-spill response activities, and oil spills. The effects of the majority of these activities are estimated to be sublethal. Potential lethal effects are estimated only from oil spills greater than or equal to 1,000 bbl. Sale-related oil spills of any size are estimated to seldom contact marine turtles.

Conclusion

The impact of the Base Case scenario on marine turtles within the potentially affected area is expected to result in sublethal effects that are chronic and could result in persistent physiological or behavioral changes.

Coastal and Marine Birds

Nonendangered and Nonthreatened Species (Section IV.D.2.a.(7)(a))

Activities resulting from the proposed action have the potential to cause detrimental effects on coastal and marine birds. It is estimated that the effects from oil spills, OCS service vessel and helicopter traffic near coastal areas, pipeline landfalls and coastal construction, entanglement, and ingestion of trash and debris on coastal and marine birds are negligible and of nominal occurrence. As a result there will be no perceivable disturbance to Gulf coastal and marine birds.

Conclusion

The impact of the Base Case scenario on nonendangered and nonthreatened coastal and marine birds within the potentially affected area is expected to result in no discernible decline in a population or species and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to pre-disturbance condition in less than one generation.

Endangered and Threatened Species (Section IV.D.2.a.(7)(b))

Endangered and threatened birds can be impacted by oil spills, service-vessel and helicopter traffic, displacement from onshore pipeline landfalls, and entanglement and ingestion of offshore oil- and gas-related plastic debris. The impact of these activities are inconsequential because they are primarily nonlethal and/or the probability of an interaction is unlikely.

Conclusion

The impact of the Base Case scenario on endangered and threatened birds within the potentially affected area is expected to result in no discernible decline in a population or species and no change in distribution and/or abundance on a local or regional scale. Individuals experiencing sublethal effects will recover to pre-disturbance condition in less than one generation.

Commercial Fisheries (Section IV.D.2.a.(8))

Activities resulting from the proposed action have the potential to cause detrimental effects to commercial fisheries. It is estimated that the effects from emplacement of production platforms, underwater OCS obstructions, production platform removals, seismic surveys, oil spills, subsurface blowouts, and OCS discharge of drilling muds and produced waters on commercial fisheries are negligible and of nominal occurrence. As a result there will be no perceivable disturbance to Gulf commercial fisheries.

Conclusion

The impact of the Base Case scenario on commercial fisheries within the potentially affected area is expected to result in no discernible decrease in a population of commercial importance, their essential habitat, or in commercial fisheries on a local scale. Any affected population is expected to recover to pre-disturbance condition in less than one generation.

Recreational Resources and Activities

Beach Use (Section IV.D.2.a.(9)(a))

Marine debris lost from OCS operations associated with drilling 320 new wells and producing oil and gas from 10 new platform complexes throughout the WPA will occur from time to time and adversely affect the aesthetics of Texas recreational beaches.

Conclusion

The proposed action is expected to result in periodic loss of solid waste items likely to wash up on recreational beaches, which is expected to diminish enjoyment of some beach visits but which is unlikely to affect the number or type of visits currently occurring on Texas beaches.

Marine Fishing (Section IV.D.2.a.(9)(b))

Platforms installed within 30 mi of shore as a result of this proposed action are likely to attract fishermen and to improve fishing success for a period of about 20 years. No oil spills of 1,000 bbl or greater are assumed to occur, and the few spills greater than 1 and less than or equal to 50 bbl that are expected will have little or no impact of marine fishing.

Conclusion

One platform complex (2-3 structures) installed within 30 mi of shore as a result of this proposed sale is expected to attract fishermen and to improve fishing success in the immediate vicinity of the platform complex for a period of about 20 years.

Archaeological Resources

Historic (Section IV.D.2.a.(10)(a))

The greatest potential impact to an historic archaeological resource as a result of the proposed action would result from a contact between an OCS offshore activity (platform installation, drilling rig emplacement, dredging, or pipeline project) and an historic shipwreck. A recently completed, MMS-funded study (Garrison et al., 1989) has resulted in the refinement of the high probability areas for the location of historic period shipwrecks. A new NTL for archaeological resources in the Gulf of Mexico Region (NTL 91-02) has increased the survey linespacing density for historic shipwrecks from 150 m to 50 m.

Most other activities associated with the proposed action are expected to have very low impacts on historic archaeological resources. No new onshore infrastructure construction or pipeline landfalls are expected as a result of the proposed action. Historic cultural resources, therefore, will not be affected by these activities. The chance of contact from an oil spill associated with the proposed action is very low. Furthermore, the impact from an oil-spill contact on an historic coastal site, such as a fort or lighthouse, would be visual due to oil contamination. These impacts would be temporary and reversible. Impacts from dredging are expected to be minimal.

An OCS activity could contact a shipwreck because of incomplete knowledge on the location of shipwrecks in the Gulf. Although this occurrence is not probable, such an event would result in the disturbance or destruction of important historic archaeological information. Other factors associated with the proposed action are not expected to affect historic archaeological resources.

Conclusion

There is a very small possibility of an impact between OCS oil and gas activities and a historic shipwreck or site. Should such an impact occur, unique or significant historic archaeological information could be lost.

Prehistoric (Section IV.D.2.a.(10)(b))

Several impact-producing factors may threaten the prehistoric archaeological resources of the Western Gulf. An impact could result from a contact between an OCS activity (pipeline and platform installations, drilling rig emplacement and operation, dredging, and anchoring activities) and a prehistoric site located on the continental shelf. The archaeological surveys and archaeological clearance of sites that are required prior to an operator beginning oil and gas activities in a lease block are estimated to be 90 percent effective at identifying possible prehistoric sites. The survey and clearance provide a significant reduction in the potential for a damaging interaction between an impact-producing factor and a prehistoric site. There is a very small possibility of an OCS activity contacting a prehistoric site. Should such an impact occur, there could be damage to or loss of significant or unique archaeological information.

Onshore development as a result of the proposed action could result in the direct physical contact from new facility construction, pipeline trenching, and navigation canal dredging. None of these activities is expected to occur under the Base Case. The impact level from these factors is considered to be very low.

Should an oil spill contact a coastal prehistoric site, the potential for dating the site using radiocarbon methods could be destroyed. Oil-spill cleanup operations could physically impact coastal prehistoric sites. Previously unrecorded sites could also experience an impact from oil-spill cleanup operations on beaches. The probability of a large spill occurring and contacting a coastal prehistoric site within 10 days is very low (2%), and it is assumed that no contact will occur. A few spills greater than 1 and less than or equal to 50 bbl are assumed to contact the coast, but these small spills would probably not cover an exposed site, such as a shell midden, with enough oil to contaminate all the datable organic remains. The impact level from oil-spill contact is expected to be very low.

Conclusion

There is a very small possibility of an OCS activity contacting a prehistoric site. Should such an impact occur, there could be damage to or loss of significant or unique archaeological information.

Socioeconomic Conditions

Population, Labor, and Employment (Section IV.D.2.a.(11)(a))

Peak annual changes in the population, labor, and employment of all coastal subareas in the Central and Western Gulf resulting from the proposed action in the Western Gulf represent less than 1 percent of the levels expected in the absence of the proposed action. The coastal communities of the CPA are expected to support over 72 percent of the total employment generated by the Western Gulf sale. The WPA contributes the remaining 28 percent of total employment impacts. Employment resulting from oil-spill clean-up activities due to the proposed action is negligible. It is expected that employment demands in support of the proposed action will be met with the existing population and available labor force in the region.

Conclusion

The Base Case impact of the proposed action in the Western Gulf on the population, labor, and employment of the counties and parishes of the Central and Western Gulf socioeconomic impact area is expected to be less than 1 percent of the levels expected in the absence of the proposal.

Public Services and Infrastructure (Section IV.D.2.a.(11)(b))

Impacts to public services and infrastructure would be related to dramatic increases or decreases in population. Specific impact-producing factors examined in this analysis include fluctuations in work force, migration into or out of the coastal subareas, and the relatively high wages made by personnel involved in the oil and gas industry. An analysis of historical trends indicates that population impacts of greater than 1 percent involve positive net migration into a given area. Under the Base Case, population impacts are not expected to exceed the peak year impact of 0.17 percent. No positive net migration into the coastal subareas of the Central and Western Gulf of Mexico is expected to occur as a result of the proposed action. It is expected that employment will occur from those currently employed in the oil and gas industry, as well as unemployed, underemployed, and new employees already living in the area. In addition, jobs created by the proposal would likely reduce the amount of migration out of the coastal subareas when compared to scenarios without the proposal. It is expected that employees leaving public service and infrastructure related jobs could be replaced from the existing labor pool.

Conclusion

Population and employment impacts that result from the proposed action under the Base Case scenario will not result in disruptions to community infrastructure beyond what is anticipated by in-place planning and development agencies.

Social Patterns (Section IV.D.2.a.(11)(c))

Impacts to social patterns would be related to dramatic changes in population and the disruption of environmental resources, as well as conditions inherent to OCS-related employment (i.e., work scheduling and rate of pay). Specific impact-producing factors examined in this analysis include fluctuations in the workforce, migration into or out of the coastal subareas, work scheduling, displacement from traditional occupations, and relative income. An analysis of historical trends indicates that population impacts of greater than 1 percent typically involve positive net migration into a given area. Under the Base Case, population impacts are not expected to exceed the peak year impact of 0.17 percent. No positive net migration into coastal subareas of the Central and Western Gulf of Mexico is expected to occur as a result of the proposal. It is expected that employment will occur from those currently employed in the oil and gas industry, as well as unemployed, underemployed, and new employees already living in the area. It is expected that jobs created by the proposal would likely reduce the amount of out-migration when compared to scenarios without the proposal. It is expected that minor displacement from traditional occupations will occur as a result of the proposed action. This displacement will be mitigated, to some extent, by the extended work schedule associated with OCS-related employment. The extended work schedule is expected to have some deleterious effects on family life in pertinent, individual cases. Impacts caused by the displacement of traditional occupations and relative wages are expected to occur to a minimal extent.

Conclusion

No net migration is expected to occur as a result of the proposed action. Impacts on social patterns are expected to occur in some individual cases as a result of extended work schedules, displacement from traditional occupations, and relative wages.

c. Mitigating Measures

Measures have been developed to mitigate possible impacts of OCS activities on environmental resources and non-OCS activities. The four stipulations presented below have been applied to appropriate OCS leases for many years. These stipulations, while proven effective, are considered as potential mitigating measures in this EIS. The Secretary will make a decision prior to Sale 143 on whether or not to apply these measures to appropriate leases resulting from the sale. The analyses in this EIS of the impacts to the resources to which these stipulations apply assume that the measures will be in place. However, the analyses also contain a description of possible impacts without the protection afforded by the stipulations.

(1) Topographic Features Stipulation

The topographic features of the Western Gulf provide habitat for coral and coral community organisms (Section III.B.2.). As discussed in Section IV.D.2.a.(2)(b) of the Final EIS for Sales 131, 135, and 137 (USDOI, MMS, 1990a), these communities would be severely and adversely impacted (i.e., have an expected impact level of very high) by oil and gas activities resulting from the proposed action if such activities took place on or near these communities without the Topographic Features Stipulation and were not mitigated. The USDOI has recognized this problem for some years, and since 1974 stipulations have been made a part of leases on blocks on or near these biotic communities so that impacts from nearby oil and gas activities were mitigated to the greatest extent possible. This stipulation would not prevent the recovery of oil and gas resources, but it would serve to protect valuable and sensitive biological resources.

The Topographic Features Stipulation was formulated based on consultation with various Federal agencies and comments solicited from State, industry, environmental organizations, and academic representatives. The stipulation wording is based on the scientific information collected since the inception of the stipulation. This information includes various Bureau of Land Management/MMS-funded studies on the topographic highs in the Western Gulf, numerous stipulation-imposed, industry-funded monitoring reports, and the National Research Council (NRC) report entitled *Drilling Discharges in the Marine Environment* (1983).

The rationale for the requirements in the stipulation is based on the following facts:

(a) Shunting of the drilling effluent to the nepheloid layer confines the effluent to a level deeper than that of the living reef of a high-relief topographic feature. Shunting is therefore an effective measure for protecting the biota of high relief topographic features (Bright and Rezak, 1978; Rezak and Bright, 1981; NRC, 1983).

(b) Biological effects on the benthos from the deposition of nonshunted discharge are mostly limited to within 1,000 m of the discharge (NRC, 1983).

(c) The biota of topographic features can be categorized into depth-related zones defined by degree of reef-building activity (Rezak and Bright, 1981; Rezak et al., 1983 and 1985).

The stipulation establishes No Activity Zones at the topographic features. The zone is defined by the 85-m isobath because, generally, the biota shallower than 85 m are more typical of the Caribbean reef biota, while the biota deeper than 85 m are similar to soft-bottom organisms found throughout the Gulf. Where a bank is in water depths less than 85 m, the deepest closing isobath defines the No Activity Zone for that bank. Within the No Activity Zone, no operations, anchoring, or structures are allowed. Outside of the No Activity Zones, additional restrictive zones are established within which oil and gas operations could occur, but within which drilling discharges would be shunted.

The stipulation requires that all effluents within 1,000 m of the south Texas banks, which contain the antipatharian-transitional zone, be shunted to within 10 m of the seafloor. The shelf edge banks, which contain the more sensitive and productive algal-sponge zone, requires a shunt zone extending 1 nmi and a 3-nmi shunt zone for development only.

Exceptions to this general stipulation scheme are made at two classes of banks: the Flower Gardens and the low relief banks. The Flower Gardens, because they contain the northernmost example in the Gulf of living coral reefs and are being considered for National Marine Sanctuary status (Section I.B.4.h.), are protected to a greater degree than the other banks. The added provisions of the stipulation at the Flower Gardens require that: (a) the No Activity Zone be based on the 100-m isobath instead of the 85-m isobath and would be defined by the "1/4 1/4 1/4" system (a method of defining a specific portion of a block) rather than the actual isobath; and (b) there be a 4-Mile Zone instead of a 1-Mile Zone in which shunting is required. The second exception is for the low relief banks, where shunting is considered counterproductive because it would put the potentially toxic drilling muds in the same water zone as the bank biota that are being protected. Because of their low relief, these banks are adapted to high turbidity. Therefore, these banks contain only a No Activity Zone. Claypile Bank is a low relief bank that contains the *Millepora*-sponge community. Because of its higher priority it is given the added protection of a 1,000-Meter Zone in which monitoring is required. Since shunting would be counterproductive, monitoring was chosen as a means of assuring that effluent discharge within 1,000 m of this high priority, low relief bank would not affect the biota of Claypile Bank.

The banks causing this stipulation to be applied to blocks of the Western Gulf are as follows:

Shelf Edge Banks

Bank Name	Isobath (meters)
West Flower Garden Bank[1] (defined by 1/4 1/4 1/4 system)	100
East Flower Garden Bank[1] (defined by 1/4 1/4 1/4 system)	100
MacNeil Bank	82
29 Fathom Bank	64
Rankin Bank	85
Geyer Bank	
Elvers Bank	
Bright Bank[5]	85
McGrail Bank[5]	85
Rezak Bank[5]	85
Sidner Bank[5]	85
Parker Bank[5]	85
Stetson Bank	62
Applebaum Bank	85

Low Relief Banks[2]

Bank Name	Isobath (meters)
Mysterious Bank (see leasing map)	74, 76, 78, 80, 84
Blackfish Ridge	70
Big Dunn Bar	65
Small Dunn Bar	65
32 Fathom Bank	52
85 Coffee Lump 85 (see leasing map)	Various
Claypile Bank[3]	50

South Texas Banks[4]

Bank Name	Isobath (meters)
Dream Bank	78, 82
Southern Bank	80
Hospital Bank	70
North Hospital Bank	68
Aransas Bank	70
South Baker Bank	70
Baker Bank	70

[1]Flower Garden Banks - In paragraph (c), a 4-Mile Zone rather than a 1- Mile Zone applies.
[2]Low Relief Banks - Only paragraph (a) applies.
[3]Claypile Bank - Paragraphs (a) and (b) apply. In paragraph (b) monitoring of the effluent to determine the affect on the biota of Claypile Bank shall be required rather than shunting.
[4]South Texas Banks - Only paragraphs (a) and (b) apply.
[5]Central Gulf of Mexico banks with a portion of their 1-Mile Zone and/or 3-Mile Zone in the Western Gulf of Mexico.

The stipulation reads as follows:

Topographic Features Stipulation
(Western Planning Area)

(a) No activity including structures, drilling rigs, pipelines, or anchoring will be allowed within the listed isobath ("No Activity Zone") of the banks as listed above.

(b) Operations within the area shown as "1,000 Meter Zone" shall be restricted by shunting all drill cuttings and drilling fluids to the bottom through a downpipe that terminates an appropriate distance, but no more than ten meters, from the bottom.

(c) Operations within the area shown as "1 Mile Zone" shall be restricted by shunting all drill cuttings and drilling fluids to the bottom through a downpipe that terminates an appropriate distance, but no more than ten meters, from the bottom. (Where there is a "1 Mile Zone" designated, the 1,000 Meter Zone in paragraph (b) is not designated.)

(d) Operations within the area shown as "3 Mile Zone" shall be restricted by shunting all drill cuttings and drilling fluids from development operations to the bottom through a downpipe that terminates an appropriate distance, but no more than ten meters, from the bottom.

Effectiveness of the Lease Stipulation

The purpose of the stipulation is to protect the biota of the topographic features from adverse effects due to routine oil and gas activities. Such effects include physical damage from anchoring and rig emplacement and potential toxic and smothering effects from muds and cuttings discharges. The Topographic Features Stipulation has been used on leases since 1974 and this experience shows conclusively that the stipulation effectively prevents damage to the biota of these banks from routine oil and gas activities. Anchoring on the sensitive portions of the features by the oil and gas industry has been prevented. Monitoring studies conducted as required by the stipulation have demonstrated that the shunting requirements are effective in preventing the muds and cuttings from impacting the biota of the banks. The stipulation, if adopted for the proposed action, will continue to protect the biota of the banks, specifically as discussed below.

The analyses of the proposed actions in the Final EIS for Sales 131, 135, and 137 (USDOI, MMS, 1990a) were done without the stipulations in place. A thorough analysis of the impacts of oil and gas activities as they relate to topographic features is presented there. The following is a summary of that analysis, which is hereby incorporated by reference.

Several impact-producing factors may threaten the communities of the topographic features. Anchoring of vessels and structure emplacement result in physical disturbance of the benthic environment and are the most likely activities to cause permanent or long-lasting impacts to sensitive offshore habitats. Recovery from damage caused by such activities may take 10 or more years. Operational discharges (drilling muds and cuttings, produced waters) may impact the biota of the banks due to turbidity and sedimentation, resulting in death to benthic organisms in large areas. Recovery from such damage may take 10 or more years. Blowouts may similarly cause damage to benthic biota by resuspending sediments, causing turbidity and sedimentation, and resulting in death to benthic organisms. Recovery from such damage may take up to 10 years. Fortunately, blowouts seldom occur in the Gulf. Oil spills will cause damage to benthic organisms if the oil contacts the organisms; such contact is likely only from spills from blowouts. Structure removal using explosives (as is generally the case) results in water turbidity, sediment deposition, and potential explosive shock-wave impacts. Such effects include physical damage from anchoring and rig emplacement and potential toxic and smothering effects from muds and cuttings discharges. Severe damage to benthic organisms could result. Recovery from such damage could take more than 10 years. The above activities resulting from this proposal, especially bottom-disturbing activities, have a potential for causing very high impacts to the biota of the topographic features. While some of the activities are expected to result in lower impacts, those having the greatest impacts are also those most likely to occur. The proposed action, without benefit of the Topographic Features Stipulation or comparable mitigation, is expected to have a very high impact on the sensitive offshore habitats of the topographic features.

Mechanical damage resulting from oil and gas operations is probably the single most severe impact to benthic areas. The No Activity Zone designation would completely eliminate this threat from leasing activities. The sensitive biota within the zones provided for in the Topographic Features Stipulation will thus be protected.

The stipulation protects the low relief banks, except Claypile Bank, with only a No Activity Zone. The biota of these banks and the turbidity of the water are such that protective measures for the drilling discharges are not warranted. However, mechanical damage to the banks from drilling and anchoring could significantly impact these resources. The No Activity Zone protects the banks from these impacts. The stipulation provides an added measure of protection for Claypile Bank, a low relief bank. The stipulation requires a No Activity Zone and a 1,000-Meter Zone in which monitoring will be required. Claypile Bank is the only low-relief bank that is known to be inhabited by the *Millepora*-sponge community. This assemblage is categorized by Rezak and Bright (1981) as a Category B community, a zone of minor reef-building activity worthy of increased protection. Due to the low relief of the bank (only 5 m), shunting would be counterproductive. Therefore, a 1,000-Meter Zone in which monitoring is required will be imposed. Any impacts from drilling will thereby be documented so that further protective measures could be taken.

The categories of Rezak and Bright (1981) and their definitions are as follows:

Category A: zone of major reef-building activity; maximum environmental protection recommended;

Category B: zone of minor reef-building activity; environmental protection recommended;

Category C: zone of negligible reef-building activity, but crustose algae present; environmental protection recommended; and

Category D: zone of no reef-building or crustose algae; additional protection not necessary.

The stipulation requires that all effluents within 1,000 m of a high-relief topographic feature categorized by Rezak and Bright (1981) as a Category C bank be shunted. The banks will be protected from impact from drilling discharges within the 1,000-m zone because the potentially harmful materials in drilling muds are trapped in the bottom boundary layer and do not move upon the bank where the biota of concern are located. Surface drilling discharge at distances greater than 1,000 m from the bank is not expected to adversely impact the biota since effects are limited to 1,000 m.

The stipulation will protect the remaining Category A and B banks with greater restrictions. (Applebaum Bank is categorized as Category C; however, it contains the algal-sponge community, which is indicative of Category A banks, and is, therefore, stipulated as a Category A bank.) Surface discharge will not be allowed within 1 nmi of these more sensitive banks. Thus, the stipulation prevents impacts to the biota of these sensitive banks from drilling discharges within 1 nmi. Surface discharges outside of 1 nmi are not expected to adversely impact the biota of the banks, as adverse effects from surface discharges are limited to 1,000 m. However, it is possible that because multiple wells from a single platform (surface location) are typically drilled during development operations extremely small amounts of muds discharged more than 1 nmi from the bank may reach the bank. In order to eliminate the possible cumulative effect of muds discharged from numerous wells outside of 1 nmi, the stipulation imposes a 3-Mile Zone in which shunting of development effluent would be required. The stipulation will require increased protection to the Flower Gardens out to four miles. Shunting would be required within a 4-Mile Zone. This is a measure proven effective near topographic features.

The stipulation would prevent damage to the biota of the banks from routine oil and gas activities resulting from the proposal. Furthermore, oil and gas resources present near such areas could be recovered. However, the stipulation will not protect the banks from the adverse effects of an accident such as a large blowout on a nearby oil or gas operation.

(2) Archaeological Resource Stipulation

The Archaeological Resource Stipulation has been placed on leases issued in the Gulf of Mexico Region since 1974. The stipulation provides protection for prehistoric and historic archaeological resources by requiring remote sensing surveys in areas designated to have a high probability for archaeological resources and by requiring protection of archaeological resources discovered outside of the designated high probability zones. The stipulation is included in the analysis of this proposed action.

(a) "Archaeological resource" means any prehistoric or historic district, site, building, structure, or object (including shipwrecks); such term includes artifacts, records, and remains which are related to such a district, site, building, structure, or object (16 U.S.C. 470w(5)). "Operations" means any drilling, mining, or construction or placement of any structure for exploration, development, or production of the lease.

(b) If the Regional Director (RD) believes an archaeological resource may exist in the lease area, the RD will notify the lessee in writing. The lessee shall then comply with subparagraphs (1) through (3).

(1) Prior to commencing any operations, the lessee shall prepare a report, as specified by the RD, to determine the potential existence of any archaeological resource that may be affected by operations. The report, prepared by an archaeologist and geophysicist, shall be based on an assessment of data from remote- sensing surveys and of other pertinent archaeological and environmental information. The lessee shall submit this report to the RD for review.

(2) If the evidence suggests that an archaeological resource may be present, the lessee shall either:

(i) Locate the site of any operation so as not to adversely affect the area where the archaeological resource may be; or

(ii) Establish to the satisfaction of the RD that an archaeological resource does not exist or will not be adversely affected by operations. This shall be done by further archaeological investigation, conducted by an archaeologist and a geophysicist, using survey equipment and techniques deemed necessary by the RD. A report on the investigation shall be submitted to the RD for review.

(3) If the RD determines that an archaeological resource is likely to be present in the lease area and may be adversely affected by operations, he will notify the lessee immediately. The lessee shall take no action that may adversely affect the archaeological resource until the RD has told the lessee how to protect it.

(c) If the lessee discovers any archaeological resource while conducting operations on the lease area, the lessee shall report the discovery immediately to the RD. The lessee shall make every reasonable effort to preserve the archaeological resource until the RD has told the lessee how to protect it.

Effectiveness of the Lease Stipulation

Prehistoric archaeological resources would be slightly affected (i.e., have an expected impact level of very low) by oil and gas activities resulting from the proposed action if such activities took place within the zone of high probability for prehistoric resources. Historic archaeological resources would be adversely affected (i.e., have an expected impact level of moderate) by oil and gas industry activities resulting from the proposed action if such activities took place within the zone of high probability for historic resources. The DOI has recognized its legal responsibilities for protection of archaeological resources on the Gulf of Mexico OCS, and since 1974 stipulations have been made a part of leases on blocks within the Gulf of Mexico Region. The stipulation does not prevent the recovery of oil and gas resources, but it does provide a mechanism to protect our Nation's prehistoric and historic OCS archaeological resources.

The Archaeological Resource Stipulation should assure MMS compliance with Federal laws and regulations requiring protection of archaeological resources. The National Historic Preservation Act of 1966, as amended, requires each Federal agency to establish a program to locate, inventory, and nominate to the Secretary all properties under the agency's ownership or control that appear to qualify for inclusion on the National Register. Section 2(a) of Executive Order 11593 provides that Federal agencies shall locate, inventory, and nominate to the Secretary of the Interior all sites, buildings, districts, and objects under their jurisdiction or control that appear to qualify for listing on the National Register of Historic Places. Section 11(g)(3) of the OCSLA, as amended, states that "such exploration (oil and gas) will not . . . disturb any site, structure, or object of historical or archaeological significance." Because of these laws and regulations, the withdrawal of the

Archaeological Resource Stipulation would not relieve the MMS of its legal responsibility to protect OCS archaeological resources.

The analyses of the proposed actions in the Final EIS for Sales 131, 135, and 137 (USDOI, MMS, 1990a) were presented without the stipulations in place. A thorough analysis of the impacts of oil and gas activities as they relate to archaeological resources is presented there. The following is a summary of that analysis, which is incorporated by reference.

The purpose of the stipulation is to provide a mechanism to protect OCS archaeological resources from adverse effects due to oil and gas exploration and development. Several impact-producing factors may threaten prehistoric and/or historic archaeological resources. The placement of drilling rigs, production platforms, pipelines, and anchoring could destroy artifacts or disrupt the provenience and stratigraphic context of artifacts, sediments, and paleoindicators from which the scientific value of the archaeological resource is derived. Oil spills could destroy the ability to date prehistoric sites by radiocarbon dating techniques. Dredging new channels and maintaining current channels could impact a historic shipwreck. Ferromagnetic debris associated with OCS oil and gas activities would tend to mask magnetic signatures of significant historic archaeological resources.

The stipulation is the agency's effort to comply with existing Federal laws and regulations. It provides a mechanism for the protection of the Nation's OCS archaeological resources. Remote-sensing surveys mandated in the stipulation will serve to protect archaeological resources from oil and gas activities resulting from the proposed action. Without the stipulation in place, the agency would still be responsible for protecting the Nation's OCS archaeological resources. Remote-sensing surveys would still be required to ensure compliance with existing laws and regulations.

(3) Military Areas Stipulation

The proposed Military Areas Stipulation for the Western Gulf is identical to the proposed Military Areas Stipulation for the Central Gulf (Section II.A.1.c.(4)) and could apply to all blocks leased within a warning area. The stipulation has been applied to blocks in warning areas in past lease sales in the Western Gulf and may be included, at the Secretary's option, in all leases resulting from this proposed action. It is considered by DOI and DOD to be an effective method of mitigating potential multiple-use conflicts. The military stipulation would place requirements for liability, electromagnetic emissions, and operational controls on the lessees.

Effectiveness of the Lease Stipulation

The hold harmless section of the proposed Military Areas Stipulation serves to protect the U.S. Government from liability in the event of an accident involving the lessee and military activities. The actual operations of the military and the lessee and its agents would not be affected.

The electromagnetic emissions section of the stipulation requires the lessee and its agents to reduce and curtail the use of radio, CB, or other equipment emitting electromagnetic energy within some areas. This serves to reduce the impact of oil and gas activity on the communications of military missions and reduces the possible effects of electromagnetic energy transmissions on missile testing, tracking, and detonation.

The operational section requires notification to the military of oil and gas activity to take place within a military use area. This allows the base commander to plan military missions and maneuvers that may avoid the areas where oil and gas activities are taking place or to schedule around these activities. Prior notification helps reduce the potential impacts associated with vessels and helicopters traveling unannounced through areas where military activities are underway.

The proposed Military Areas Stipulation reduces potential impacts, particularly in regards to safety, but does not reduce or eliminate the actual physical presence of oil and gas operations in areas where military operations are conducted. The reduction in potential impacts resulting from this stipulation makes multiple-use conflicts most unlikely. Without the stipulation, some potential conflict is likely. The best indicator of the overall effectiveness of the stipulation may be that there has never been an accident involving a conflict between military operations and oil and gas activities.

(4) Notices to Lessees and Letters to Lessees

Notices to Lessees and Operators (NTL's) are formal documents that provide clarification, description, or interpretation of a regulation or OCS standard; provide guidelines on the implementation of a special lease stipulation or regional requirement; provide a better understanding of the scope and meaning of a regulation by explaining MMS interpretation of a requirement; or transmit administrative information such as current telephone listings and a change in MMS personnel or office address. A detailed listing of current and effective Gulf of Mexico NTL's was published in the *Federal Register* on May 16, 1991 (56 FR 22735-22737). The MMS publishes an updated NTL listing annually in the *Federal Register.*

The MMS also conveys important information by way of LTL's and ITL's. These documents further clarify or supplement operational guidelines. Separate Regional mailings and the EIS process have served as the vehicles for communicating previously issued NTL's, LTL's, and ITL's.

2. Alternative B - The Proposed Action Excluding the Blocks Near Biologically Sensitive Topographic Features

This alternative, offered for the Secretary's consideration, would protect valuable offshore biological resources. It affects the biologically sensitive banks (topographic features) of the Western Gulf.

All of the blocks included in the deletion alternative are also the blocks that are covered by the proposed Topographic Features Stipulation (discussed in Section II.B.1.c.(1)), which may be included as a part of the proposed action by the Secretary to protect the biological habitats of these areas. The Secretary could choose to adopt only a part of this alternative in order to promote the environmental protection policies of the Department.

a. Description

This alternative would offer for lease all the blocks offered by the proposed action, except for the 87 unleased blocks (Figures II-3 and II-4) of the total 200 blocks (these blocks are listed in Appendix A) affected by the proposed Topographic Features Stipulation. These blocks are on or near biologically sensitive areas of the topographic features of the WPA. These blocks represent about 1.8 percent of the 4,715 blocks to be offered in the Western Gulf. This alternative would also exclude the two biologically sensitive blocks (High Island Area, East Addition, South Extension Block A-375 at the East Flower Garden Bank and High Island Area, East Addition, South Extension Block A-398 at the West Flower Garden Bank). It is estimated that the proposal could result in the discovery and production of 0.05 BBO and 0.74 tcf of gas during the time period 1993-2027. For more information describing the proposed action and alternatives, see Section I.

The analyses of impacts summarized in this section and presented in detail in Section IV.D.2.b. are based on a development scenario (Base Case) formulated to provide a set of assumptions and estimates on the amounts, locations, and timing for OCS exploration, development, and production operations and facilities, both offshore and onshore. These are estimates only and not predictions of what will happen as a result of holding the proposed sale. A detailed discussion, with tables, of the development scenario and major related impact-producing factors is included in Section IV.A. The following are the major estimates of activities and associated impact-producing factors assumed for proposed Sale 143 (Base Case). These estimates and factors were utilized in the impact analyses:

(1) During the exploration phase, 1994-2004, there will be 210 wells drilled, resulting in the following:

- the generation of 1.50 MMbbl of drilling mud and 0.39 MMbbl of drill cutting wastes, about 18 percent of which will be disposed of onshore;
- offshore air emissions from well drilling operations of 204 tons of total suspended particulate matter, 59 tons of total hydrocarbons, 237 tons of sulphur oxides, 542 tons of carbon monoxide, and 2,031 tons of nitric oxides;

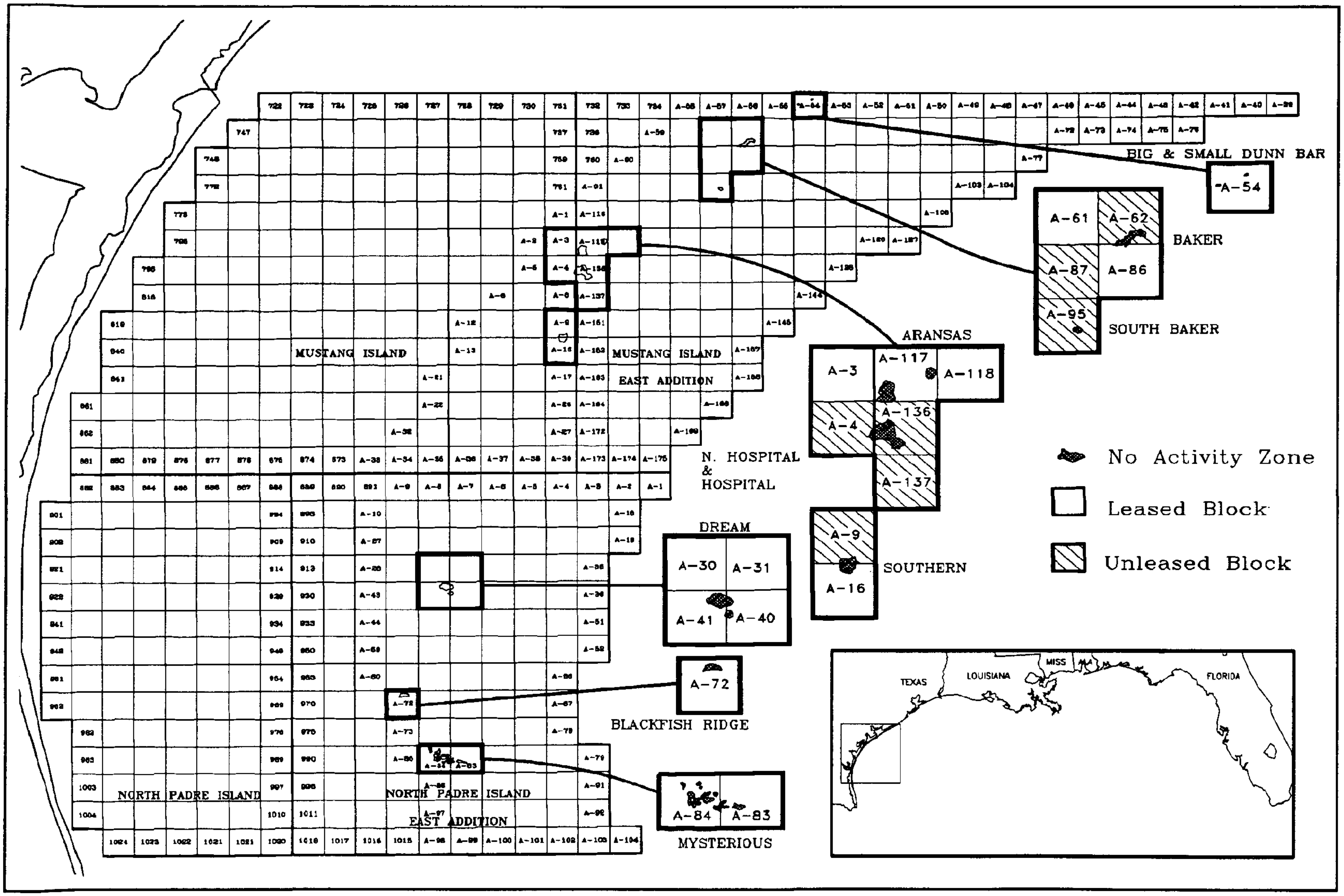


Figure II-3. Location and Lease Status of Blocks Affected by Alternative B (South Texas).

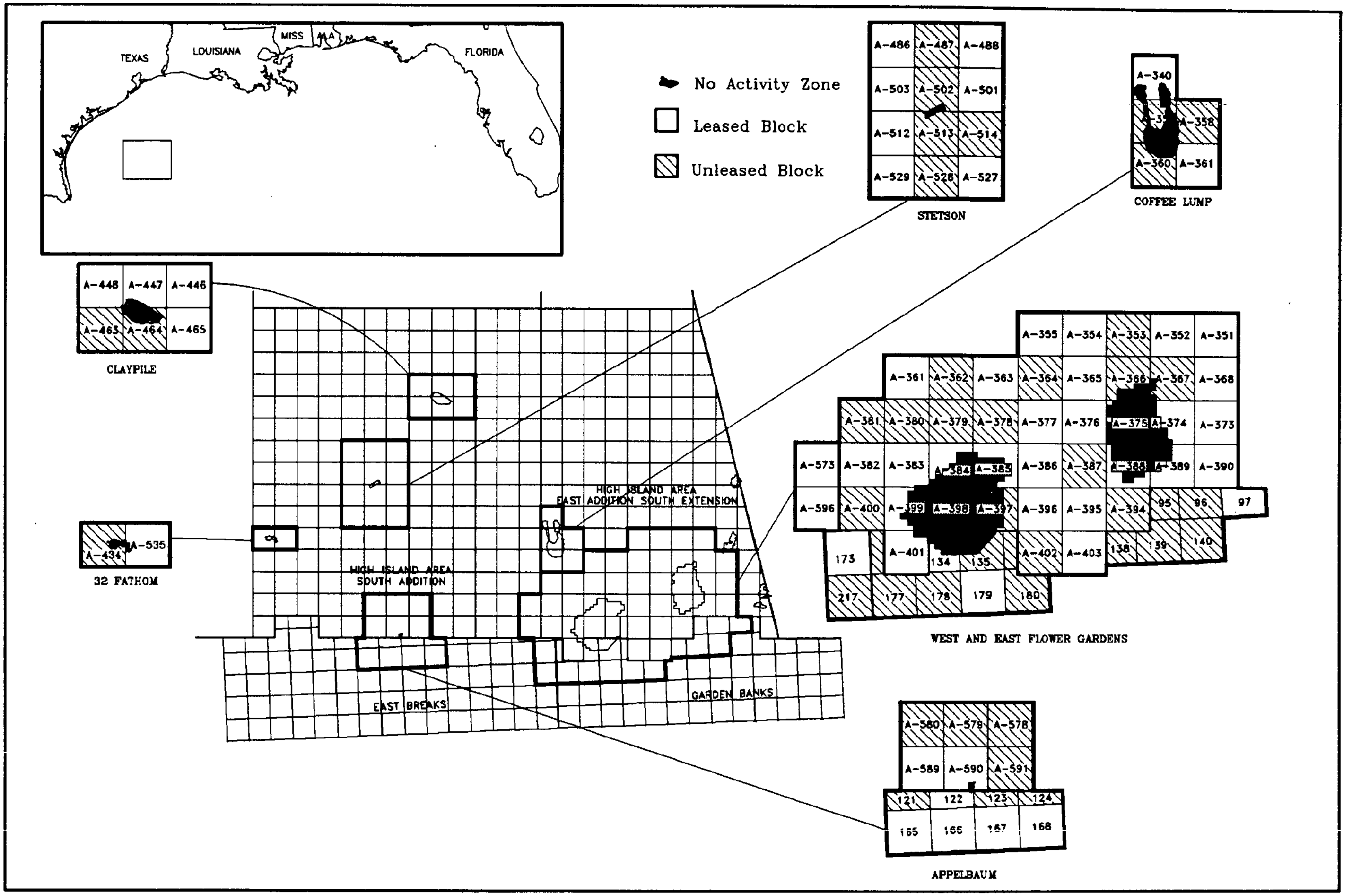


Figure II-4. Location and Lease Status of Blocks Affected by Alternative B (North Texas).

- 4,050 service vessel trips and 14,200 helicopter landings;
- disturbance from rig emplacements of 83 ha of ocean bottom; and
- the likelihood of 1 blowout (Section IV.A.2.d.(8)).

(2) During the development phase, 1995-2016, there will be 50 oil wells and 60 gas wells drilled, resulting in the following:

- the generation of 0.74 MMbbl of drilling mud and 0.157 MMbbl of drilling cutting wastes, a small amount of which will be disposed of onshore;
- offshore air emissions from well drilling operations of 94 tons of total suspended particulate matter, 27 tons of total hydrocarbons, 109 tons of sulphur oxides, 248 tons of carbon monoxide, and 9,31 tons of nitric oxides;
- 2,120 service vessel trips and 7,425 helicopter landings;
- the disturbance from fixed structure emplacements of 10 ha of ocean bottom; and

(3) During the production phase, 1995-2026, 0.05 BBO of oil and 0.74 tcf of gas will be produced from 8 platform complexes and two floating production systems, resulting in the following:

- the open-water discharge of 126 MMbbl of produced water;
- 24,000 bbl of produced sands disposed of onshore;
- offshore air emissions from platforms of 42 tons of total suspended particulate matter, 6,500 tons of total hydrocarbons, 30 tons of sulphur oxides, 2,234 tons of carbon monoxide, and 17,150 tons of nitric oxides;
- 2,086 service vessel trips and 109,000 helicopter landings;
- the removal of 15 ha of commercial fishing area (peak year estimate); and
- the likelihood of 1 blowout (Section IV.A.2.d.(8)).

(4) During platform removal operations, which will occur the year after production ceases, 3 platforms will be removed using explosives.

(5) The transportation of gas and oil will require the following:

- the construction of 80 km of gathering pipelines that will connect with existing trunklines prior to landfall, resulting in the disturbance of 26 ha of bottom and the displacement of 40,000 m^3 of sediment;
- 9 barge trips carrying oil to 3 existing shore terminals along the Texas and Louisiana coasts; and
- 66 shuttle tanker trips carrying oil to four Texas and two Louisiana terminals.

(6) Support activity will result in the following:

- No new major onshore support or processing facility construction is expected; existing OCS-related facilities will be used, with sale-related activities utilizing about 3 percent, on the average, of the capacities of the onshore infrastructure.

- the use of 15 navigation channels (less than 1 percent), that will be maintenance dredged periodically and one deepened to support vessel traffic;

- 26 million liters of bilge water discharged in coastal waters from service vessel traffic to 27 existing bases;

- 73,000 helicopter coastal crossings to reach 20 helicopter hubs; and

- air emissions from service vessels and helicopters of 211 tons of total suspended particulate matter, 154 tons of total hydrocarbons, 56 tons of sulphur oxides, 470 tons of carbon monoxide, and 2,857 tons of nitric oxides.

(7) Eight crude oil spills greater than 1 and less than or equal to 50 bbl are projected to occur, but none will reach land.

(8) Fewer than 10 crude oil spills greater than one and less than 50 bbl are assumed to occur from onshore support activities.

(9) Total employment from all activities associated with the exploration, development, and production of oil and gas generated as a result of Sale 143 is 24,000 personnel, 45 percent of which will be directly employed.

It should be noted that the assumptions and estimates for Alternative B are the same as in the Base Case of Alternative A. Alternative B is essentially Alternative A minus 73 widely scattered blocks (representing about 1.7 percent of the blocks to be offered under Alternative A). (As in Alternative A, the two deferred blocks at the Flower Gardens would also be deferred under this alternative.) Due to the scattered nature of the blocks that would not be offered by this alternative, resource estimates for Alternative B do not differ from those estimated for Alternative A. To the extent that adoption of Alternative B, by reducing the blocks available for leasing, reduces the activities resulting from the leasing, these assumptions and estimates will be similarly reduced. For instance, it may be reasonable to assume that one oil or gas field may be present in one or more of the blocks not offered under Alternative B. As discussed in Section IV.A., not conducting exploration or development activities on that field (because the blocks are not part of the sale area under this alternative) could possibly result in the following activities not happening (which might otherwise occur under Alternative A): 2-4 exploration wells with the disturbance of 1.5 ha of seafloor per well; 1 platform with the disturbance of 2 ha of seafloor (4 ha in water deeper than 1,500 feet); 12 development wells from that platform; 8 km of gathering pipeline for that platform; no anchoring, pipeline burial, or sediment disturbance will occur in the block; no use of service vessels or helicopters to and from that block will be required; no discharges of drilling muds (7,134 bbl per exploration well, 6,749 bbl per development well), drill cuttings (1,853 bbl per exploration well, 1,430 bbl per development well); no discharge of produced waters (450 bbl per oil well per day, 68 bbl per gas well per day); no air emissions; and no chance for oil and gas industry-related accidents.

The primary difference between Alternative A (with consideration of the Topographic Features Stipulation for this analysis) and Alternative B (which excludes the blocks affected by the proposed stipulation) is that under Alternative B oil and gas activities would be completely excluded from taking place within the blocks which, under Alternative A, activities could take place (although with certain restrictions in certain portions of the blocks). Figure III-5 shows a topographic feature with its attendant No Activity Zone, 1 Mile Zone, and 3 Mile Zone. Under Alternative A, all those blocks containing any of those zones could be leased, although no oil and gas activities would be permitted in the No Activity Zone and activities would be restricted in the 1 and 3 Mile Zones. Under Alternative B, none of those blocks containing any of those zones would be leased, thus precluding any oil and gas activities anywhere in those blocks.

b. Summary of Impacts

The following summarizes the detailed impact analyses of Section IV.D.2.b. It should be emphasized that these are impact summaries and that the reader should refer to Section IV.D.2.b. for detailed information regarding particular resources. Table S-4 compares the impacts of Alternatives A-D and the cumulative impacts on each resource category estimated as a result of the various scenarios.

To facilitate the analyses, the Federal offshore area is divided into subareas. The WPA is comprised of three subareas (W-1, W-2, and W-3) and the coastal region is divided into two coastal subareas (W-1 and W-2). These subareas are delineated on Figure IV-1.

This alternative is offered for the Secretary's consideration to protect valuable offshore biological resources. It affects the biologically sensitive banks (topographic features) of the Western Gulf.

Given the size of the area available for lease under Alternative A, it is reasonable to assume that the removal of 1.8 percent of the area probably will not significantly change the projected level of activity (i.e., numbers of wells, platforms, vessel trips, etc. (Table IV-2)) projected under that alternative. The only differences are that under Alternative B no activity will take place in the deletion areas. The assumption that the levels of activity for Alternative B are virtually identical to those projected for Alternative A indicates that the impacts expected to result will be very similar to those described under Alternative A (Section IV.D.2.a.). The areas that would not be offered under Alternative B make up only a small portion of the WPA, and with the exception of topographic features, only contain comparatively small amounts, if any, of the resources analyzed in this document. Therefore, the regional impacts for all resources are estimated to be identical to those described under Alternative A. However, there are some localized changes in the impacts as described below.

Coastal Resources

Coastal resources include beaches, seagrass beds, salt and fresh marshes, and estuaries. The beaches serve as important recreational sites in addition to storm protection and erosion control areas. The marshes and estuaries support numerous commercially and recreationally important fish and wildlife species. The primary impact-producing factors of concern for these environmental resources are contact by oil spills and disturbance from the emplacement of pipelines or the dredging of channels.

The areas that would be deleted from the proposed sale with the selection of Alternative B are scattered across the shelf far from the coastline. A small percentage of the area available for deletion is located, at its closest point, about 56 km (35 mi) offshore. The majority of the acreage that may be deleted is over 160 km (100 mi) offshore. Considering the assumption that the estimated level of activity will not change from that projected for Alternative A and the substantial distances from the deletion areas to coastal resources, it is extremely unlikely that selection of Alternative B would have any influence on the impacts estimated for Alternative A.

Conclusion

The impacts on the following coastal resources are estimated to be the same as those estimated under Alternative A: coastal barriers; wetlands; coastal and nearshore water quality; air quality; coastal and marine birds (nonendangered and nonthreatened and endangered and threatened); recreational beach use; and population, labor, and employment.

Offshore Resources

Deletion of this area would preclude drilling operations and associated activities from occurring within the 87 affected blocks. It would further eliminate the threat of damage from drilling discharges, anchoring, or platform/pipeline emplacement and removal related to the exploration and development of this area. The following analyses deal specifically with the sensitive resources that may exist in the deletion area and for which there might be a change in impacts with the selection of Alternative B. Deep-water benthic communities are not located in or near the area, and only 12 blocks containing potential archaeological resources would not be offered under this alternative that would be offered under Alternative A, so there would be no change in the impact level projected under Alternative A. Impact to commercial fisheries and recreational marine fishing would also remain as under Alternative A.

Topographic Features

Essentially, oil and gas operations within certain distances of topographic features are considered potential sources of impact to the biota of those features: blocks that fall within 4 nmi of the 100-m isobath of the East and West Flower Garden Banks; within 3 nmi of the 85-m isobath of the seven high-relief, shelf edge banks of the Western Gulf (and 5 banks of the Central Gulf that are within 3 nmi of the Western Gulf); within 1,000 m of seven low-relief South Texas banks; and within designated areas of seven other low-relief banks. The biological resources of the topographic features are considered very sensitive to potential impacts due to oil and gas operations; however, topographic features in the Western Gulf are usually the surface expressions of salt domes, which are often associated with oil and gas reserves. The recovery of such reserves, the extent of which is unknown at this time, would be prevented by the adoption of this alternative. It is noted that 113 of the 200 blocks affected are already leased. This deletion alternative is presented in order to fully protect the biological resources inhabiting the crests of the topographic features.

This alternative, if adopted, would prevent any oil and gas activity whatsoever in the affected blocks (except for pipeline construction, which would be regulated through the normal pipeline permitting procedures); thus, it would eliminate any impacts to the biota of the area from oil and gas activities, which otherwise would be conducted within the blocks. However, because of the operation of the proposed Topographic Features Stipulation, which is a part of Alternative A (Section II.B.1.c.(1)), the impact levels to the topographic features will be essentially the same for both Alternative A and Alternative B.

Conclusion

Selection of Alternative B would preclude oil and gas operations in the unleased blocks (87 of 200) affected by the proposed Topographic Features Stipulation. The activities assumed for Alternative B are expected to cause little to no damage to the physical integrity, species diversity, or biological productivity of the habitat of the topographic features of the Gulf of Mexico. Small areas of 5-10 m^2 would be impacted, and recovery from this damage to pre-impact conditions is expected to take less than 2 years, probably on the order of 2-4 weeks.

Marine Water Quality

The impact-producing factors leading to water quality degradation resulting from offshore OCS oil and gas operations include the resuspension of bottom sediments through exploration and development activities, pipeline construction, and platform removal operations; the discharge of deck drainage, sanitary and domestic wastes, formation waters (produced waters), and drilling fluids (muds and cuttings); and accidental hydrocarbon discharges due to spills, blowouts, or pipeline leaks. Routine operational discharges may degrade water quality with high impacts occurring within a few meters to tens of meters from the source. These impacts decrease to very low with distance (500-1,000 m) from the source. Accidental oil spills may degrade water quality somewhat, changing the measurements from background levels only in a very limited area close to the source. Adoption of this alternative would preclude impacts associated with routine exploration and production activities in the area not offered. It would not eliminate the threat of degradation from those OCS activities occurring outside the area not offered. However, because the area not offered is a small portion of the entire area offered for leasing under either Alternative A or Alternative B, the regional impact will be reduced by only that small amount, assuming that oil and gas activities would be reduced proportionally.

Conclusion

Selection of Alternative B would eliminate potential impacts on very localized areas contained in the deletion area, but this would not be significant enough to change the regional impact level on marine water quality as projected under Alternative A.

Cetaceans and Marine Turtles

As benthic feeders, adult loggerhead, green, hawksbill, and Kemp's ridley sea turtles are unlikely to occur in the proposed deletion area because the topographic features in the CPA and WPA are at depths in excess of 300 m, which is the lower limit of the feeding habitat for these species. However, the pelagic stages of all sea turtles could occur in the vicinity of any of these areas. Sperm whales have been sighted near topographic features in the CPA and several of the more common small marine mammals--*Stenella, Kogia*, and *Grampus*--could be expected in the vicinity of topographic features because of the presence of prey species. Sea turtles and marine mammals could be impacted by oil and gas activities in this area by contact with or ingestion of oil, collision with vessels, entanglement in or ingestion of debris generated from platforms, or physical/acoustic disturbances (drilling and structure placement and removal). Not offering this area would eliminate all impacts to sea turtles and marine mammals that would otherwise occur from proposed action-related oil and gas operations within the blocks not offered. If the area is not offered, impacts to marine mammals and sea turtles will not change from those of the proposed action because of the comparatively low level of oil and gas activity proposed in the area.

Conclusion

Selection of Alternative B would eliminate potential impacts on endangered species and marine mammals in or near the area that would not be offered under this alternative. This slightly smaller number of blocks to be offered would not be significant enough to change the regional impact level on these resources as projected under Alternative A. These impacts are as follows: marine mammals - sublethal effects that occur periodically and result in short-term physiological or behavioral changes, as well as some degree of avoidance of the impacted area(s); marine turtles - sublethal effects that are chronic and could result in persistent physiological or behavioral changes.

3. Alternative C - The Proposed Action Excluding the Western Naval Operations Area

a. Description

The proposed alternative would delete 340 lease blocks (approximately 1.7 million acres) in the Western Naval Operations Area located east of Corpus Christi, Texas (Figure I-1). In late 1990, MMS and the Department of Defense (DOD) agreed to the deferral of this area from Western Gulf lease Sale 135 (held in

August 1991) and proposed Western Gulf lease Sale 141 (scheduled for August 1992). It was also agreed that the deferral would be subject to a two-year review period, after which a decision would be made to either continue the deferral for another two years or move the area to another acceptable location. Consultation has begun between DOD and MMS, and negotiations are continuing regarding this deferral area. Since negotiations regarding this matter are still ongoing, the deletion of this 340-block area is included in this EIS as a separate alternative.

b. Summary of Impacts

The following summarizes the detailed impact analyses of Section IV.D.2.c. It should be emphasized that these are impact summaries and that the reader should refer to Section IV.D.2.c. for detailed information regarding particular resources. Table S-4 provides a comparison of impacts related to Alternatives A-D and the cumulative impacts on each resource category estimated as a result of the various scenarios.

Given the size of the area available for lease under the proposed alternative and the distribution of the resources contained within, it is reasonable to assume that removal of this area will not significantly change the projected level of activity (i.e., numbers of wells, platforms, vessel trips, etc. (Table IV-2)) projected under Alternative A. Alternative C will preclude all leasing and sale-related activity from occurring in the area deleted. It will not preclude the threat from activities associated with oil and gas resource development outside this area. Shuttle tankering and pipeline construction may still occur in the area from such activities. The assumption that the levels of activity for Alternative C are virtually identical to those projected for Alternative A indicates that the impacts expected to result will be very similar to those described under Alternative A (Section IV.D.2.a.). The regional impacts for all resources are estimated to be identical to those described under Alternative A, with only some localized changes in the impacts as described below.

Coastal Resources

The majority of the acreage proposed for deletion is from 80-160 km (50-100 mi) offshore. Considering the estimated level of activity will not change from that projected for Alternative A and the distances from the deletion area to coastal resources, it is unlikely that selection of Alternative C would have any influence on the impacts to coastal resources expected for Alternative A.

Conclusion

The impacts on the following coastal resources are expected to be the same as those expected under Alternative A: coastal barriers; wetlands; coastal and nearshore water quality; air quality; coastal and marine birds (nonendangered and nonthreatened and endangered and threatened); recreational beach use; and population, labor, and employment.

Offshore Resources

Deletion of this area would preclude drilling operations and associated activities from occurring within some 340 affected blocks. It would further eliminate the threat of damage from drilling discharges, anchoring, or platform/pipeline emplacement and removal related to the exploration and development of this area. The following analyses deal specifically with the sensitive resources that may exist in the deletion area and for which there might be a change in impacts with the selection of Alternative C. No topographic features are located in or near the area, and only 12 blocks containing potential historic archaeological resources would not be offered under this alternative that would be offered under Alternative A; therefore, there would be no change in the impact level projected under Alternative A. Impact to commercial fisheries and recreational marine fishing would also remain as under Alternative A.

Deep-water Benthic Communities

As noted in Section IV.D.2.a.(2)(a), the only impact-producing factor threatening these communities results from those activities that would physically disturb the bottom, such as the routine operations of anchoring, drilling, and pipeline installation, and the rare seafloor blowout accident.

The proposed alternative differs from Alternative A by offering all of the blocks of Alternative A except for approximately 340 blocks that comprise the Western Naval Operations Area (Figure I-1). Of these blocks, all or part of 197 blocks are in water depths below 400 m, with 6 of these under active lease. Thus, if Alternative C is adopted, those blocks would not be subject to the potential impacts described for Alternative A (Section IV.D.2.a.(2)(a)). Not leasing these 191 unleased blocks (6% of the 3,104 unleased blocks in water depths below 400 m in the WPA) will not alter the conclusions reached in the analysis for Alternative A.

The majority of these deep-water communities are of low density and are widespread throughout the deep-water areas of the Gulf, and disturbance to a small area would not result in a major impact to the ecosystem. For purposes of this analysis, the frequency of such impact is expected to be once every six months to two years, and the severity of such an impact is judged to result in few losses of ecological elements with no alteration of general relationships.

Such communities are largely protected by the provisions of NTL 88-11. For purposes of this analysis, the frequency of some small percentage of impact is expected to be once every six months to two years, but the severity of such an impact is such that there may be some loss of ecological elements and/or some alteration of general relationships.

Conclusion

Alternative C is expected to cause little damage to the physical integrity, species diversity, or biological productivity of either the widespread, low-density chemosynthetic communities or the rare, widely scattered high-density Bush Hill-type chemosynthetic communities. Recovery from any damage is expected to take less than two years.

Marine Water Quality

The impact-producing factors leading to water quality degradation resulting from offshore OCS oil and gas operations include the resuspension of bottom sediments through exploration and development activities, pipeline construction, and platform removal operations; the discharge of deck drainage, sanitary and domestic wastes, formation waters (produced waters), and drilling fluids (muds and cuttings); and accidental hydrocarbon discharges due to spills, blowouts, or pipeline leaks. Routine operational discharges may degrade water quality with high impacts occurring within a few meters to tens of meters from the source. These impacts decrease to very low with distance (500-1,000 m) from the source. Accidental oil spills may degrade water quality somewhat, changing the measurements from background levels only in a very limited area close to the source. Adoption of this alternative would preclude impacts associated with routine exploration and production activities in the area not offered. It would not eliminate the threat of degradation from those OCS activities occurring outside the area not offered. However, because the area not offered is a small portion of the entire area offered for leasing under either Alternative A or Alternative C, the regional impact level will be reduced by only that small amount, assuming that oil and gas activities would be reduced proportionally.

Conclusion

Selection of Alternative C would eliminate potential impacts on very localized areas contained in the deletion area, but this would not be significant enough to change the regional impacts on marine water quality expected under Alternative A.

Cetaceans and Marine Turtles

Sea turtles and marine mammals could be impacted by oil and gas activities in this area by contact with or ingestion of oil, collision with vessels, entanglement in or ingestion of debris generated from platforms, or physical/acoustic disturbances (drilling and structure placement and removal). Not offering this area would eliminate all impacts to sea turtles and marine mammals that would otherwise occur from proposed action-related oil and gas operations within the blocks not offered. If the area is not offered, impacts to marine mammals and sea turtles will not change from those of the proposed action because of the comparatively low level of oil and gas activity proposed in the area.

Conclusion

Selection of Alternative C would eliminate potential impacts on endangered species and marine mammals in or near the area that would not be offered under this alternative. This smaller number of blocks to be offered would not be significant enough to change the regional impacts on these resources expected under Alternative A. These impacts are as follows: marine mammals--sublethal effects that occur periodically and result in short-term physiological or behavioral changes, as well as some degree of avoidance of the impacted area(s); and marine turtles--sublethal effects that are chronic and could result in persistent physiological or behavioral changes.

4. Alternative D - No Action

a. Description

The alternative is equivalent to cancellation of a sale scheduled on an annual basis. By canceling the proposed sale, the opportunity is postponed or foregone for development of the estimated 0.05 BBO and 0.74 tcf of gas that could have resulted from proposed Sale 143 in the Western Gulf.

b. Summary of Impacts

If Alternative D is selected, all impacts, positive and negative, associated with the proposed action would be canceled. This alternative would therefore result in no effect on the sensitive resources and activities discussed in Section IV.D.2.a. The incremental contribution of the proposed action to cumulative effects would also be foregone, but such effects from other activities, including other OCS sales, would remain. One contribution to cumulative effects that could increase is oil spill risk due to the importation of foreign oil to replace the resources lost through cancellation of the proposed action.

Alternative energy strategies that could provide replacement resources for lost domestic OCS oil and gas production include energy conservation; conventional oil and gas supplies; coal; nuclear power; oil shale; tar sands; hydroelectric power; solar and geothermal energy; and imports of oil, natural gas, and LNG. These are discussed in some detail in Appendix D. The energy equivalents that may be required from several alternative energy sources, should this lease sale be permanently canceled, are shown on Table D-8 and are based on the resources estimated by MMS to be produced as a result of the proposed action. For the purpose of clarity, this table has separately identified each potential alternative source of energy regarding substitution requirements. It is unlikely, however, that there would be a single choice between these alternatives sources, but instead, some combined effort to explore and develop further many or all of these forms as a substitute for OCS oil and gas production.

5. Comparison of Alternatives

Table S-4 provides a comparison and summary of the impacts of the proposed action (Alternative A), the proposed action excluding the blocks near biologically sensitive topographic features (Alternative B), the proposed action excluding the western naval operations area (Alternative C), no action (Alternative D), and the cumulative analyses for Sale 143.

SECTION III

DESCRIPTION OF THE AFFECTED ENVIRONMENT

III

III. DESCRIPTION OF THE AFFECTED ENVIRONMENT

A. PHYSICAL ELEMENTS OF THE ENVIRONMENT

1. Geology

General Description

Geology of the Central and Western Gulf of Mexico is shown on Visual No. 6, and the general sediment distribution is shown on Visual No. 5. Shedding of sediments from the Laramide Orogeny and the North American Craton resulted in deposition of a thick, terrigenous, clastic sequence in the Gulf Coast basin. If rate of deposition exceeds rate of subsidence, deltas prograde out over the continental shelf; and the sediments are redistributed over the shelf through wave action and currents. If sedimentation is less than subsidence, then a transgression results and the deltas are modified by marine processes (Shinn, 1971).

Since late Cretaceous and early Tertiary, depocenters shifted progressively southward and eastward along the Gulf Coast (Winker, 1982). The locus of deposition shifted laterally in response to changes in source of sediment supply. Lower Tertiary deposits are thickest in the Rio Grande embayment. By late Miocene, depocenters had shifted farther south and east, forming the "Terrebonne Trough" in southern Louisiana.

Regional dip of sediments of the Gulf of Mexico is interrupted by salt diapirs, growth faults, and shale diapirs. Regional systems of growth faults penetrate into the Cenozoic units beneath coastal Texas and Louisiana and the adjacent shelf. Growth faults, formed contemporaneously with sedimentation, resulted in throws increasing with depth and strata on the downthrown side thicker than on the upthrown side. The faults resulted from simultaneous failure of the slope from deltas that had prograded to the edge of the continental margin (Martin et al., 1984).

The prospective horizons of the northwestern continental shelf are of Miocene, Pliocene, or Pleistocene age. The environment of deposition of the continental shelf and slope in the northern Gulf of Mexico is one of the most significant factors controlling hydrocarbon production. Sediments deposited on the outer shelf and upper slope have the greatest potential for accumulating hydrocarbons. This environment is the optimum zone for encountering the three ingredients necessary for the successful formation and accumulation of oil and gas: reservoir rock, source beds, and traps. Sediments deposited on the outer shelf and upper slope have the greatest potential for bearing hydrocarbons due to the following three reasons: (a) this is the location where nearshore sands interfinger with the deeper water marine shales, providing an optimum ratio of sandstone to shale--the shale may be the source rock that provides the oil and gas while the sandstone provides the reservoir into which the hydrocarbons migrate and are trapped; (b) in this environment, the organic material deposited with the fine-grained clays and muds is preserved and not oxidized as it might be in more shallow, turbulent water; and (c) it is this location where the increased overburden of prograding shallow marine deposits over plastic salt and marine shales initiates the flow of salt that triggers the growth of salt domes and regional expansion faults, that provide traps for the hydrocarbons.

The most prolific offshore production to date in the Gulf has come from the Miocene of the eastern Louisiana OCS. This area has more oil than the remainder of the Texas-Louisiana area. The next most productive trend is the Pliocene trend of the central Louisiana OCS, which produces about 50 percent oil and 50 percent gas. Farther to the west, this producing trend dies out. The Miocene of western Louisiana is the third most productive trend, producing primarily gas, and the Pleistocene of offshore western Louisiana ranks fourth.

Recently, a number of oil and gas discoveries have been made along the shelf and upper slope offshore of Louisiana and Texas in Pleistocene sediments known as the Flexure Trend. On the upper slope, interdomal areas between salt structures contain a thickness as great as 3,500 m of sediment, much of which appears to be muddy slump deposits with infrequent turbidite sand zones. Some of the new discoveries indicate that turbidite sands of reservoir quality are present on the upper slope, especially in Pleistocene deposits. These turbidite sands would have been derived from inner-shelf areas and deposited during glacial epochs when sea level was lower and the shoreline was close to the present shelf edge.

An MMS-funded study (Berryhill, 1987) has investigated the spatial and vertical dimensions of Late Quaternary facies that occur on the continental shelf and upper slope of the northern Gulf of Mexico. This effort was the first comprehensive study of a continental shelf that relied on high-resolution seismic data as the primary data source. The results of the study were based on analyses of 145,000 km of subbottom profiler and 72,000 km of minisparker data. The study presents late Quaternary seismic-reflection models that can be used as exploration tools and demonstrates the interactions and processes that are involved among sediment deposition, diapirism, and sea-level fluctuations in the building of the continental shelf.

Geologic Hazards

Major hazards to oil and gas development are associated with geologic features on the Gulf of Mexico seafloor that result in its instability. These hazards present many operational limitations to the exploration and development of oil and gas. Seafloor instabilities necessitate adaptations in the siting and structural engineering of pipelines, drilling rigs, and production platforms.

Various conditions can result in sediment mass wasting. The basic criterion, known as the "angle of slide," is a combination of slope and the consolidation of sediments. Sediments at angles less than 0.5° have been known to fail in the Gulf of Mexico because of their underconsolidation. Seismic activity, overloading, cyclic loading, and migrating shallow gas can drastically reduce the necessary angle of slide for given sediments and can even cause liquefaction in horizontal sediments. Currents in submarine canyons can undercut canyon walls, and uplift, associated with diapirs, can oversteepen the slope allowing sediments to slump, slide, or generate turbidity currents.

Fine-grained sediments that retain pore fluids produce sediment instability that results in slumping and mudflows. Rapid deposition of these sediments prograding out of the Mississippi River is the primary cause of abnormally high pressures in the Gulf Coast. Pore fluids trapped in sediment help framework grains support the overburden, thereby restricting compaction. Normally pressured sediments compact with the extrusion of saline pore fluids from the shales.

Sediments of fine-grained sands and clays, retaining high amounts of water and organic matter, contain large quantities of interstitial gas that often degrade the seismic signal. Shallow gas may weaken shallow geologic formations, providing avenues of escape for high pressure fluids and gas from deeper formations. Dissolved or undissolved gas either dispersed or in pockets can also be a serious problem to platforms, supports, pipelines, and subsea installations. Gas-charged sediments can contribute to low shear strength or promote liquefaction. Storm surges or seismic shaking, coupled with an upward release of gas, could trigger slides and subsidence. Their identification is important to any drilling program because of the danger of ignition or blowout.

A delta front slope prograding from the mouths of distributaries can also produce geologic hazards. Oversteepening of the upper delta front slope occurs as the delta front migrates out to the continental slope. Strong storms and hurricanes generate much sediment movement at depth causing sediment instability. Additionally, hurricanes can generate mudslides along the delta front. After destructive Hurricane Camille in 1969, USGS published a map showing bottom sediment stability along the periphery of the Mississippi delta.

Furthermore, mudslides produce geologic hazards that can be a serious problem to pipelines. One method to combat mudslides is to allow pipelines to be laid in the direction of the flow of mud (USDOI, BLM, 1982). Additionally, pipelines are laid on top of mudflows rather than allowed to sink into the sediments. Engineering technology and improved soil borings by the oil industry have made drilling safer in mudslide environments and other domains susceptible to geologic hazards.

Deepwater Geologic Hazards

A small investment to evaluate possible geologic hazards on the continental shelf/slope and more distal regions is essential before funding expensive deep-water operations. The shedding of sediments from the Appalachians and the North American craton resulted in deposition of a thick terrigenous clastic sequence in the Gulf Coast basin. These sediments were deposited over the Louann salt with lower density salt having flowed both basinward and upward through the overlying sediments. These events have resulted in a myriad of geologic hazards.

Active faults on the continental slope are a result of the upward movement of salt through overlying sediments. The rate and timing of movement of the faults is difficult to ascertain (Roberts, 1991). Another geologic hazard identified with salt diapirs is slumping that is associated with the steep flanks of these geologic features. Other geologic hazards to avoid on the shelf/slope are carbonate mounds. Carbonate mounds are situated on the crests of salt diapirs. These mounds were near sea level during the last major low stand and these features are interpreted as "seismic wipeout" zones on subbottom profiles (Roberts et al., 1988). Both rapid changes in topography and isolated carbonate mounds with steep flanks also present problems when laying pipelines or installing a platform. Biogenic and thermogenic gas are also construed as "seismic wipeout" features. Bacteria produce biogenic gas from organic matter whereas thermogenic gas is generated deep in the subsurface under high temperatures and pressures. Thermogenic gas migrates updip towards the surface along fault planes.

To avoid these geologic hazards, industry invests in ROV's, conventional cores, subbottom profiles, and side-scan sonar. The geophysical and geological data acquired is invaluable and necessary to properly evaluate the deeper regions of the Gulf of Mexico.

Non-Oil and Non-Gas Mineral Resources

Several minerals in the Central Gulf of Mexico have the potential to become commercially exploitable. The State of Louisiana is mapping sand deposits to determine shoreline restoration. Most of these deposits occur in State waters, but some potential deposits have been found in Federal waters. Ship Shoal, a large sand shoal seaward of the Isles Dernieres, contains a high qualtity sand that could be mined for coastal restoration and protection against accelerating rates of wetland loss (Byrnes and Groat, 1991). Deposits of quartz sand in Federal and State waters off the coasts of Mississippi and Alabama are of interest because of their potential use in the production of glass. Sulphur and salt deposits associated with the diapiric structures beneath the OCS seafloor have mining potential. The Caminada sulphur mine in Federal waters has recently been activated, and DOI conducted an offshore sulphur lease sale on February 24, 1988.

In addition, known mineral resources in adjacent coastal areas include phosphate, quartz, sand, sulphur, salt, oyster-shell, limestone, sand and gravel, and magnesia. As part of the national initiative to develop the marine mineral resources of the OCS, MMS is working with the Gulf Coast States to complete preliminary economic reconnaissance studies of nonenergy marine minerals. These efforts began during the summer of 1987. During the Ninth Annual Gulf of Mexico Information Transfer Meetings, sponsored by MMS in October 1988, participating states presented progress reports on these efforts in a session entitled Marine Mineral Resources in the Northern Gulf of Mexico (USDOI, MMS, 1989a).

2. Meteorological Conditions

General Description

The Gulf of Mexico and adjacent coastal areas are part of the Atlantic tropical cyclone basin. Because of its extensive coastal region and almost complete enclosure by land, the Gulf is also a favorable region for the development of atmospheric disturbances associated with land and sea-surface-temperature contrasts. The area has two well-defined seasons; the summer (May-October) and winter (December-March). The two transitional months are April and November. In winter the Atlantic high moves southward and creates a clockwise wind field. The polar front also moves southward and brings cold fronts into the region at 3- to 10-day intervals. In summer the subtropical gyre decreases in size and moves northward allowing the northeast trade winds to reach northwards and influence the entire Gulf. The polar front returns to its northern position preventing the cold fronts from reaching the Gulf region. The northward penetration of the trade winds makes it possible for tropical cyclones and hurricanes to come into the Gulf.

Pressure, Temperature, and Relative Humidity

The western extension of the Azores-Bermuda high-pressure cell dominates circulation throughout the year, weakening in winter and strengthening in summer. The average monthly pressure shows a west to east gradient along the northern Gulf during summer; minimum at Texas (1,013.85 millibars (mb)) and maximum at Florida (1,016.67 mb). In winter the monthly pressure is more uniform along the northern Gulf; most of the pressure is around 1019 mb and slightly lower in southern Texas (1,018 mb). The minimum average monthly pressure occurs during the summer when the equatorial trough shifts northward. The maximum pressure occurs during the winter as a result of the presence and influence of continental cold air.

Average air temperatures at coastal locations vary with latitude and exposure. Seasonally, air temperatures at coastal areas are highest in summer (from 24.69 to 27.96°C), with the highest temperatures occurring in south Florida. In winter, air temperature is at a minimum (from 12.05 to 21.73°C), with the coldest temperatures in Alabama. Winter temperatures depend on the frequency and intensity of penetration by polar air masses from the north. These incursions, when they bring strong northerly winds, are called "northers" and may occur some 15-30 times between November and March. Air temperatures over the open Gulf exhibit narrower limits of variations on a daily and seasonal basis. The average temperature over the center of the Gulf is about 29°C in the summer; winter temperatures average between 17° and 23°C.

The relative humidity over the Gulf is high throughout the year. Minimum humidities occur during the late fall and winter when cold, continental air masses bring dry air into the northern Gulf. Maximum humidities occur during the spring and summer when prevailing southerly winds bring in warm, moist air. The recording stations from Brownsville, Texas, to Key West, Florida, show the relative humidity varies annually from a high of 87 percent at 6:00 a.m. to a low of 44 percent at noon. This variation in a 6-hour period is caused by daily warming.

Surface Winds

Winds are more variable near the coast than over open waters because coastal winds are more directly influenced by the moving cyclonic storms that are characteristic of the continent and because of the sea- and land-breeze regime. The Azores-Bermuda atmospheric high-pressure cell dominates circulation over the Gulf, particularly during the spring and summer months. In late summer, there is a general northward shift of the circulation, and the Gulf becomes more directly influenced by the equatorial low-pressure cell. During the relatively constant summer conditions, the southerly positions of the Azores-Bermuda cell generates predominantly southeasterly winds, which become more southerly in the northern Gulf. In the CPA, inshore wind components during summer have a frequency of 52-85 percent with average speeds between 4 and 6 ms^{-1}. In the WPA, summer inshore components have a frequency of 38-61 percent with speeds of 3-5 ms^{-1}. Winter winds usually blow from easterly directions with fewer southerlies but more northerlies. Winds from the west and southwest are rare at anytime during the year. The inshore components during winter in the CPA have a frequency of 47-64 percent with speeds of 4-5 ms^{-1} and offshore components occur 19-34 percent of the time. In the WPA the inshore wind component frequency is 26-37 percent with speeds of 4-6 ms^{-1}; the offshore components occur 45-55 percent of the time with speeds of 4-8 ms^{-1}. Annual average wind speeds at other coastal areas in the Gulf of Mexico can be found in Table III-1.

Precipitation and Visibility

Average annual precipitation along the Gulf Coast ranges between approximately 69 cm in Brownsville, Texas; 102 cm at Galveston, Texas; and 137 cm at New Orleans, Louisiana, and Fort Myers, Florida. Other annual averages of precipitation in the coastal areas of the Gulf can be found in Table III-1. With the exception of the South Texas region, rainfall is fairly evenly distributed throughout the year, with the greatest amounts occurring during June, July, and August when the winds are predominantly out of the south and southeast.

Table III-1

Climatological Data for Selected Gulf Coast Locations

Location	Precipitation (Annual Average) meters	Temperature (Mean Annual Degree C)	Wind Speed (Average Annual Mean) ms^{-1}	Humidity (Average Percent)	Barometric Pressure (Average Annual)	Stability Conditions Annual Percent Unstable	Stability Conditions Annual Percent Neutral	Stability Conditions Annual Percent Stable
Corpus Christi, Tex.	0.77	21.7	5.4	89	1,014 mb*	11.0	61.0	28.0
Galveston, Tex.	1.07	20.9	4.9	83	1,015 mb	16.0	61.4	22.6
Lake Charles, La.	1.35	19.9	3.9	90	1,016 mb	23.0	44.0	33.0
Gulfport, Miss.	1.50	20.0	3.6	85	1,016 mb	17.5	47.4	35.1
Pensacola, Fla.	1.55	19.9	3.7	85	1,013 mb	18.0	22.0	60.0
Key West, Fla.	1.01	25.3	5.0	79	1,014 mb	80.0	18.0	2.0

*mb = millibar.

Sources: USDOC, NOAA, 1961-1986.

Precipitation is frequent and abundant throughout the year but does show distinct seasonal variation. In New Orleans, October is the only month when precipitation averages less than 8 cm; July is the wettest month and receives just under 18 cm. Stations along the entire coast record the highest precipitation values during the warmer months of the year. The warmer months usually have convective cloud systems that produce showers and thunderstorms; however, these thunderstorms rarely cause any damage or have attendant hail (USDOC, 1967; Brower et al., 1972). The month of maximum rainfall for most locations is July; however, Brownsville's record maximum is in September. Winter rains are associated with the frequent passage of frontal systems through the area. Rainfalls are generally slow, steady, and relatively continuous, often lasting several days. Snowfalls are rare, and when frozen precipitation does occur, it usually melts on contact with the ground. Incidence of frozen precipitation decreases with distance offshore and rapidly reaches zero.

Warm, moist Gulf air blowing slowly over chilled land or water surfaces brings about the formation of fog. Fog occurrence decreases seaward, but visibility has been less than 800 m due to offshore fog. Coastal fogs generally last 3 or 4 hours, although particularly dense sea fogs may persist for several days. The poorest visibility conditions occur during winter and early spring. The period from November through April has the highest frequencies of low visibilities. On the South Texas coast, fog reduces visibility to less than 1,000 m on an average of 28 days/year; very dense fog in Galveston reduces visibility to 600 m about 16 days/year; and Port Arthur has an average of 42 days/year with visibility less than 600 m. Visibility around the Mississippi Delta may be lowered by industrial pollution from New Orleans or by burning marshlands. The number of days that visibility decreases to less than 400 m (heavy fog) in the Eastern Gulf decreases from 35 days/year in Pensacola to 1 day/year at Key West.

Atmospheric Stability and Mixing Height

Table III-1 shows the frequency of atmospheric stability using the Pasquill classification at several coastal locations along the Gulf area. Along the Texas coastal areas, stability is mainly either neutral (61% of the time) or stable (22-28%); unstable conditions occur only 11-16 percent of the time. In Louisiana and Mississippi the atmospheric stability is chiefly either neutral (44-47%) or stable (33-35%), and slightly more frequently unstable (17-23%). Along Florida's northern coast the atmospheric stability is mainly either neutral (22%) or stable (60%); unstable conditions occur rarely (18%). In southern Florida, the atmospheric is unstable most of the time (80%), while neutral (18%) and stable (2%) occur rarely.

The mixing height is very important because it determines the space available for spreading the pollutants. Because the mixing height is directly related to vertical mixing in the atmosphere, a mixed layer is expected to occur under neutral and unstable atmospheric conditions. The mixing height does not exist under stable atmospheric conditions. Although mixing heights information throughout the entire Gulf of Mexico is very scarce, measurements near Panama City, Florida (Hsu, 1979) show that the mixing height can vary between 400 and 1,300 m, with a mean of 900 m. The mixing height tends to be lower in winter, and daily changes are smaller than in summer. A climatology of mixing heights (Schulze, 1991) shows that in summer the afternoon mean mixing height around Louisiana coastal areas is between 1,200 and 1,400 m, and between 1,400 and 1,600 m around the rest of the Gulf. In winter, the afternoon mean mixing height is over 800 m in Louisiana coastal areas and between 800 and 1,000 m throughout the remaining Gulf area. The southern tip of Florida, however, has mixing heights between 1,000 and 1,200 m.

Severe Storms

The most intense and destructive storms affecting the Gulf of Mexico and adjacent coastal zones are tropical cyclones, which originate over the warm waters of the central Atlantic Ocean, Caribbean Sea, or the Gulf of Mexico. Tropical cyclones occur most frequently between June and November. There is a relatively high probability that cyclonic storms will cause damage to physical, economic, biological, and social systems in the Gulf. These storms are categorized by the U.S. National Weather Service according to intensity. The most intense storms, which are called hurricanes, have winds of greater than 121 kilometers per hour (km/h). The determination of storm intensity at sea and in the coastal region is readily measured by current weather-forecasting methods and surveillance techniques. Recorded historical data on past storms prior to 1950 is often difficult to obtain. The probability of storm occurrence in certain coastal areas and meteorological disturbance intensity is discussed in BLM Open File Report 80-02 (USDOI, BLM, 1982) and is depicted on Visual No. 7.

Extratropical cyclones originate in middle and high latitudes, forming on the fronts that separate different air masses. These storms, which may vary greatly in intensity, occur primarily during the winter months and have attained wind speeds as great as 55-93 km/h. The Gulf of Mexico is an area of cyclone development during the cooler months due to the contrast in temperatures of the warm air over Gulf waters and the cold continental air over the United States.

Hurricanes have always posed a seasonal threat to the people of the Gulf of Mexico coastal region. Damages resulting from these violent storms have been noted as far back as the Spanish explorations by Columbus in the late 1400's. Five unidentified Spanish ships carrying unknown cargo were destroyed during a 1766 hurricane in the Bay of St. Bernard (Galveston Bay). In 1778, 14 unidentified large British ships carrying lumber to Jamaica were destroyed in Pensacola Harbor by a hurricane (CEI, 1977). Indianola, Texas, was struck by a hurricane in 1875; this resulted in the destruction of three-quarters of the town, and 176 lives were lost. Eleven years later Indianola was destroyed by another hurricane; the town was never rebuilt. In 1900, Galveston, Texas, was the location of the worst hurricane disaster in the history of the Gulf of Mexico. Tidal surges were recorded at 4.6-6.1 m, more than 3,600 homes were destroyed, and 6,000-8,000 people lost their lives.

Hurricanes vary considerably in intensity, track patterns, and behavior when crossing land. McGowen et al. (1970) explain that storm approach is marked by rising tides and increased wind velocities; generally, the longer a storm lingers in the Gulf, the larger the surge of water it pushes ashore as it approaches land. These storm tides are commonly higher in the bays than on Gulf sea beaches, although flooding and pounding waves affect both areas. There is no preferred approaching route of hurricane tracks (DeWald, 1982), although early season storms generally approach from the southeast and later ones are more out of the south. Most hurricanes form in tropical ocean areas; however, some are generated in the Gulf of Mexico. From 1900 to 1985, 64 tropical storms formed in the Gulf of Mexico, 32 of which became hurricanes (USDOC, NOAA, 1978, updated 1985).

Hurricane damage results from high winds and, particularly in the coastal areas, the storm surge or tide, which is an abnormally high rise in the water level. Maximum surge height at any location is dependent on many factors including bottom topography, coastline configuration, and storm intensity. Damages from severe storms include environmental losses due to shore and bay erosion, wildlife- and fisheries-habitat disruptions, and direct animal population loss; economic losses to oil and gas operations, the seafood industry, and vessel casualties; and social losses resulting from human displacement, property damage, and loss of life.

In recent years, hurricanes have had a great impact on offshore oil development in addition to posing threats to residents of coastal regions. Hurricane Camille (1969) caused 262 deaths, and tidal surges were recorded at 7 m in Mississippi. Three offshore platforms were affected; the first was completely destroyed, the second was severely damaged and removed from the offshore, and the third suffered damages but was repaired and reused in another area. The damage to these three platforms, plus 1,828 m of pipelines, exceeded $40 million.

Other hurricanes that have caused destruction to offshore development are as follows: Hurricane Hilda (1964) destroyed six platforms; Hurricane Carmen (1974) caused four pipeline breaks; Hurricane Eloise (1975) caused one pipeline break; and Hurricane Bob (1979) caused one pipeline break (DeWald, 1982).

More than 500,000 people from Louisiana were evacuated in advance of Hurricane Elena (September 1985). Although Elena caused millions of dollars worth of property damage, no deaths or serious injuries resulted. Winds were recorded up to 201 km/h, and at least 10 tornados were sighted. Over 110,000 homes and businesses were left without power.

Hurricane Elena caused severe coastal erosion and landloss along the Chandeleur Islands off Louisiana. Approximately 20 percent of the total island area was removed by the storm. On many parts of the island, vegetation was stripped and major dune fields were severely damaged. The northern end of the island near the lighthouse was partially destroyed, and many tidal channels were cut through the northern quarter of the island (Louisiana Geological Survey, 1985). Elena further affected the beaches and shores of the Florida west coast from Escambia County through Sarasota County, a shoreline distance of about 795 km. Balsillie (1985) performed a Type I erosion-value analysis relative to Hurricane Elena's effects on Florida's beaches and shores. This was an average for sampled profiles where only erosion occurred. Through this analysis, it was determined that beach and coast erosion volumes from Pinellas, Franklin, Gulf, and Escambia Counties ranged from 21 to 40 m^3 per shorefront meter of coast. The average erosion was 25 m^3 per meter.

Ninety percent of the Alabama oyster resources were lost as a result of Hurricane Elena. All major reefs--Cedar Point, Buoy, and Kings Bayou--were impacted by extreme tidal activity, hurricane force winds, and heavy rainfall from Hurricane Elena; and oyster populations were subjected to acute mechanical and physiological stress that may have drastically altered oyster population dynamics on impacted reefs. The most productive reef, Cedar Point Reef (Mobile County), was virtually destroyed. Estimates were that restoration of 479 ha of reef area by planting adequate cultch material should result in replacement of the lost oyster resources within a period of 1.5-2.0 years, provided adequate spat set occurs (Tatum, 1985). Shellfish resources in Apalachicola Bay (Franklin County) sustained severe damage. This bay system is vital to the oyster industry of Florida--over 90 percent of Florida's oyster landings come from this bay. In 1984, approximately 900 oyster-harvesting licenses were issued in Franklin County. Damage assessment following the storm indicates oyster populations on the bay's most productive reefs (Cat Point Bar and East Hole Bar) have been reduced to levels that would not support commercial harvesting. Commercially harvestable concentrations of oysters on Cat Point Bar were reduced to approximately 20 percent of the estimated harvestable oysters present before the storm. Those resources on East Hole Bar were virtually eliminated (Berrigan, personal comm., 1986).

Hurricane Juan (October/November 1985) intensified so quickly that the offshore oil and gas industry was unable to evacuate personnel on many rigs and platforms. As a result, a massive rescue of more than 140 people was performed by the U.S. Coast Guard. When the legs collapsed on the Penrod 61 drilling rig offshore Louisiana, 43 people evacuated into escape capsules; however, one capsule swamped, which resulted in the death of one crewman. By October 31, Hurricane Juan had come within 97 km of New Orleans. As a result of this storm, seven lives were lost, 50,000 homes were flooded, and there was an estimated $1 billion loss. On November 1, tropical storm Juan left Louisiana and slowly drifted toward Alabama. It was the most destructive hurricane of all as far as coastal erosion and landloss are concerned. Beaches along the entire Louisiana coast eroded 6-30 m as a result of long-lasting, high tidal surges and storm waves. Channels were widened and several new inlets were created along the barrier islands, which were devegetated in some areas (Louisiana Geological Survey, 1986). Hurricane Juan also adversely affected the Louisiana shrimp industry. It hit the Louisiana coast at historically the most productive time of the year for shrimping, but boats stayed at port because of rough seas. Considerable debris and detritus were deposited on the shrimping grounds, resulting in losses to fishing gear and fishing time. The storm dispersed the population of shrimp, caused premature immigration, resulted in some shrimp mortalities, and resulted in a decrease in shrimp landings (Chatry, 1986).

3. Air Quality

This section contains a description of air quality in the coastal areas of the Gulf of Mexico. One of the mandates of the Clean Air Act was the establishment of National Ambient Air Quality Standards (NAAQS). The Act established two standards, the primary standard to protect public health and a secondary standard to protect public welfare. The National Ambient Air Quality Standards (40 CFR 50.4 to 50.11, 1990) are shown in Table III-2. The Clean Air Act amendments of 1990 established a classification scheme based on degrees of nonattainment for areas with air quality problems. These designations impose time tables and other requirements for reaching the attainment status, which depends on the degree of nonattainment.

Pollutant measurements are collected from monitoring stations located at sites selected by State, Federal, and/or private organizations. These measurements of pollutant concentration are processed using methods described in 40 CFR 50 to calculate the annual number of expected exceedances of the national standards. After the expected number of exceedances is calculated and compared with NAAQS, an area's air quality is classified. Although the five states bordering the Gulf have adopted the standards established by the Clean Air Act, Florida has modified the standards for total suspended particulates (TSP) and sulphur dioxide (SO_2). On occasion, the comparisons use stricter State-adopted standards. The USEPA classification for air quality is as follows:

Table III-2

National Ambient Air Quality Standards for the Five Gulf of Mexico States, with More Restrictive Standards Shown for the State of Florida[a]

Pollutant	Timeframe	Primary Standards	Secondary Standards	Florida Standards
PM 10 particulate	annual (arithmetic mean[c])	50 $\mu g/m^3$[c] 150 $\mu g/m^3$	50 $\mu g/m^3$ 150 $\mu g/m^3$	50 $\mu g/m^3$ 150 $\mu g/m^3$
Sulphur oxides	annual (arithmetic mean[c])	80 $\mu g/m^3$ (0.03 ppm)[d]	150 $\mu g/m^3$ (0.02 ppm)	60 $\mu g/m^3$ (0.02 ppm)
	24-hour	365 $\mu g/m^3$ (0.14 ppm)	260 $\mu g/m^3$ (0.1 ppm)	260 $\mu g/m^3$ (0.1 ppm)
	3-hour[b]		1,300 $\mu g/m^3$	1,300 $\mu g/m^3$ (0.5 ppm)
Carbon monoxide	8-hour[b]	10 mg/m^3 (9 ppm)	(same as primary)	(same as primary)
	1-hour[b]	40 mg/m^3 (35 ppm)	(same as primary)	(same as primary)
Nitrogen dioxide	annual (arithmetic mean)	100 $\mu g/m^3$ (0.05 ppm)	(same as primary)	(same as primary)
Photochemical oxidants[e]	maximum daily[b] value	235 $\mu g/m^3$ (0.12 ppm)	(same as primary)	0.12 ppm[3]

[a]The air quality standards and a description of the Federal Reference Methods (FRM) can be found in 40 CFR 50 on July 1, 1990.
[b]Not to be exceeded more than once a year.
[c]Arithmetic mean is sum of the data collected during the given period divided by the number of observations in the same period.
[d]Parts per million.
[e]The FRM measures O_3 (ozone).

Note: mg/m^3 = milligrams per cubic meter = 1,000 $\mu g/m^{-3}$.
$\mu g/m^3$ = micrograms per cubic meter.

Source: 40 CFR 50, 1990, and Florida Dept. of Environmental Regulation, 1987.

Classification	Definition
Attainment	Meets or is less than standard
Nonattainment	Exceeds Standards
Unclassified	No data exist to classify an area

Unclassified areas may either be nonattainment or attainment, but cannot be classified due to the lack of air quality data in these areas. Figure III-1 presents the air quality status in the Gulf Coast as of July 1990 (40 CFR 81.301-319). (Notice that Figure III-1 includes a second layer of counties or parishes.) All air quality nonattainment areas reported in Figure III-1 include suspended particulate matter and ozone problems. The following Texas coastal counties are classified as nonattainment for ozone: Brazoria, Galveston, Victoria, Harris, Jefferson, and Orange. Chambers County, Texas, is being reclassified by USEPA to nonattainment. According to the *Federal Register* notice of April 22, 1991, USEPA has notified the Governor of Texas that the SO_2 designation of Harris and Jefferson Counties should be revised. Cameron and Nueces Counties are nonattainment for suspended particulate matter. The following Louisiana parishes are nonattainment: Calcasieu, Jefferson Davis, Lafayette, St. Mary, Ascension, St. James, St. Charles, Lafourche, Jefferson, Orleans, and St. Bernard. The State is taking steps to reclassify the parishes of Orleans, St. Bernard, Jefferson, and St. Charles.

Pollutant levels in some coastal areas of Texas are reported in the *Air Monitoring Report, 1988* (Texas Air Control Board, 1989). The pollutants monitored were nitrogen dioxide (NO_2), carbon monoxide (CO), sulphur dioxide (SO_2), particulate matter (TSP), and ozone (O_3). The Beaumont-Port Arthur area reported annual average NO_2 concentrations of 13.2 μgm^{-3}. This value is below the national standard of 100 μgm^{-3}, but it cannot be used for regulatory purposes because the sample is not adequate. Concentrations of CO in the Beaumont-Port Arthur area had an 8-hr average of 3,435 μgm^{-3}, which is well below the national standard of 10,000 μgm^{-3}. Most stations near coastal areas were below the national standard for CO. Sulphur dioxide concentrations in the Beaumont-Port Arthur area had a highest 24-hr average of 107.7 μgm^{-3}; Corpus Christi reported a highest 24-hour average of 78.5 μgm^{-3}. Both values are below the 24-hour average national standard of 365 μgm^{-3}. Particulate matter (PM_{10}) concentration in the Houston-Galveston-Brazoria area reported a highest 24-hr average of 50 μgm^{-3} most of the year; this value is below the national standard of 150 μgm^{-3}. Data for South Texas had highest 24-hr averages between 60 and 100 μgm^{-3}; these averages are still below the standard. Ozone measurements are more comprehensive and continuous. Concentrations in the Beaumont-Port Arthur and Brazoria areas reported 1-hr average monthly maximum values that exceed the national standard of 235 μgm^{-3}; three times in 1988. Houston is above the standard most of the year. Corpus Christi reports values near 200 μgm^{-3} most of the year, making this a border case area.

Measurements of pollutant concentrations in Louisiana are presented in the *Ambient Air Quality Data Annual Report, 1989* (Louisiana Dept. of Environmental Quality, 1989). The NO_2 measurements in New Orleans show that, during the period of 1985-1989, the 1-hr yearly maximum values varied between 161.8 and 250.2 μgm^{-3}, with the annual 1-hr mean varying between 41.3 and 48.9 μgm^{-3}. This information shows that during the last five years the NO_2 standard has not been exceeded in New Orleans. Between 1985 and 1989 the CO concentrations in New Orleans show that 1-hr yearly maximum values varied between 13,627.9 and 18,208.7 μgm^{-3}, while the annual mean varied between 1,257.7 and 2,404.9 μgm^{-3}. At other locations in New Orleans, the concentrations were about 40 percent less than the values presented above. These values are about 50 percent below the national standard. Concentrations of SO^2 are reported in two coastal areas. The Meraux station, near the Mississippi River, showed an annual mean of 7.9 μgm^{-3} in 1989. Westlake, near the Texas-Louisiana border, showed annual mean values between 5.2 and 13.1 μgm^{-3}. Both stations were below the annual average national standard of 80 μgm^{-3}. Particulate matter (PM_{10}) was also reported at two stations of interest. New Orleans reported annual mean concentrations of 31-37 μgm^{-3}, which were below the annual 50 μgm^{-3}. In 1989, Lake Charles, near the Texas-Louisiana border, showed an annual mean concentration of 28 μgm^{-3}, which was still below the national standard. It is interesting that even maximum readings were below the national standards. Ozone measurements for Louisiana are discussed in Section IV.D.1.a.(4).

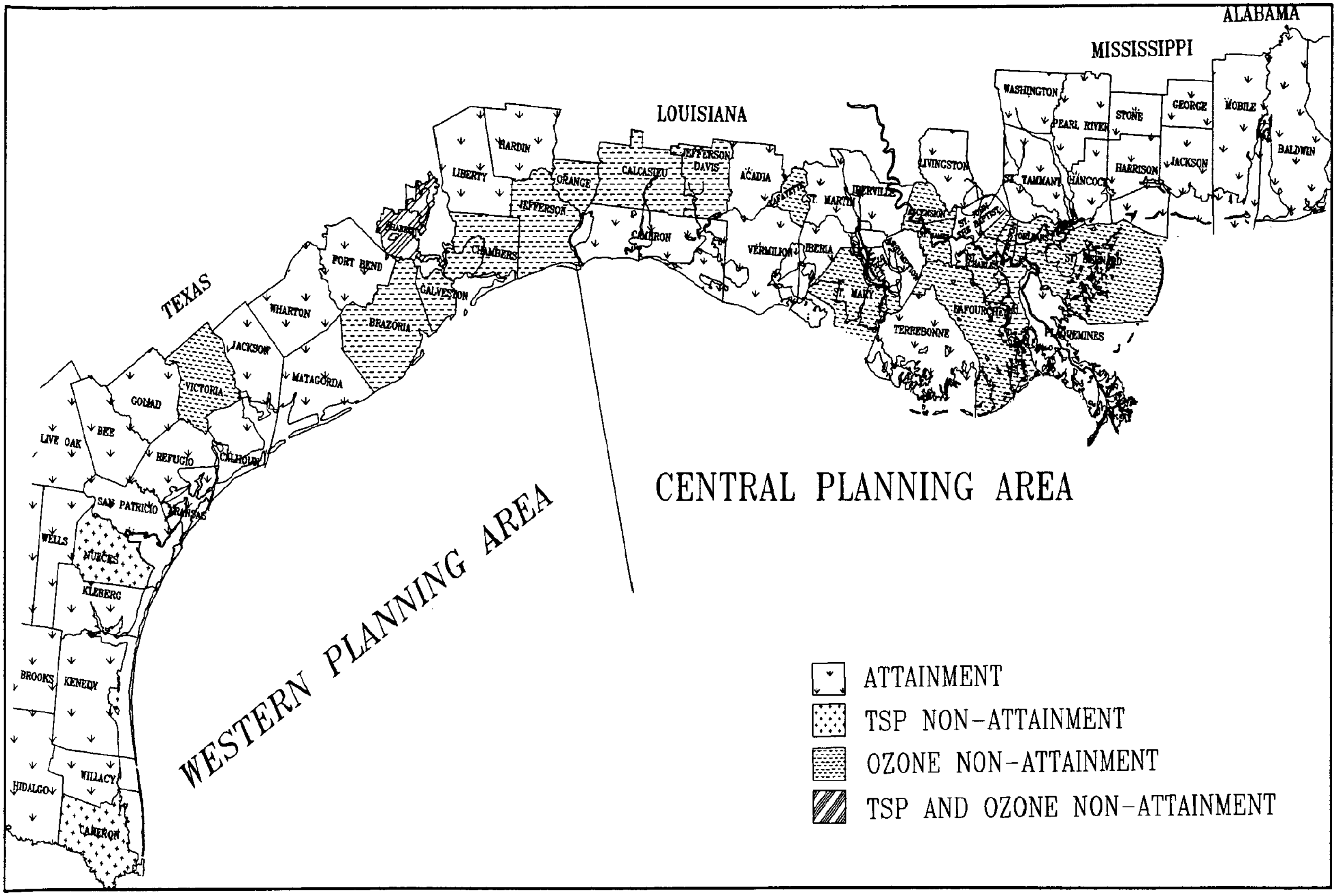


Figure III-1. Status of Air Quality in the Western and Central Planning Areas of the Gulf of Mexico.

Measurements of three air pollutants (PM_{10}, SO_2, and O_3) during 1990 and the first quarter of 1991 in Mobile County, Alabama, were secure. The sulphur dioxide monthly means varied from 13.1 to 33.9 μgm^{-3}. The highest 24-hr average concentration in the data never reached 105 μgm^{-3} and the annual average was 20.5 μgm^{-3}. Both statistics are below the national standard of sulphur dioxide. The PM_{10} measurements in Mobile County during the same time interval showed a highest 24-hr average concentration of 64 μgm^{-3}. However, the number of observations in a given year was very low and varied from 1 to 61 daily observations. Hourly ozone measurements show that the mean monthly concentration varied from 15 to 70 μgm^{-3}. The maximum 1-hr concentration during 1990 was 246 μgm^{-3}; this occurred in August. All other measurements were below the national standard. The data also show that the highest ozone concentrations tend to occur during the summer, decrease during fall and winter and reach a minimum in April.

Ambient air quality is a function of size, distribution, activities of the State's population, industrial development, and emissions from sources such as internal combustion, solid-waste incineration, and chemical processing. Climatic conditions modify air quality by dispersing, distributing, or sometimes, unfortunately, concentrating emitted pollutants. Assessments of air quality depend on emissions and dispersion rates, distances from sources, and local meteorology. Because of the changing nature of these factors, air quality is not a steady quantity.

For a more complete description of the meteorological and climatic conditions that affect air quality, see Section III.A.2.

4. Physical Oceanography

The Gulf of Mexico is a semi-enclosed, subtropical sea with an area of approximately 1.6 million km^2. The main physiographic regions of the Gulf basin are the continental shelf (including the Campeche, Mexican, and U.S. shelves), continental slopes and associated canyons, abyssal plains, and the Yucatan and Florida Straits. The continental shelf width along the U.S. coastline is about 350 km offshore West Florida; 16 km off the Mississippi River; and 156 km off Galveston, Texas, decreasing to 88 km off Port Isabel near the Mexican border. The depth of the central abyss ranges to 4,000 m. The water volume of the Gulf, assuming a 2-km mean depth, is 2 million cubic kilometers; the shelf's volume, assuming a mean water depth of 50 m, is 25,000 cubic kilometers. The Gulf is unique among the world's mediterranean seas, having two entrances: the Yucatan Strait and the Straits of Florida. Both straits restrain communication from the deep Atlantic waters because of the limited sill depths--1,600 m in the Yucatan Strait and about 1,000 m in the Straits of Florida. A portion of the Gulf Stream system, the parent Loop Current, whose presence and influence are described below, is present in the Gulf. Along the 24,800-km Gulf coastline, 21 major estuaries are found on the U.S. coast. The amount of freshwater input to the Gulf basin from precipitation and a number of rivers--dominated by the Mississippi and Atchafalaya Rivers--is enough to influence the hydrography of most of its northern shelves. However, the basin's freshwater budget shows a net deficit due to the high rate of evaporation.

Sea-surface temperatures in the Gulf, as shown in Figures 9A and 9B of Visual No. 7 for the EIS for Sales 131, 135, and 137, range from nearly isothermal (29-30°C) in August to a sharp horizontal gradient in January, ranging from 25°C in the Loop core to values of 14-15°C along the shallow northern coastal estuaries. August temperatures at 150 m show a warm Loop Current and an anticyclonic feature in the Western Gulf (both about 18-19°C) grading into surrounding waters of 15-16°C along the slope. The entire pattern is maintained during winter, but warmer by about 1°C. At 1,000 m, the temperature remains close to 5°C year-round.

Surface salinities along the northern Gulf display seasonal variations because of the seasonality of the freshwater input. During months of low freshwater input, deep Gulf water penetrates into the shelf, and salinities near the coastline range between 29 and 32 parts per thousand (ppt). High, freshwater-input conditions (spring-summer months) are characterized by strong horizontal gradients and inner-shelf salinity values of less than 20 ppt (Wallace, 1980; Cochrane and Kelly, 1986).

The vertical distribution of temperature, salinity, oxygen, and phosphate over six subareas of the Gulf are presented in Figure 8 of Visual No. 7 for the EIS for Sales 131, 135, and 137. Also shown are the characteristic five major watermasses identified in the Gulf, down to about 1,000 m. This profile arrangement illustrates the influence of the Atlantic Ocean in the Gulf hydrography and the changes in water characteristics brought about by the local climatology and hydrology. The main result is the creation of the Gulf watermass, which is confined to the surface layer through most of the Gulf basin. Intimately related with the vertical distribution of temperature is the thermocline, defined as the depth at which the temperature gradient is at maximum. During January, the thermocline depth is about 30-61 m in the Eastern Gulf and 91-107 m in the Central and Western Gulf. In May, the thermocline depth is about 46 m throughout the entire Gulf (Robinson, 1973). This depth is important because it demarcates the bottom of the mixed layer and acts as a barrier to the vertical transfer of materials and momentum.

Sharp discontinuities of temperature and/or salinity at the sea surface, such as the Loop Current front or fronts associated with eddies or river plumes, are dynamic features that may act to concentrate buoyant material such as spilled oil, detritus, or plankton. These materials are not advected by the front's translatory movement, such as Loop current incursion or the slow westward drift of eddies. The motion consists mainly of lateral movement along the front instead of motion across the front. In addition to open ocean fronts, a coastal front, which separates turbid, lower salinity water from the open-shelf regime, is probably a permanent feature of the Gulf shelf. Figure 7 of Visual No. 7 for the EIS for Sales 131, 135, and 137 indicates that the front lies about 30-50 km offshore. It is not known how strongly this front might affect buoyant material transport.

The Loop Current, a highly variable current feature, enters the Gulf through the Yucatan Strait and exits through the Straits of Florida (as the Gulf Stream) after tracing an arc that may intrude as far north as the Mississippi-Alabama shelf. The Loop consists of ascending and descending 30-km-wide bands of rapidly moving water enclosing a relatively quiescent inner region, and the entire feature may be clearly seen in hydrographic sections down to about 1,000 m. Below that level, there is evidence of a countercurrent. The volumetric flux of the Loop has been estimated at 30 million m^3s^{-1}. Velocities up to 300 cms^{-1} have been measured, but a range of 100-200 cms^{-1} is probably representative. This volume flow is enough to replace the water volume of the Gulf shelf in about 10 days.

The "location" of the Loop Current is definable only in statistical terms, due to its great variability. Figure 5A of Visual No. 7 for the EIS for Sales 131, 135, and 137 shows the relative existence probabilities for Loop Current water throughout the Eastern Gulf in March, the month of apparent greatest intrusion. Values range from a 100-percent core location at 25°N, down to small probabilities (10%) near midshelf. Figure 5B of Visual No. 7 for the EIS for Sales 131, 135, and 137 shows the results of a "wave-staff" analysis, where observed Loop front locations along selected meridional lines are analyzed for central tendency, range, and dispersion. An average northern intrusion is indicated to 26.6°N, within a wide envelope. Both analyses exclude the period June-October due to limitations on satellite data.

The process responsible for the first-order variability of the Loop is the shedding of anticyclonic, warm-water eddies, which may occur when the current is greatly extended. The usual eddies are large, resulting in significant dimensional adjustment by the Loop. This is clearly seen in the data in Figure 5C of Visual No. 7 for the EIS for Sales 131, 135, and 137. Processes responsible for smaller, or second-order, variability of the Loop include persistent wind forcing, shelf-edge interactions along the Yucatan Shelf and the West Florida Shelf, and waves along the Loop front associated with the eddy cycle. These instabilities may grow into large intrusions of warm Loop water onto the adjacent shelf and/or entrain colder shelf water into the Loop itself, as seen in Figure 5D of Visual No. 7 for the EIS for Sales 131, 135, and 137. Collectively, these processes set up a zone of Loop Current fluctuation extending over the outer shelf, the slope, and the abyssal areas off Mississippi, Alabama, and Florida (MAFLA).

The eddy-shedding cycle has earlier been the subject of much field work and currently of numerical modeling. Based on these data, Figures 1A, 1B, and 1C of Visual No. 7 for the EIS for Sales 131, 135, and 137 have been prepared to illustrate the overall cycle, including the subsequent behavior of the eddies. Recent analysis of frontal-positions data indicates that the eddy-shedding period varies between 6.5 and 9.5 months with an average of 7.5 months (Hamilton et al., 1989). Major Loop Current eddies have diameters on the order of 300-400 km and may clearly be seen in hydrographic data to a depth of about 1,000 m. Swirl velocities within the eddies have been reported from 50-200 cms^{-1}. As seen in Figures 4A, 4B, and 4C of Visual No. 7 for the EIS for Sales 131, 135, and 137, they move into the Western Gulf along various paths to a region between 25°-28°N and 93°-96°W. The eddies move at speeds ranging from 2-5 kmd^{-1}, decreasing in size as they mix with resident waters. The life of an individual eddy to its eventual assimilation by regional circulation patterns in the Western Gulf is about 1 year.

Eddy-shedding from the Loop Current is the principal mechanism coupling the circulation patterns of the eastern and western parts of the basin. The heat and salt budgets of the Gulf are dependent on this importation, balanced by seasonal cooling and river input, and probably also by internal, deeper currents that are poorly understood. These currents may be evident in intriguing hints of abyssal bottom scour and the reversed currents beneath the Loop itself. The eddies are frequently observed to affect local current patterns along the Louisiana/Texas slope, hydrographic properties, and possibly the biota of fixed platforms or hard bottoms. There is some evidence that these large reservoirs of warm water play some role in strengthening tropical cyclones when their paths coincide.

Smaller anticyclonic eddies have been observed to be generated by the Loop Current, although it is not known if the process is merely a scaled-down version of the above cycle. They have diameters on the order of 100 km, but the few data available indicate a shallow hydrographic signature on the order of 200 m. Their observed movements indicate a tendency to translate westward along the Louisiana/Texas slope. Some are included in the analysis presented in Figure 4B of Visual No. 7 for the EIS for Sales 131, 135, and 137. Similar in size, cyclonic eddies are observed in the Eastern Gulf, are associated with the eddy-shedding cycle, and are along the Louisiana/Texas slope. Their genesis and role in the overall Gulf circulation are not well studied. A major cyclonic eddy seems to be resident in the southwestern Gulf, based on older data synthesis; however, some recent evidence points toward a more complex, less homogeneous structure.

Three studies have attempted to quantify the open Gulf circulation. Figure 2A of Visual No. 7 for the EIS for Sales 131, 135, and 137 displays the results of calculating the mean surface topography from all expendable bathythermograph and Nansen cast data from the National Oceanographic Data Center (NODC), carefully edited. Figure 2B of Visual No. 7 for the EIS for Sales 131, 135, and 137 displays the mean surface elevation from a 3-year simulation with the same model as Figures 1A, 1B, and 1C of Visual No. 7 for the EIS for Sales 131, 135, and 137, including wind forcing. All figures generally agree on the Loop Current region and an anticyclonic high in the Western Gulf, with some minor disagreement on details. Figure 2C of Visual No. 7 for the EIS for Sales 131, 135, and 137 translates the mean surface elevations of Figure 2B of Visual No. 7 for the EIS for Sales 131, 135, and 137 into surface-current vectors, illustrating the interpretation of topographic contours. Although the mean surface topography may be considered to represent the mean surface circulation of the Gulf, it has little utility for the reasons discussed below.

The regions of greatest variability in surface-contour analyses represent the regions of greatest current variability in the Gulf. These are areas where the use of long-term average currents could lead to misleading results in calculations of oil-spill trajectories. The errors result from the fact that mean speeds are not representative of the prevailing circulation. The studies depicted in Figures 2A and 2B of Visual No. 7 for the EIS for Sales 131, 135, and 137 have been analyzed to yield variability surfaces. Figure 3A of Visual No. 7 for the EIS for Sales 131, 135, and 137 shows the variability from the hydrographic study, emphasizing the zone of eddy detachment from the Loop centered about 26.5°N and 88.5°W. Figure 3B of Visual No. 7 for the EIS for Sales 131, 135, and 137 shows the variability from the modeling study, emphasizing a broad eddy detachment zone, a zone centered about 23°N and 94.5°W where many eddies go initially, and the zone identified in Figure 2B of Visual No. 7 for the EIS for Sales 131, 135, and 137. Figure 3C of Visual No. 7 for the EIS for Sales 131, 135, and 137 displays the results of direct measurements of surface variability from satellite altimeters.

Aside from the wind-driven surface layer, current regimes on the outer shelf and slope are the result of balance between the influence of open Gulf circulation features, such as the Loop and eddies, and the shelf circulation proper, which is dominated by long-term wind forcing. A western boundary current, driven both by prevailing winds and the semipermanent anticyclonic eddy, occurs offshore northern Mexico and South Texas. A strong east-northeasterly current along the remaining Texas and Louisiana slope has been explained partly by the effects of the semipermanent, anticyclonic eddy and a partner cyclonic eddy ("modon pair") and partly by the mass-balance requirements of eddy movement. Within the Loop Current fluctuation zone, offshore the MAFLA states, the intrusion of the Loop front or the presence of minor detached eddies sets up short-term strong currents, but no permanent current has been identified other than a weak statistical residual. When the Loop Current impinges onto the Florida slope and shelf, it has been observed that the current structure acts to upwell nutrient-rich water from deeper zones, a mechanism that may also take place as eddies move along the Louisiana/Texas slope, accounting for the increased productivity recognized in these areas. West of approximately Cameron, Louisiana (93°W), current measurements clearly show a strong response of coastal current to the winds, setting up a large-scale, anticyclonic gyre. The inshore limb of the gyre is the westward or southwestward (downcoast) component that prevails along much of the coast, except in July-August. Because the coast is concave, the shoreward prevailing wind results in a convergence of coastal currents at a location where the winds are normal to the shore or at the downcoast extent of the gyre. A prevailing countercurrent toward the northeast along the shelf edge constitutes the outer limb of the gyre. The convergence at the southwestern end of the gyre migrates seasonally with the direction of the prevailing wind, ranging from a point south of the Rio Grande in the fall to the Cameron area by July. The gyre is normally absent in July but reappears in August-September when a downcoast wind component develops (Cochrane and Kelly, 1986).

The Mississippi/Alabama shelf circulation is controlled by the Loop Current, winds, tides, and freshwater input. During intrusions of the Loop into the shelf, the Loop will completely dominate the shelf circulation; when located offshore, the Loop may drive a counter-clockwise circulation. Tidal currents of 15 cms^{-1} have been observed in this area (Vittor and Associates, Inc., 1985). The general circulation is a two-season event. During winter, the water column is homogeneous and surface circulation is mainly alongshore and westward at mean speeds of 4-7 cms^{-1}. The cross-shelf component is smaller and directed onshore. During spring-summer conditions, the surface flow is mostly eastward with mean speeds in the range of 2-7 cms^{-1}. However, during periods of sustained winds from the west, northwest, north, and northeast, near-bottom speeds average 20 cms^{-1} in water depths of 20 m. With sustained winds from the southeast, south, and southwest, the near-bottom average speed increases to 26 cms-1. Under winds with easterly components, the water tends to flow shoreward and accumulate against the shoreline, creating a pressure gradient that drives bottom water alongshore in the direction of the winds (Vittor and Associates, Inc., 1985).

The West Florida shelf circulation is dominated by tides, winds, eddy-like perturbations, and the Loop Current. Tidal currents are slightly dominated by diurnal components with speeds of about 5 cms^{-1} at spring tides. The wind-driven flow is mostly alongshore and parallel to the isobaths at water depths less than 30 m. The mean flow is directed southward with mean speeds ranging from 0.2-7 cms^{-1} in the surface layer. Near the shelf edge the flow is onshore from surface to mid-depth and offshore below. The mean onshore speeds are 0.4-3 cms^{-1}, and the general offshore speeds are less than 1 cms^{-1}. The Loop influence is by direct or indirect forcing by the intrusions and meanders. This influence is felt most strongly along the shelf break and slopes. The actual circulation is composed of several components of different frequencies of which the 10-14 days component contains a large fraction of the variance. Wind-driven events induce horizontal particle excursions, which are proportional to the period of the event; thus, longer periods cause longer particle excursions (SAIC, 1986).

Longshore currents, consisting of tidal, wind-driven, and density-gradient components, predominate over across-shelf components within a narrow band close to the coast (on the order of 10-20 km, referred to as the coastal boundary layer). Typical maximum tidal currents within this band would be about 15 cms^{-1}. These currents will cause a particle displacing, known as the tidal excursion, at 2-3 km. Currents, driven by synoptic-scale winds, range up to 25-50 cms^{-1} for nonextreme conditions, with 10- to 100-km excursions expected for a typical 5-day "wind event." Longshore currents due to winter northers, tropical storms, and hurricanes may range up to hundreds of cms^{-1}, depending on local topography, fetch, and duration. Should an oil spill occur, deviations from results predicted by open-ocean models could happen at coastal fronts, where concentration and lateral translation could occur, and within the longshore-current zone, where significant transport away from the "expected" point of contact could occur, as determined by local tidal phase and predominant winds.

Studies of surface drifters are useful and illustrative in the study of oil movement because, hopefully, surface slicks will respond to currents in a similar way. A summary of drifter studies across the Gulf (Parker et al., 1979) indicated that the Texas coastline and the southern and eastern Florida coastlines receive the most landings. Other coastlines along the Gulf received very small numbers of landings. A study along the Florida west coast (Williams et al., 1977) found that during fall and winter most reports were from south and eastern Florida. During the spring and summer, the lower west, south, and eastern Florida coastlines received similar landings. Strangely, during summer and fall, the Louisiana and Texas coastlines received sizable fractions of the landings. However, these results contain some bias because populated or frequently visited areas would show more landings than desolated areas.

Figures 6A, 6B, 6C, and 6D of Visual No. 7 for the EIS for Sales 131, 135, and 137 show the seasonal mean winds from a multiyear analysis. An annual cycle of wind direction is indicated: winter winds from the east-northeast; spring winds from the southeast; summer winds from the southeast and south; and fall winds shifting back to the east-northeast. The distribution of wind speeds is shown in Figure 6G of Visual No. 7 for the EIS for Sales 131, 135, and 137. Western summer winds have a mode at 4-6 ms^{-1}, compared to 2-4 ms^{-1} in the Eastern Gulf. Winter winds are stronger in both regions, principally in the 8-10 ms^{-1} interval, which may be due to cold fronts transiting the southeastern United States every 3-10 days in the fall and winter. Not reflected in the wind climatology are the much stronger winds associated with tropical cyclones that frequently move through the greater Caribbean area. The classes of cyclones, and their defining minimum wind speeds, are as follows: tropical depression (up to 16 ms-1); tropical storm (17-31 ms^{-1}); and hurricane (32 ms^{-1} or more). Figure 6E of Visual No. 7 for the EIS for Sales 131, 135, and 137 gives the probabilities that at least one cyclone in the storm or hurricane category will occur in a defined zone in a given year.

A summary of significant wave-height measurements, based on a multiyear analysis, is presented in Figure 6G of Visual No. 7 for the EIS for Sales 131, 135, and 137. Western summer waves tend to be smaller than those in the Eastern Gulf; waves in both regions intensify in winter, with the Western Gulf showing a clear mode at 2-3 m. Not reflected in these results are the much larger waves associated with hurricanes. Figure 6F of Visual No. 7 for the EIS for Sales 131, 135, and 137 displays the hindcast significant wave heights for several hurricanes since the onset of offshore development, indicating a range of about 6-12 m for open shelf waves. Also displayed are the expected 100-year maximum wave heights, which could range to 21+ m.

5. Chemical Oceanography

Regional Overview

The discussion that follows heavily emphasizes hydrography and the productivity aspects of classical chemical oceanography. Process-oriented material is not presented, as no unique mechanisms are known to prevail in the Gulf of Mexico.

The Gulf enjoys the benefit of having been the subject of a number of regional- or basin-scale studies emphasizing chemistry of the water column, and of several valuable reviews. The material synthesized below is derived from an extensive library of sources, some of which are identified by specific information.

Due to the ambience of the medium, space scales far greater than those considered relevant in biological considerations apply to chemical oceanographic assessment. Watermass characterizations are generally applicable at scales on the order of 1,000 km, while processes related to mesoscale-circulation patterns, such as primary production, probably should be described in terms of 100-km scales. For these reasons, the following description is organized to proceed from greater to lesser scales as the emphasis shifts from nearly conservative basinwide characteristics to regionally variable, inshore/offshore parameters.

The Gulf of Mexico is a semienclosed system with oceanic input through the Yucatan Channel and principal outflow through the Straits of Florida. Runoff from approximately two-thirds of the area of the United States and more than one-half the area of Mexico empties into the Gulf. This large amount of runoff, with its nonoceanic composition, is mixed into the surface water of the Western Gulf and makes the chemistry of parts of this system quite different from that of the open ocean. For a discussion of Gulf circulation patterns, see Section III.A.4.

Mixed-Layer Hydrography

Salinity: The mixed layer, extending down to a depth of approximately 100-150 m, is characterized by salinities between 36.4 ppt and 36.5 ppt in the open Gulf. Salinity values in shelf and estuarine regions may vary widely from this range due to the opposing effects of river input and enhanced evaporation. Alternating floods and droughts may cause salinity changes from nearly fresh to 100 ppt, three times that of normal seawater. These variations can lead to mass mortality of marine organisms (Caruthers, 1972; Corcoran, 1973; Nowlin, 1972).

Temperature: In the Eastern Gulf, maximum surface temperatures range from 27°C in late winter to about 30°C in the summer. A range of 22-29°C is observed in the Western Gulf; the difference reflects the steadying influence of the Loop Current (Corcoran, 1973; Dames and Moore, 1979; Flint and Rabalais, 1980; Ichiye et al., 1973; Nowlin, 1972; SUSIO, 1977 and 1978; Williams, 1954; Woodward-Clyde Consultants, 1982). The lowest values encountered may range as low as approximately 10°C in the Louisiana-Mississippi shelf region at times of extraordinary snowmelt in the upper Mississippi valley.

Oxygen: Dissolved oxygen values in the mixed layer average about 4.6 ml/L, with certain seasonal variation, particularly a slight lowering during the summer months. Oxygen values generally decrease to about 3.5 ml/L, with depth through the mixed layer (Caruthers, 1972; Corcoran, 1973; Nowlin, 1972; Williams, 1954).

Watermass Hydrography

Eight specific watermasses are recognized to occur in the Gulf (Table III-3).

Exotic Waters

Hypersaline Basins: Two basins containing hypersaline waters have been identified. Salinities as high as 196 ppt at a small pool on the East Flower Garden topographic high and 250 ppt in the Orca Basin have been measured (Rezak et al., 1985; Addy and Behrens, 1980). Unique regimes may be present at these sites due to the partial absence of oxygenated chemical species.

Midshelf Freshwater Vents: At a number of sites on the southwest Florida shelf, submarine springs are present, found in association with extensive karst topography. Little is known about the chemical regime of the associated biota within these features.

Micronutrients

Nutrient Cycling: The principal micronutrients about which generalizations can be drawn, based on the limited data available, are phosphate, nitrate, and silicate. Phytoplankton consume phosphorus and nitrogen, principally via their ionic species, in an approximate ratio of 1:16 for growth. Silicon is consumed for production of skeletal structures, particularly by diatoms, which are present in enormous numbers in Gulf waters. Mineralization of dead plankters returns the nutrients to the water column, although typically at a greater depth than that of initial assimilation, due to sinking.

Mixed-Layer-Distribution Patterns: Phosphates range from 0 to 0.25 parts per million (ppm), averaging 0.021 ppm. Shelf values do not differ significantly from open Gulf values. Integrated Eastern Gulf values are somewhat lower than Central and Western Gulf values. Silicates range predominantly from 0.048 to 1.9 ppm. Open Gulf values tend to be lower than shelf values. Integrated Eastern Gulf values are again somewhat lower than Western Gulf values. Nitrates range from 0.0031 to 0.14 ppm, averaging 0.014 ppm. Open Gulf values are slightly higher than shelf values. There is no clear pattern in depth-integrated values between regions (Corcoran, 1973; Dames and Moore, 1979; Flint and Rabalais, 1980; Ichiye et al., 1973; Nowlin, 1972; SUSIO, 1977 and 1978; Williams, 1954; Woodward-Clyde Consultants, 1982).

Vertical Distribution: Vertical distributions of nutrients show five general features related to both the identified watermasses and the biological activity: (a) low concentration in the mixed layer (to 100 or 200 m); (b) substantial increase from 200 m to 700 or 800 m; (c) maximum values at approximately 800-1,000 m; (d) small decreases in concentration below 1,000 m; and (e) homogeneous concentrations below about 1,500 m. At the maxima, phosphate concentrations range from 0.14 to 0.23 ppm, silicates from 1.9 to 2.3 ppm, and nitrates from 1.8 to 2.1 ppm (Corcoran, 1973; Dames and Moore, 1979; Flint and Rabalais, 1980; Ichiye et al., 1973; Nowlin, 1972; SUSIO, 1977 and 1978; Williams, 1954; Woodward-Clyde Consultants, 1982).

Table III-3

Water Mass Characteristics in the Gulf of Mexico

Water Mass	Extreme	Concentrations	Depth Range (m)	Location
Gulf Water	Salinity maximum	36.4-36.5 ppt	0-250	Gulfwide
Subtropical Underwater (SUW)	Salinity maximum	less than 36.8 ppt	100-300	Eastern Gulf*
18° Sargasso Seawater 18°SSW	Oxygen maximum	(small and variable)	200-400	Eastern Gulf*
Tropical Atlantic Central Water	Oxygen minimum	2.5-2.9 ml/l	250-400	Gulfwide
Antarctic Inter-mediate Water	Nitrate maximum	29-35 μg-at/l	500-700	Gulfwide
Antarctic Inter-mediate Water	Phosphate maximum	1.7-2.5 μg-at/l	600-800	Gulfwide
Antarctic Inter-mediate Water	Salinity maximum	34.88-34.89 ppt	700-800	Gulfwide
Mixture of North Atlantic Deep Water and Caribbean Mid-Water	Silicate maximum	24-28 μg-at/l	1,000-1,100	Gulfwide

*SUW may occasionally be found in the Western Gulf in eddies detached from the Loop Current. There have also been indications of 18° SSW in detached eddies, but the evidence is slight.

Sources: Barnard and Froelich, 1981; Caruthers, 1972; Corcoran, 1973; El-Sayed, 1972; Iverson and Hopkins, 1981; Nowlin, 1972; SUSIO, 1977 and 1978; Williams, 1954; Woodward-Clyde Consultants, 1982.

Particulate and Optical Parameters

Biological primary production in the Gulf is critically dependent on both chemical and physical factors. The driving photosynthetic mechanism is light-limited; and, due to attenuation processes in the water column, it is ineffective below an average depth of about 75 m, where incident light has been reduced to about 1 percent. The most highly variable component of total light-field attenuation in the water column is the scattering induced by suspended particles, both organic and inorganic. Particles also act as substrates for bacterial activity, transport loci for absorbed species, and act as physical irritants to sensitive biological species. Open Gulf waters have particulate loads ranging from about 0.1 to 0.2 ppm. Over 50 percent of the suspended particulate matter is organic in surface waters, decreasing to about one-third in deeper waters. The inorganic fraction is composed largely of clay minerals, reflecting the importance of the Mississippi River as a source (Hedges and Parker, 1976).

A common phenomenon in the Gulf, especially on the shelf, is the local presence of greatly elevated levels of suspended material, with values above 1 ppm. Typically, near-bottom layers of turbid water are encountered and are separated from overlying waters by sharp discontinuities. These "nepheloid" layers may be associated with resuspension by bottoms currents, internal waves, intense at-depth biological activity, or a complex combination of these factors. These features appear to occur naturally at nearly all locations on the shelf and upper slope environment, excepting the promontories of significant topographic highs.

Primary Production

Productivity Measurements

Regional Distribution: Primary production, the conversion of mineralized nutrients to living phytoplankton tissue as measured by C^{14} uptake, occurs predominantly at the low level of 0.25 $m^C/m^3/hr$ or less throughout the Gulf. Higher levels, between 0.25 and 1.0 units, are found at northeastern and southern locations, with maximum values on the Yucatan shelf. In terms of depth-integrated values, western regions seem to be more productive than the eastern regions (Barnard and Froelich, 1981; El-Sayed, 1972; Iverson and Hopkins, 1981; LaRock and Bittaker, 1973; Williams, 1954).

Depth Distribution: Higher productivity levels are sustained at subsurface levels rather than at the surface. Maximum C^{14} assimilation generally occurs at depths corresponding to 50-25 percent of surface-light intensity (Barnard and Froelich, 1981; El-Sayed, 1972; Iverson and Hopkins, 1981; LaRock and Bittaker, 1973; Williams, 1954).

Seasonal Distribution: Unlike temperate or high-latitude waters where the amplitude of the seasonal variations in productivity is manifold, the amplitude in the Gulf is very much damped. The ratio of maximum (winter) to minimum (spring) integrated productivity is approximately 2:1 (Barnard and Froelich, 1981; El-Sayed, 1972; Iverson and Hopkins, 1981; LaRock and Bittaker, 1973; Williams, 1954).

Chlorophyll Measurements

Regional Distribution: The distribution of chlorophyll closely parallels that of productivity. Most values range from 0.05 to 0.30 mg/m^3 (ppb), with highest values found off the Mexican coast. In terms of depth-integrated values, the region of the Loop Current seems to show higher values for chlorophyll than the Central and Western Gulf (Barnard and Froelich, 1981; El-Sayed, 1972; Iverson and Hopkins, 1981; LaRock and Bittaker, 1973; Williams, 1954).

Depth Distribution: Maximum chlorophyll concentrations occur very deep within the portion of the water column where the light exceeds 1 percent of surface insolation, the euphotic zone. In some cases, maxima are found below the euphotic zone, possibly reflecting sinking plankters. Secondary peaks of chlorophyll above the maximum may be associated with thermal gradients in the water column.

Seasonal Distribution: Maximum (winter) depth-integrated values for chlorophyll exceed minimum (fall) values only by a factor of about 1.2 (Barnard and Froelich, 1981; El-Sayed, 1972; Iverson and Hopkins, 1981; LaRock and Bittaker, 1973; Williams, 1954).

Total Production

Average depth-integrated primary productivity in the Gulf is about 0.1 g^C/m^2/day, for an annual production of 17 g^C/m^2/day. This value is about one-half the average for all the world's seas and one-half to one-fourth the value for the western-central Atlantic. Annual total production for the Gulf is about 43 million metric tons of carbon (Barnard and Froelich, 1981; El-Sayed, 1972; Iverson and Hopkins, 1981; LaRock and Bittaker, 1973; Williams, 1954). Assuming a carbon content of 50 percent in the biomass, a gross annual production of 86 million metric tons can be calculated.

Central Gulf of Mexico

Estuarine and Inner Shelf

Hydrography and Nutrient Chemistry: This area is strongly influenced by the presence of America's major river, the Mississippi, as well as a host of other major drainage systems. A complex geography of sounds and bays protected by barrier islands and extensive tidal marshes acts to delay mixing, resulting in extensive areas of mesohaline (middle salinity) conditions. Turbidity is normally quite high, with suspended sediments up to 1-10 mg/L, primarily composed of clay minerals. The salinity gradients established in estuarine areas are extremely important for the maintenance of finfish and shellfish production; thus, enormous fluctuations in harvest may occur paralleling annual hydrology (Barrett et al., 1971; Christmas and Eleuterius, 1973; Gallaway, 1981; SUSIO, 1977 and 1978; Woodward-Clyde Consultants, 1982).

In general, Louisiana's estuaries and open nearshore waters are low in salinity and high in nutrient concentrations as compared with other states bordering the northern Gulf. These characteristics are due primarily to Louisiana's high rainfall and the large volume of river water that makes its way through rich alluvial soils to the Gulf of Mexico. The major contributors of nutrients to the estuaries are the Mississippi and Atchafalaya Rivers (Barrett et al., 1971; Christmas and Eleuterius, 1973; Gallaway, 1981; SUSIO, 1977 and 1978; Woodward-Clyde Consultants, 1982).

The Mississippi River input acts to create a lens of fresher, more turbid water, often curling to the west. Hydrographic studies, suspended-sediment characteristics, and sensitive chemical analyses demonstrate its influence as far west as South Texas. Of importance is the water-column stratifying effect of this fresh lens on nearshore waters. It is frequently observed during summer months, particularly August, that hypoxic bottom-water conditions exist on the central Louisiana shelf in zones that may extend over 50 km along shore-normal transects. Mass mortality of organisms and characteristic chemical changes also occur. These conditions have serious implications for the continued viability of the local fisheries and for monitoring programs of any sort (Boesch and Rabalais, 1987).

Primary Production: As a probable consequence of the large fluvial input of nutrients, the Louisiana nearshore shelf is considered one of the most productive areas of phytoplankton in the Gulf. Integrated chlorophyll values are two times average Gulf values, and integrated production values range an order of magnitude greater than the Gulf average (Barrett et al., 1971; Christmas and Eleuterius, 1973; Gallaway, 1981; SUSIO, 1977 and 1978; Woodward-Clyde Consultants, 1982).

Outer Shelf and Slope

Hydrography and Nutrient Chemistry: Less is known about the central area than other zones. Observations indicate that the effects of the Mississippi are felt here, although much reduced by distance. Hypoxic bottom waters are not reported, although surface freshening occurs at times of maximal discharge. Upwelling of cooler, nutrient-rich waters onto the shelf is known, but the mechanism is not fully understood since regional circulation patterns remain unclear. The passage of detached, anticyclonic eddies toward the west may be important in this regard. The water column is frequently observed to contain turbid layers associated with interfaces between two or three distinct water layers. A Mississippian origin is suggested for these layers (Gallaway, 1981; Southwest Research Institute, 1981).

Primary Production: No studies characterizing this specific region have been identified. It is believed that values for productivity and chlorophyll approach Gulf averages, but that circulation events, such as the transient effects of passing eddies, might play a role in enhancing these values (Gallaway, 1981; Southwest Research Institute, 1981).

Western Gulf of Mexico

Estuarine and Inner Shelf

Hydrography and Nutrient Chemistry: Nutrient concentrations are generally representative of open-Gulf surface waters, but continental runoff influences nearshore surface concentrations, especially in spring. Nutrients are reduced to extremely low values after spring and summer blooms but are replenished in the fall (Caillouet et al., 1981; Flint and Rabalais, 1980; Gallaway, 1981).

The water column over the inner shelf is very nearly isothermal during the fall, winter, and spring months, showing a slight stratification only in summer. Temperatures characteristic of the mixed layer over the inner Texas shelf range from approximately 11-13°C in late summer. Salinities range from open-Gulf surface values of about 36.4 to 20 ppt or less during the spring runoff or during heavy rainfall. A bottom nepheloid layer is nearly always observed (Caillouet et al., 1981; Flint and Rabalais, 1980; Gallaway, 1981).

Primary Production: Chlorophyll is highly correlated with salinity decreases in this area, indicating the influence of riverine input. The local input from Texas rivers is the major source of freshwater nutrients and turbidity in the region. These effects decrease with distance from shore. Most chlorophyll is found at the bottom of the water column, from the shore out to mid-shelf (Caillouet et al., 1981; Flint and Rabalais, 1980; Gallaway, 1981).

Outer Shelf and Slope

Hydrography and Nutrient Chemistry: Beyond the nearshore region of heavy influence by Texas rivers, the effects of the Mississippi River are more obvious. Although salinity variations are seen to respond to Mississippian input, nutrients do not correspond as closely, due perhaps to some depletion during transit. Overall, the nutrient values are somewhat lower than inshore values. The intrusion of nutrient-rich, oxygen-poor water from apparent depths of 200-300 m is indicated in many cases, with effects seen all the way up to 70 m in depth. An area of major upwelling has been indicated along the shelf break (Flint and Rabalais, 1980; Gallaway, 1981; McGrail et al., 1978).

Primary Production: Productivity on the outer shelf exhibits much less variability, which can be ascribed to riverine input. Chlorophyll values in this area average less than inshore areas, as expected, but an inverse relation with salinity is not found. Aperiodic upwelling events are probably of primary importance in regulating offshore production in this area (Flint and Rabalais, 1980; Gallaway, 1981; McGrail et al., 1978).

Eastern Gulf of Mexico

Estuarine and Inner Shelf

Hydrography and Nutrient Chemistry: The major influence on this zone is atmospheric forcing combined with the seasonal input from fluvial sources. Pockets of high salinity (greater than 36.8 ppt) may be found on the bottom, possibly produced by enhanced evaporation during the summer. It is very rare for Loop Current waters to intrude landward of the 20-m contour, bringing nutrient-rich waters. In general, resident waters remain nutrient deficient with the exception of the immediate vicinity of estuaries. Oxygen values are at or near saturation, and profiles show little structure. Extraordinary blooms of pathogenic phytoplankton, known as "red tide," may occur on the mid- to inner-shelf. These outbreaks may be associated with rare Loop Current intrusions, nutrient flux from estuaries, or both (Corcoran, 1973; Dames and Moore, 1979; Ichiye et al., 1973; LaRock and Bittaker, 1973; SUSIO, 1977 and 1978; Woodward-Clyde Consultants, 1982).

Primary Production: Outside the estuaries, productivity values generally are low.

Outer Shelf and Slope

Hydrography and Nutrient Chemistry: The major influence in this zone is undoubtedly the pervasive influence of the Loop Current. It is fairly well-established that the Current acts to pump nutrient-rich, deeper waters up onto the shelf. This mechanism acts most demonstrably during the passage of frontal eddy structures and may be reinforced by wind-driven upwelling. Near-bottom increases in particle content are a usual condition, but the explanation consists of a complex summation of occasional bottom-current effects and enhanced productivity at depth. Watermasses present range from surface mixed-layer characteristics to upwelled, subtropical underwater (SUW) characteristics (Corcoran, 1973; Dames and Moore, 1979; Ichiye et al., 1973; LaRock and Bittaker, 1973; SUSIO, 1977 and 1978; Woodward-Clyde Consultants, 1982).

Primary Production: Both chlorophyll and productivity values at the surface are normally low in this area, with the significant exception of patches of enhanced activity occurring within the upwelled parcels of colder waters found in cyclonic circulation cells associated with Loop Current frontal eddies. Chlorophyll and productivity values about an order of magnitude greater are probably the usual condition near the bottom of the euphotic zone due to the often intruded, nutrient-rich Loop undercurrent waters (Corcoran, 1973; Dames and Moore, 1979; Ichiye et al., 1973; LaRock and Bittaker, 1973; SUSIO, 1977 and 1978; Woodward-Clyde Consultants, 1982).

6. Water Quality

a. Offshore

Degradation of offshore waters is primarily associated with effluent discharges from offshore enterprises, consisting of OCS activities and marine transportation. As of December 1988, some 26,645 wells have been drilled within the Central and Western Gulf of Mexico (USDOI, MMS, 1989b). Production from these wells has been estimated at 7.8 billion bbl of oil (BBO)/condensate and 73 trillion cubic feet (tcf) of gas. Potential discharges associated with these activities are estimated at 13.6 million yd^3 of drill cuttings, 58.6 million bbl (MMbbl) of drilling muds, and up to 66 billion bbl (Bbbl) of produced waters. Historically, the highest concentration of oil and gas activity within the Gulf has taken place southward of Timbalier Bay, Louisiana, and eastward to an area some 20 mi east of the Mississippi River Delta. Estimated produced water discharges here range from 0.5 to 1.5 million gal/m^2/yr (USDOC, NOAA, 1985). A general description of marine water quality is provided in Section III.A.5.

During production of oil and gas, fossil or connate water located in the permeable sedimentary rock strata may be brought up to the surface. On average, 8.42 bbl of produced waters are discharged for every barrel of oil produced, and 17.7 MMbbl of produced water are generated per trillion cubic feet of gas. Produced waters may be high in total dissolved solids, total organic carbon, petroleum hydrocarbons, some trace metals and elemental sulfur and sulfide, and may be low in dissolved oxygen. Although much of the water produced from OCS oil and gas operations is discharged directly at offshore production platforms into surrounding waters, some of the water is piped ashore and then treated and disposed of at coastal separation facilities. The major discharges from offshore oil and gas exploration and production activities include produced water, drilling fluids and cuttings, ballast water, and storage displacement water. Drilling fluids are required in rotary drilling for oil and gas exploration and development to remove cuttings from beneath the bit, to control well pressure, to cool and lubricate the drill string, and to seal the well. Drilling fluids must be eventually disposed of for a number of reasons, as must drill cuttings from the drilled formation. Although drilling discharges can be barged ashore or to other sites at sea for disposal, cost and operational considerations favor on-site disposal by either overboard discharge or shunting through a pipe to some depth.

All ocean dumping is regulated by the Marine Protection, Research, and Sanctuaries Act of 1972. A USEPA permit is required for all ocean dumping of industrial wastes and municipal sludge materials. Ocean dumping of sewage sludge and industrial wastes is no longer permitted. The USEPA had one designated deep-water disposal area in the Gulf of Mexico. The site was designated for the incineration of hazardous wastes, but the disposal area was officially de-designated on February 27, 1991 (56 FR 8133-8135). Dredged Material Disposal Sites, mostly located in State waters, are used for the disposal of dredged material from the U.S. Army Corps of Engineers channel-dredging programs.

The Louisiana Offshore Oil Port (LOOP) is the only deep-water port in the Gulf. It is located in 35 m (115 ft) of water in Grand Isle Block 59, approximately 30 km (19 mi) from shore. The purpose of a deep-water port is to provide offshore terminal facilities for offloading oil from tankers too large (typically supertankers with drafts greater than 40 ft and up to 700,000 dwt) for conventional ports and to transport the oil to shore via pipeline, thus avoiding the need for lightering.

Sulphur is produced from leases in Federal waters in the Gulf of Mexico. This information is presented in Section IV.B.3.c., "Sulphur Operations."

The most significant contributions of marine transportation to cumulative impacts in the Gulf are from the tankering of imported crude oil. Extensive refinery capacity, easy port access, and a well-developed, onshore-transportation system have contributed to the development of the Gulf Coast region as an important center for handling imported oil and production from other domestic sources such as Alaska and California. Crude-oil tankering routinely contributes to contamination of the marine environment in two ways: (1) Operational discharges occur when oily bilge water is pumped overboard and during tank cleaning and ballasting. Tankers' bilges must be periodically pumped out to remove oil and water collected in the lower part of the ship's hull from leaking pipes, valves, and machinery. Bilge water may first be put into a settling tank to separate the oil from the water. Some vessels pump bilge water through an oil-water separator, which can significantly reduce the amount of oil discharged. (2) Oil is usually discharged during tank cleaning because some oil inevitably remains in the tanks after offloading. Also, ships that do not have segregated ballast tanks take on seawater into "empty" oil tanks for use as ballast. When discharged, this water will contain the oil residue left in the tank. United States and international regulations generally prohibit any operational discharges within 80 km (50 mi) of land and require that no more than 15.8 gallons (60 liters) of oil be discharged per nautical mile. In addition, no vessel may discharge more than 1/15,000 of its dwt.

Accidental spills normally result from collisions and groundings. In 1988, about 6 percent of the tanker fleet was involved in collisions or groundings (Kasoulides, 1988). Approximately 92 percent of all spills occur in port (Oil Spill Intelligence Report, 1982). Since 1974, there have been 35 tanker spills of either crude oil or refined products greater than 1,000 bbl in the Gulf area (USDOI, MMS, 1990a); 19 of these spills were crude oil. While spills capture the attention of the general public, operational discharges occurring from tanker transportation of oil account for the majority of oil discharges. The National Academy of Sciences' report (NRC, 1985) estimated that total losses of oil from transportation activities ranged from 7.4 to 19.2 MMbbl per year, with a best estimate of 10.7 MMbbl per year. About one-half of this amount is attributed to ballast water operational discharges from oil tankers (about 5 MMbbl annually); the remainder being attributed to bilge water and fuel oil released from all vessel movement in the ocean (about 2 MMbbl annually), terminal operations (about 150,000 bbl annually), dry-docking (about 222,000 bbl annually), and accidental spills (about 3 MMbbl annually).

b. Coastal and Nearshore

River outflows into the Gulf of Mexico, primarily that of the Mississippi River, determine coastal and nearshore water quality. The Mississippi River is also the most significant source of pollution to this area. Major point and nonpoint sources of contaminants occurring along the Gulf Coast include the petrochemical industry; hazardous waste sites and disposal facilities; agricultural and livestock farming; citrus processors; chemical manufacturing industry operations; fossil fuel and nuclear power plant operations; pulp and paper mill plants; silviculture; commercial and recreational fishing; municipal wastewater treatment and individual septic-tank effluents; coastal maritime commerce activities, especially at ports; dredging of harbors, docks, navigation channels, and pipeline canals; the USEPA dredged-material disposal-site program; and urban expansion. The petrochemical industry operations include oil and gas exploration, development, and production operations; pipeline transport; tanker and barge movement of both imported and domestic petroleum products and crude oils; petroleum and petrochemical refinery and processing operations; and oil-field waste disposal. There is a substantial amount of domestic waterborne commerce along the Gulf Coast that does not always use open Gulf waters. Vessels engaged in this activity generally use the Gulf Intracoastal Waterway (GIWW), which follows the coastline inshore and through bays and estuaries, and in some cases from offshore Fort Myers, Florida, to Brownsville, Texas.

At service bases and marine terminals, hydrocarbons and other pollutants are discharged in the bilge and ballast waters of support vessels docking at these facilities. The bases and support vessels also contribute contaminants through their use of antifouling marine paints and through accidental oil-spillage events and the release of heavy metals and contaminated sludge. Pipecoating yards, platform-construction facilities, and repair and maintenance yards contaminate surrounding waters by releasing thermal effluents, radioactive substances, antifouling paint chemicals, heavy metals, and a variety of process waters, as well as solid waste such as packaging materials, metal scraps, and other debris. Gas processing plants and refineries discharge a number of types of wastewaters, including cooling and boiler waters, sanitary and domestic wastewaters, and process waters. These waters may be contaminated with dissolved hydrocarbons, sulfuric acid, chromium, zinc, phosphates, alkaline substances, and suspended solids. The following discussion on wastewater effluents discharged to surface waters by OCS-related support facilities is largely taken from NERBC (1976).

Wastewater effluents from OCS-related support facilities are commonly discharged to surface waters after treatment. Although the degree of environmental damage, if any, is related directly to the toxic nature of the discharge and the biota in the receiving waters, certain characteristics of the discharge zone are important. These characteristics include the size of the effective mixing zone (dilution factor) or the ratio of discharge volume to receiving volume, the flushing rate of residence time (estuaries characteristically have a slow flushing rate), and the physical-chemical characteristics of the receiving waters (e.g., marine waters have a higher buffering capacity than fresh or estuarine waters).

Construction of onshore support bases and ancillary access facilities and associated hydrologic modifications would result in runoff and other nonpoint source pollution to the surrounding water bodies. Navigation channels and canals and other water bodies may be diked, leveed, or impounded; piers, bulkheads, and beach-stabilization actions may be undertaken. To construct the support facility, the site must be prepared, roadways and bridges may need to be built, sewage and stormwater systems installed, and groundwater or adjoining bodies of water accessed for water use. During preparation, the vegetation is cleared from the area, the topsoil is exposed, and the soil profile is altered by grading and leveling operations. The soil is compacted by the constant movement of heavy machinery, which in turn alters the retention properties of the soil and gives rise to increased erosion and runoff from the site. Land clearing and associated development changes the natural process of stormwater runoff, causing the volume and rate of runoff to increase as the natural vegetation is modified.

Increases of nonpoint source pollution due to runoff at support facilities contribute particulate matter, heavy metals, petroleum products, chemicals, and radionuclides (particularly from pipe yards) to local streams, estuaries, and bays, causing temporary elevations in pollutant and turbidity levels. Two major pollutants contained in this runoff include suspended solids (organic and inorganic) from exposed soil at the site and contaminants such as heavy metals. Suspended solids may significantly decrease light penetration in water and lead to oxygen depletion of bottom waters, and they may contain nutrients that increase growth rates of endemic plant and animal populations.

Commercial oil and gas industry waste facilities used by both the OCS and State oil and gas industry have caused a number of environmental problems associated with their management and the disposal practices at the sites, particularly along the Gulf Coast (USEPA, 1987; Hall, 1990; Subra, 1990). With regard to water resources, the principal types of damage caused by these wastes include contamination of water supplies for human, livestock, and agricultural uses; damage to aquatic vegetation; and impairment of aquatic and terrestrial wildlife habitats. Subra (1990) documented the damage caused by commercial facilities located in Vermilion Parish, Louisiana, and reported that three of these facilities are now on the Superfund list.

Improper storage or disposal of drums containing solvents, corrosion inhibitors, and biocides used in drilling operations also presents a potential for environmental problems. Likewise, the improper design and management of storage tanks at commercial oil-field disposal facilities poses the potential for causing adverse impacts to surrounding surface and ground waters and wetland areas.

Low dissolved oxygen (below 3-4 mg/l) occurs in the summer in Gulf coastal waters because of combined high nutrient or organic matter levels, high water temperatures, high benthic metabolic rates, low light penetration, and weak winds resulting in density stratification. These low dissolved-oxygen levels, called hypoxia, have been measured in recent years in Gulf Coast estuaries and along portions of the inner continental shelf.

A good indicator of coastal and estuarine water quality is the quality of bivalve molluscans harvested from its waters. Because they are filter feeders, these bottom dwellers may concentrate pollutants and pathogens, as well as marine biotoxins, that are unrelated to human activities. A combination of point and nonpoint sources affect approximately half of the harvest-limited waters in the Gulf (USDOC, NOAA, 1988b). Most of the productive oyster reefs in Gulf estuaries are in conditionally approved areas or areas where shellfish harvesting is affected by predictable levels of pollution.

The National Mussel Watch Program was established to determine the long-term temporal and spatial trends of selected environmental contaminants in bays and estuaries nationwide. Sediment and oyster samples are collected at some 50 sites across the Gulf of Mexico and are analyzed for contaminant concentrations, disease incidence, and other parameters to determine contaminant distributions. Based on Year I and II findings, chlorinated hydrocarbons (primarily PCB and DDT compounds) were present in Gulf coastal sediments. Moderately elevated concentrations of pesticides and PCB appeared along the central Louisiana coastline and at isolated stations in Texas (Matagorda and Galveston Bays). Maximum concentrations of chlorinated hydrocarbons were observed along the Mississippi to northern Florida coast and at stations in Tampa Bay. Based on tissue samples examined, the geographical trends in organochlorine loadings in oysters follow those observed in sediments (Texas A&M University, 1988).

Central Gulf of Mexico

The Central Gulf region is characterized by water quality problems resulting from the discharge or release of industrial and domestic wastes. The Mississippi River, as well as a number of other major drainage systems, strongly influences the region. A major source of contaminants to the coastal and nearshore waters is from upstream runoff into the Mississippi River-Atchafalaya River system. A complex geography of sounds and bays and extensive tidal marshes acts to delay mixing, resulting in extensive areas of mesohaline (middle salinity) conditions. In general, compared with the waters of other states bordering the northern Gulf, Louisiana's estuaries and open nearshore waters are low in salinity and high in nutrient concentrations. Elevated nutrient levels can result in eutrophication of water bodies, causing algal blooms and fish kills. Estuaries on the northern coast, such as Mobile Bay and Lake Pontchartrain, receive large loads of nutrients from local sources and experience such problems. Hypoxia (low dissolved oxygen levels) is a recurrent summer phenomenon in bottom waters off Louisiana's inner continental shelf, occasionally extending as far westward as Freeport, Texas. This event is linked to density stratification caused by late spring river discharges and inorganic and organic nutrient inputs (Boesch and Rabalais, 1987). Estuaries along the Central Gulf coast where hypoxia has been noted include Perdido Bay, Mobile Bay, Mississippi Sound, Pascagoula Bay, Biloxi Bay, Lake Pontchartrain, and Calcasieu Lake. Mobile Bay is unique in that it has become hypoxic in the winter (USDOC, NOAA, 1985).

Boesch and Rabalais (1989a) indicated that of the 2 MMbbl (434,772 bbl/day [BPD] from OCS activities) of produced waters discharged into Louisiana waters daily, 23 percent is discharged into fresh marsh, 22 percent into brackish marsh, and 17 percent into salt marsh environments. The remaining 38 percent is discharged into open embayments or nearshore Gulf waters. The largest number of discharges are located in the Terrebonne (199 discharge points) and Barataria (136 discharge points) estuarine systems. The largest aggregate volumes are reportedly discharged in Chandeleur Sound (416,000 BPD), the Mississippi River Delta (402,000 BPD), and Barataria Bay (363,000 BPD) estuarine systems.

Due to their high salinities, Gulf Coast produced waters are generally much denser than Louisiana inland waters. Boesch and Rabalais concluded that produced-water discharges can act as dense plumes after discharge into estuarine waters. Produced waters can contain various radionuclide and volatile and semivolatile organic hydrocarbon contaminants. Boesch and Rabalais demonstrated that produced-waters discharged into Louisiana waters contained high concentrations of petrogenic hydrocarbons, with sediments near these effluents contaminated with semivolatile organic hydrocarbons. Petroleum contamination was noted in sediments up to 1 km from discharge sites. Reid surveyed several Louisiana produced-water effluents and found radium 226 (Ra-226) levels ranging from 131 $\pm$ 3 to 393 $\pm$ 7 picoCuries per liter (pCi/l). The natural Ra-226 activity in Louisiana surface waters is below 1.0 pCi/l; for Louisiana soils, levels range from less than 1.0 to 7.0 picoCuries per gram (pCi/g) (Louisiana Dept. of Environmental Quality, 1989). Ra-226 levels for open ocean waters and marine sediments average 2 pCi/l and 1-17 pCi/g, respectively. Some of these discharges have been found to contain high levels of toxic metals (vanadium, copper, and arsenic) and organics; these levels represent a significant negative impact to confined (poorly flushed) waterways. Because of the hydrology of such systems and the particle reactive nature of the metals and organics being discharged, it has been anticipated that these substances will continue to accumulate at high levels within sediments in proximity to the discharge (St. Pé, 1990). Louisiana DEQ reports indicate that 70 percent of the produced water from oil-field operations in Louisiana is discharged into surface waters.

In March 1991, the Louisiana State Legislature approved regulations banning the discharge of all wastewater (primarily produced water) associated with oil and natural gas exploration and production activities. The State's effluent guideline standards have been amended such that there shall be no discharge of produced water into State waters after January 1, 1995, unless the discharge(s) is authorized in an approved elimination schedule or is in effluent limitation compliance. Produced water shall not be discharged within 1,300 ft of an active oyster lease, live natural oyster or molluscan reef, designated oyster seed bed, or seagrass bed.

Western Gulf of Mexico

The Texas coastal area has been plagued with numerous water quality problems. Most of these problems have occurred in the Houston-Galveston and Beaumont-Port Arthur areas where the majority of Texas energy facilities are located. The use of the adjacent water bodies as effluent receiving systems has seriously impacted surface water quality. A second influence, inland movement of offshore, saline waters into more brackish and fresh waters, referred to as saltwater intrusion, has also been identified as a significant water quality problem for both Texas and Louisiana. While nutrient concentrations in the Western Gulf are generally representative of open Gulf surface waters, continental runoff influences nearshore surface concentrations, especially in spring. Estuaries on the Texas coast where hypoxia has been noted include Sabine Pass, Galveston-East-West Bays, Corpus Christi-Nueces Bays, and Lower Laguna Madre. Galveston Bay receives large loads of nutrients from local sources and has experienced eutrophication problems. Texas coastal counties identified as receiving the greatest heavy metal discharges include Calhoun, Harris, Orange, and Jefferson (USDOC, NOAA, 1985).

Boesch and Rabalais (1989a) estimated the total volume of produced waters discharged into Texas waters at 823,575 BPD, including 87,721 BPD (11%) into those designated as "inland." The Texas Railroad Commission stated there were no discharges of OCS-generated produced waters in Texas coastal waters. By far the greatest volume of these waters is discharged into the Galveston-Trinity estuarine system. Within this estuary there are 208 discharge points that deliver an estimated 400,000 BPD. Matagorda-Lavaca and Corpus Christi-Nueces estuarine systems receive substantial produced-water discharges from 32 discharge points (approximately 200,000 BPD) and 54 discharge points (approximately 60,000 BPD), respectively.

B. BIOLOGICAL RESOURCES

1. Sensitive Coastal Environments

a. Barrier Beaches

Coastal barrier landforms consist of islands, spits, and beaches that stretch in an irregular chain from Alabama to Texas. These elongated, narrow landforms are composed of sand and other unconsolidated, predominantly coarse sediments that have been transported and deposited by waves, currents, storm surges, and winds. Barrier landforms are young coastal features. They began to form 5,000 to 6,000 years ago after the main mass of continental ice sheets had melted and the global rate of sea-level rise began to slow.

The term "barrier" identifies the structure as one that protects other features, such as bays, lagoons, estuaries, and marshes, from the direct impacts of the open ocean. By separating coastal waters from the ocean, barriers contribute to the amount of estuarine habitat available along the coast. As much as two-thirds of the high-value Atlantic and Gulf species of fish are considered to be directly dependent during some stage of their life on conditions in an estuary (Clark, 1976). Another benefit of both the barriers and their adjacent marshes and bays is that of providing habitats for a large number of birds and other animals, including several threatened or endangered species, such as the loggerhead turtle, the southern bald eagle, the alligator, and the brown pelican.

Barrier landforms are relatively low landmasses that are continually adjusting their configuration in response to changing environmental conditions. Landform changes can be seasonal and cyclical, such as the transition from a summer (swell wave) beach to a winter (storm wave) beach, or they can be indicative of a trend, such as a net landward movement of a feature. The long-term survival of fixed structures, such as roads, buildings, and power lines, constructed on a barrier landform can often be jeopardized by the changing and migratory nature of the barrier features. Some types of construction or stabilization projects on barrier landforms may actually encourage erosion, especially when the project interferes with longshore or shore-normal sediment movements.

The MMS has funded a study entitled *Pipelines, Navigation Channels, and Facilities in Sensitive Coastal Habitats: An Analysis of Outer Continental Shelf Impacts, Coastal Gulf of Mexico* (Wicker et al., 1989) to examine the impacts of pipeline and navigation-canal installations on barrier islands in the Western and Central Gulf of Mexico. The results of this study indicate that, in many cases, these projects have not resulted in alterations of coastal landforms or processes compared to control sites. Where jetties have been installed to stabilize navigation channels at barrier passes, some accelerated erosion downdrift from the jetties has been observed. In one case (Belle Pass, Louisiana), however, the deposition of the material excavated during maintenance dredging operations downdrift from the jetties resulted in slower erosion rates than compared to updrift locations. Wicker et al. (1989) did not find evidence that pipeline landfalls on barrier beaches had up to now either resulted in accelerated erosion near the crossing or formed zones of weakness where island breaching preferentially occurred. They did point out, however, that in the future, as islands narrow because of coastal erosion, open-ditch pipeline canals could become sites of accelerated erosion or island breaching.

Coastal barriers consist of several component environments. The beach itself consists of the foreshore, the sloping part of the beach facing the ocean, and the backshore, the part of the beach from the berm crest to the dunes. The dune zone of a barrier landform can consist of a single dune ridge, several parallel dune ridges, or a number of curving dune lines that are stabilized by beach grass. In most cases, the berm grades into the dune zone, but sometimes the berm may be missing and the beach foreshore may be adjacent to the dunes. Overwash fans are located behind the dunes along barriers whose dunes are breached by storm surges. Along more stable barriers, the area behind the dunes consists of broad, vegetated flats. These flats grade into wetlands and intertidal mud flats that fringe the shore of lagoons and embayments. In other areas, barriers can be located right against the mainland with no bay or lagoon separating the two landforms.

The accumulation and movements of the sedimentary deposits that make up barriers are often described in terms of transgressive and regressive sequences. Transgressions and regressions are related to local relative sea-level change and the rate of sedimentation and erosion. A transgressive sequence is one in which the shore moves landward and marine deposits rest on terrestrial deposits. In contrast, a regressive sequence is one in which terrestrial sediments are deposited over marine sediments as the land builds out into the sea.

Transgressive barrier landforms have a predominantly low-profile morphology. These barriers are characterized by narrow widths; low, sparsely vegetated and discontinuous dunes; and numerous, closely spaced active washover channels. Transgressive barriers are usually undergoing active erosion. Regressive barriers, in contrast, have high-profile morphologies including broad widths; high, continuous, and well-vegetated sand dunes; few, if any, washover channels; parallel accretion ridges; and thick accumulations of sand. Both transgressive and regressive barriers occur in the Gulf of Mexico.

The barrier landforms of the Central Gulf of Mexico occur in three settings. From east to west, these include the barrier islands of Mississippi Sound, the Mississippi River deltaic plain barriers, and the barriers of the Chenier Plain in Louisiana. The Mississippi Sound barrier islands are relatively young, having formed some three to four thousand years ago as a result of shoal-bar aggradation (Otvos, 1979). The positions of the islands have not changed significantly since that time. The islands are well vegetated by a southern maritime climax forest of pine and palmetto. The islands generally are regressive with high beach ridges and prominent sand dunes. Although overwash channels do not commonly occur, the islands may be overwashed during strong storms. The islands in general are stable, with no trend toward erosion or thinning of the island but with a trend toward westward migration in response to the predominantly westward-moving longshore currents. An exception to this general rule is Dauphin Island, Alabama, which is essentially a low-profile transgressive barrier island, except for a small Pleistocene core at its eastern end. The western end is a Holocene spit that is characterized by small dunes and washover fans with marsh deposits and tree stumps exposed in the surf zone. The Mississippi Sound islands are separated from each other by tidal inlets with deep, wide channels. These channels have associated ebb and flood tidal deltas. Shoals are adjacent to all the barriers. The barriers are separated from the mainland by the Mississippi Sound. Most of the Mississippi Sound barrier islands are included in the Gulf Islands National Seashore.

Louisiana has the most rapidly retreating beaches in the nation. The average retreat rate for Fourchon Beach over the past 100 years has been in excess of 18 m/yr. The statewide average exceeds 3.6 m/yr (Dolan et al., 1982). Beaches along the deltaic plain in Louisiana fit into one of three categories, depending on the stage of the deltaic cycle that the nearby landmass is experiencing. When a major distributary of the Mississippi River is abandoned, subsidence results in a local sea-level transgression that transforms the active delta into an erosional headland with flanking barriers. Fourchon Beach is an example of an eroding headland beach. With increased age and subsidence, the barrier shoreline evolves into a transgressive barrier-island arc that is separated from the mainland by a lagoon. Isles Derniers is an example of a barrier that underwent the transformation from a headland beach to a barrier arc within the past century. Eventually, with continued subsidence and sediment deprivation, the island ceases to exist, its remnant forming a submarine inner-shelf shoal (Penland and Boyd, 1985).

The Chenier Plain is located farther to the west in Louisiana. Here, the coast is fronted by sand beaches and coastal mudflats. The source of the mud is the discharge of the Mississippi and Atchafalaya Rivers, which tends to drift westward along with the prevailing winds and associated nearshore currents. Fluid mud extends from the seaward edge of the marsh grasses to a few hundred yards offshore. The mud is an extremely effective wave-energy absorber. Consequently, the mainland shore is rarely exposed to effective wave action except during storms. The sand beaches occurring along the Chenier Plain rest against the mainland marshes. Although the beaches consist of only a thin accumulation of sand and although some parts of the coast are experiencing erosion, on the average, much of the Chenier coast has a stable configuration.

From the Texas-Louisiana border to Rollover Pass, Texas, the Texas coast is a physiographic continuation of the Chenier Plain. Here, thin accumulations of sand, shell, and caliche nodules make up beaches that are migrating landward over tidal marshes. These beaches are narrow and have numerous overwash features and local, poorly developed sand dunes.

The rest of the Texas coast is a continuous barrier shoreline. The barrier islands and spits were formed from sediments supplied from three deltaic headlands: the Trinity delta, which is immediately west of the Sabine River, in Jefferson County; the Brazos-Colorado Rivers delta complex in Brazoria and Matagorda Counties; and the Rio Grande delta in southernmost Cameron County.

The Texas barriers are arranged symmetrically around these erosional deltaic headlands. Erosional and accretionary barriers are about evenly split. Erosional barriers have developed along the deltaic headlands and tend to be narrow, sparsely vegetated, and have a low profile and numerous washover channels. Accretionary (regressive) barriers occur on either side of retreating deltaic headlands and tend to be wide; to have prominent vegetated dunes; and to contain few, if any, washover channels. Accretionary barriers grade into erosional barriers within interdeltaic embayments.

Climate is an important variable that affects the Texas coast. Texas is the only Atlantic or Gulf State with a significant climate range. The climate changes from humid-subtropical in the east to semiarid in the south. South of Corpus Christi, the annual evaporation exceeds the precipitation, and the landscape has an arid appearance. On high-profile, southern barriers, vegetation is sparse; and nearly continuous winds have built high dunes.

The Central and Western Gulf Coast includes barrier islands that are part of the National Park System. These are the Padre Island National Seashore along the south Texas coast and the Gulf Islands National Seashore offshore Mississippi. Within the Central Gulf, the Gulf Islands National Seashore includes Ship, Horn, and Petit Bois Islands offshore Mississippi and the Davis Bayou area along the mainland where the park administrative offices and visitor center are located. The islands include about 50 km (30 mi) of beaches fronting the Gulf of Mexico. Padre Island consists of North and parts of South Padre Islands and includes about 130 km (80 mi) of beaches. These islands were included in the National Park System because they were notable examples of relatively pristine barrier settings, including broad, sandy beaches, prominent sand dunes, fringing wetlands, and broad sounds or lagoons that separate the islands from the mainland. Laguna Madre behind Padre Island is notable because it is one of the few examples of a hypersaline marine lagoon in the United States. Congress considered the preservation of these habitats an important national goal because these types of settings were rapidly disappearing as a result of commercial, residential, and recreational developments.

Numerous specific, high-value features are located within these seashores. A wide diversity of cultural resources occur within the seashores, including Fort Massachusetts, an important Civil War site on Ship Island; several archaeological sites; and shipwreck sites in the vicinity of Padre Island. The islands are also important recreational areas. Annual visitation to the Gulf Islands Seashore has ranged from about 250,000 to nearly 1,000,000 during the 1980's (USDOI, NPS, 1988). In recent years, the Padre Island National Seashore has been receiving about 1,000,000 visitors annually (USDOI, NPS, 1982). The islands also are being used as habitat for replenishing the populations of endangered species, including the bald eagle and the red wolf. The diversity of environments within the seashores, including shorefront, wetlands, sand dune, and lagoonal habitats, offers visitors opportunities for personal and educational enrichment.

b. Wetlands

Wetland habitat types occurring along the Gulf Coast include fresh, brackish, and saline marshes; forested wetlands; and small areas of mangroves. Marshes and mangroves form an interface between marine and terrestrial habitats, while forested wetlands occur inland from marsh areas. Wetland habitats may occupy narrow bands or vast expanses and can consist of sharply delineated zones of different species, monotonous stands of a single species, or mixed-plant-species communities.

The importance of coastal wetlands to the coastal environment has been well documented. Coastal wetlands are characterized by high organic productivity, high detritus production, and efficient nutrient recycling. Wetlands provide habitat for a great number and wide diversity of invertebrates, fish, reptiles, birds, and mammals. Wetlands are particularly important as nursery grounds for juvenile forms of many important fish species. The Louisiana coastal wetlands support over two-thirds of the Mississippi Flyway wintering waterfowl population (including 20-25% of North America's puddle duck population) and the largest fur harvest in North America (from 40 to 65% of the nation's total per year) (Olds, 1984).

Louisiana contains most of the Gulf coastal wetlands. These wetlands occur in two physiographic settings--the Mississippi River Deltaic Plain and the Chenier Plain. The present wetlands on the deltaic plain formed on top of a series of overlapping riverine deltas that have extended onto the continental shelf during the past 6,000 or so years. These wetlands are established on a substrate of alluvial and organic-rich sediment that is subject to high, natural-subsidence rates. The effects of subsidence are compounded by sea-level rise, which has been occurring during the past several millenia. Under natural conditions, sedimentation encourages vertical accretion of wetland areas and may offset the submergence and inundation that result from subsidence and sea-level rise. Areas of the deltaic plain that are located near an active channel of the Mississippi River tend to build outward, and marsh areas tend to expand. At the same time, areas located near inactive, abandoned channels tend to deteriorate and erode as a result of the lack of sediment.

The Chenier Plain, located to the west of the Atchafalaya Bay in the western part of coastal Louisiana, is a series of separate ridges of shell and sand, oriented parallel or oblique to the coast, that are separated by progradational mudflats that are now marshes or open water. The mudflats are built during times when the Mississippi River channel is located on the western side of the deltaic plain or when minor changes in localized hydrologic and sedimentation patterns favor deposition in the Chenier area.

The deterioration of coastal wetlands, particularly in Louisiana, is an issue of concern. In Louisiana, the annual rate of wetlands loss has been measured at 130 km^2 for the period 1955-1978. A recent study has shown that the current rate of landloss on the Deltaic Plain area of the Louisiana coast has decreased to about 90 km^2 per year (Britsch and Kemp, 1990). Several factors contribute to wetlands loss in coastal Louisiana, including sediment deprivation (a result of a 50% decrease in the suspended-sediment load of the river since the 1950's and the channelization of the river, which has prevented overbank sediment deposition), subsidence and sea-level rise, and the construction of pipeline and navigation canals through the wetlands.

The MMS recently funded a study entitled *Causes of Wetland Loss in the Coastal Central Gulf of Mexico* (Turner and Cahoon, 1987). This study investigated how wetland habitats have changed in the northern Gulf of Mexico as a result of natural processes and human activities. The study's primary focus was on assessing and quantifying the direct and indirect impacts of OCS-related activities on wetland areas since the 1950's. Canal construction for pipelines and navigation has been the major OCS-related impacting factor.

Direct impacts were defined as those physical alterations that are the direct result of canal construction. Direct impacts include wetlands alterations resulting from the actual dredging of the canal, the disposal of dredge spoil, and any subsequent widening of the canal as a result of channel-bank erosion. Based on the study's findings, OCS-related direct impacts have accounted for 16 percent of all the direct impacts that have occurred in Louisiana's wetlands (12,000 ha out of 74,000 ha). Direct OCS impacts account for only 4-5 percent of the total wetlands loss during the period 1955/1956 to 1978. The average areal impact per kilometer of constructed pipeline was estimated at 2.5 ha. In recent years, more stringent construction regulations have required that pipelines installed across wetlands be backfilled with spoil material immediately after the pipeline is emplaced in its ditch. The study showed that the backfilling of pipeline canals reduced direct impacts to 0.7-1.0 ha/km. Direct impacts per unit length of OCS-related navigation canals are about 20 times greater than OCS pipeline canals.

Indirect impacts are those that occur as a result of hydrologic changes (salinity and drainage regimes) brought on by canal construction. Indirect impacts from canals associated with the OCS program have been estimated as accounting for 4-13 percent of the total amount of wetland loss that occurred in coastal Louisiana between 1955/1956 and 1978 (Turner and Cahoon, 1987). Turner and Cahoon calculated this range by dividing the length of OCS canal spoil banks by the length of all canal spoil banks (OCS, State onshore oil and gas, general navigation, and drainage canals), and then multiplying this proportion by the range of estimates of the contribution of indirect impacts in general. They assumed that the proportion of spoil banks attributable to OCS dredging could be used as a direct surrogate for the proportion of indirect impacts attributable to OCS dredging.

The MMS does not consider this method of indirect impact determination acceptable for analytical use in the EIS. This conclusion is based on two considerations: the calculation of the proportion was based on untested and inaccurate assumptions and the method did not incorporate the data collected and analyzed in the body of the study, even though the data were relevant to the issue.

Concerning the first point, MMS questions the indirect impact percent allocation numbers as they were derived by Turner and Cahoon. As stated by the authors, OCS spoil banks may have been overestimated in their calculations because OCS canals and spoil banks tend to be large and thus more visible on remote-sensing imagery. Also, the Turner and Cahoon study only reveals a number for the length of OCS spoil banks. The length of all spoil banks (the number used in the denominator of their proportion) is not revealed within the study, nor is the methodology that was used to determine this unrevealed number indicated. Furthermore, the study defined indirect losses as all wetland losses minus the direct losses attributable to canal dredging and urban, residential, and agricultural development. The contribution of sediment deprivation and subsidence were not factored into the indirect losses, even though many researchers believe these factors to be the base cause of wetlands loss in the area. Turner and Cahoon (1987), in essence, inappropriately allocated a proportion of the impacts of sediment deprivation to OCS canals. Based on the above discussion, MMS cannot validate the accuracy of the study's apportionment of indirect impacts to OCS canals.

In addition, the study data generated from field, laboratory, modeling, and remote-sensing analysis efforts were not used in developing the indirect impact proportion number, even though much of the data were relevant to the issue. An important hypothesis within the study was that the indirect impacts of canals could affect wetlands through the influence of canals on saltwater intrusion and through the influence of associated spoil banks on sedimentation and drainage patterns. The study, however, did not document a relationship between saltwater intrusion and marsh loss, nor did the study show a statistically valid correlation between spoil banks and vertical rates of marsh accretion. The computer analyses of remote-sensing imagery did not establish a statistically valid relationship between either canal density or proximity to a canal and marsh loss. While the data did not confirm the hypothesized mechanisms of indirect impacts, the study did document a greater than 50 percent reduction in the suspended sediment discharge of the Mississippi River since the 1950's and a widespread accretionary deficit within the wetlands of coastal Louisiana. These data, which did not confirm the hypothesized mechanisms of indirect wetland loss but suggested an emphasis on sedimentary deficits and subsidence as causes of marsh loss, were not brought into the methodology for assessing OCS indirect impacts.

To conclude, the range of indirect impact numbers derived in the study were not based on the body of data generated by the study, but were instead developed using an indirect and incomplete approach that could have been done even in the absence of the study data. The MMS considers the Turner and Cahoon estimates to be no more reliable and better supported by field data than any of the other attempts in the past to determine the role of indirect impacts.

In Mississippi and Alabama, the mainland marshes behind Mississippi Sound occur as discontinuous wetlands associated with estuarine environments. The most extensive wetland areas in Mississippi occur east of the Pearl River delta near the western border of the State and in the Pascagoula River delta area near the eastern border of the State. The wetlands of Mississippi seem to be more stable than those in Louisiana, perhaps reflecting the more stable substrate and more active sedimentation per unit of wetland area. Also, there have been only minor amounts of canal dredging in the Mississippi wetlands. Wicker et al. (1989) have studied the impacts of three pipeline canals in the Mississippi wetlands near the Pearl River delta. One of the pipelines was backfilled after construction; no noticeable geologic or botanic impacts were observed along the pipeline route. The two other pipelines were installed with the open-ditch dredging method and the canals had not been backfilled. The open ditches did not revegetate and had, in fact, widened over time as a result of channel-bank erosion. No indirect impacts, however, were observed in the marshes away from the canals as has been frequently observed in Louisiana.

Most of the wetlands in Alabama occur on the Mobile River delta or along northern Mississippi Sound. Between 1955 and 1979, fresh marshes and estuarine marshes declined in these area by 69 and 29 percent, respectively. On a percentage basis, wetlands loss has occurred more rapidly in Alabama during these years than it did in Louisiana. Major causes of non-fresh wetland losses were industrial development and navigation, residential and commercial development, natural succession, and erosion/subsidence. The loss of fresh marsh was mainly attributable to commercial and residential development and silviculture (Roach et al., 1987).

In Texas, coastal marshes occur along the inshore side of barrier islands and bays and on river deltas. Salt marshes consisting primarily of smooth cordgrass occur at lower elevations and at higher salinities. Brackish marshes occur in transition areas landward of salt marshes on slightly higher elevations and at greater distances from saltwater bodies. Freshwater marshes of the region occur primarily along the major rivers and tributaries. Sparse bands of black mangroves are also found in this region. Broad expanses of emergent wetland vegetation do not commonly occur south of Baffin Bay at the northern edge of Kenedy County because of the arid climate and hypersaline waters to the south. In these areas, *Spartina alterniflora*, the most common salt-marsh grass elsewhere in the Gulf, occurs rarely in salt marshes. Common salt-marsh plants here include more salt-tolerant species such as *Batis maritima* and *Salicornia* (White et al., 1986).

Wetland changes observed in Texas during the past several decades appear to be driven by subsidence and sea-level increases. Open-water areas are appearing in wetlands along their seaward margins, while new wetlands are encroaching onto previously non-wetland habitat along the landward margin of wetland areas on the mainland, on the back side of barrier islands, and onto spoil banks. In addition, wetlands are being affected by human activities including canal dredging, impoundments, and accelerated subsidence caused by fluid withdrawals. The magnitudes of these wetland acreage changes in most of Texas have not been determined at the present time. In the Freeport, Texas, area along the Louisiana border, wetlands loss is occurring at rates similar to those occurring in adjacent parts of the Louisiana Chenier Plain. In the Sabine Basin area of coastal Texas, for example, 20,548 ha wetlands were lost between 1952 and 1974 (Gosselink et al., 1979).

Seagrasses

There are an estimated 3,000,000 ha of submerged seagrass beds in the exposed, shallow coastal waters of the northern Gulf of Mexico. An additional 166,000 ha confined to the natural embayments are considered unexposed and are not dealt with in detail for this report. The area off Florida contains the vast majority of such beds, containing approximately 98.5 percent of all coastal seagrasses in the northern Gulf of Mexico. Coastal seagrass beds in Texas and Louisiana comprise approximately 0.5 percent of the exposed seagrasses, with Mississippi and Alabama the remaining 1 percent of the habitat. A combination of low salinity and high turbidity accounts for the narrow bands and scattered patches of seagrasses occurring between Louisiana and Laguna Madre, Texas.

The beds grow in shallow, relatively clear and protected waters with predominantly sand bottoms. Their distribution depends on an interrelationship among a number of environmental factors that include temperature, water depth, turbidity, salinity, and substrate suitability. In general, the luxuriant growth of seagrasses and the concomitant high diversity of associated marine species are found only within a few scattered protected locations in the Central and Western Gulf of Mexico.

Turtle grass (*Thalassia testudinum*), the largest of the common species, is most commonly found forming dense beds at water depths of less than 10 m and may possess a rhizome buried up to 25 cm below the seafloor. In terms of biomass production, turtle grass is one of the most prolific of the seagrass species, with average biomass values of 500-3,100 g/m^2, and extremes up to 8,100 g/m^2 (values summarized from Zieman, 1982). Manatee grass (*Syringodium filiforme*) possesses very long, thin leaves, with vegetative reproduction from the shallowly buried rhizome, which is less massive than that found in turtle grass. Shoal grass (*Halodule wrightii*) may be considered a "pioneer species" in that it is important in colonizing disturbed areas and deeper water areas beyond the ranges of the more coastal species.

Seagrasses dominate the aquatic floral habitat in the estuarine communities along the Texas coast. Dominant species include shoal grass (*Halodule wrightii*) and widgeongrass (*Ruppia maritima*). These species occur in abundance due to their ability to sustain salinity variations that occur in a number of the lagoon and bay systems of Texas. The Laguna Madre and Copano-Aransas estuaries account for the major portion of the seagrass populations. Seagrasses are less common in Corpus Christi Bay because of the Bay's greater water depth. These seagrasses provide an important habitat for immature shrimp, black drum, spotted seatrout, juvenile southern flounder, and several other fish species; and they provide a food source for several species of wintering waterfowl.

The turbid waters and soft sediments of Louisiana's estuaries limit widespread distribution of seagrass beds. Consequently, there are only a few areas in coastal Louisiana where seagrass beds occur. The most extensive beds occur in Chandeleur Sound. Seagrasses also occur within Mississippi Sound.

The distribution of seagrass beds in the Central and Western Gulf have diminished during recent decades. The primary factors believed to be responsible for these conditions include hurricanes, freshwater diversions from the Mississippi River during flood stage into coastal areas, dredging activities, and water quality degradation.

2. Sensitive Offshore Resources

The term "offshore habitats" refers to the water column and the seafloor. Seafloor (benthic) habitats are the most likely to be adversely affected by offshore oil and gas operations, especially live-bottom areas, deep-water benthic communities, and topographic features; these sensitive habitats are treated in some detail in Sections III.B.2.a., b., and c. below.

Water-column biota include the plankton and nekton. In general, the diversity of planktonic species decreases with decreased salinity, and biomass decreases with distance from shore.

Nekton are dominated by five major taxonomic categories--marine mammals, reptiles, fishes, cephalopod mollusks, and crustaceans. Individuals may range over broad areas; however, most nekton are limited to geographical and vertical ranges by the same environmental conditions as less motile organisms, that is, temperature, salinity, and available food. Most of the fishes of the Gulf shelf habitats are temperate, with incursions of Caribbean faunas; they exhibit seasonal distribution and abundance fluctuations that are probably largely related to oceanographic conditions.

Generalizations regarding water-column habitats are difficult to make because of the patchy nature of biotic distributions, which tend to congregate in patches of various sizes that move with the prevailing winds and currents. Endangered and threatened species are described in Sections III.B.3.-6. below, marine mammals in Section III.B.3., birds in Section III.B.5., and fishes and fisheries in Sections III.B.6., and III.C.3. and 4. Benthic communities of the continental shelf and slope are discussed in general terms before treating the three specific offshore habitats most likely to be impacted by the leasing proposals.

Continental Shelf

The benthos has both floral and faunal components; the floral representatives being algae and seagrasses. The abundance of benthic algae is limited by the scarcity of suitable substrates and light penetration. Rezak et al. (1983) recorded algae from submarine banks off Louisiana and Texas. In exceptionally clear waters, benthic algae, especially coralline red algae, are known to grow in water depths to at least 183 m. Offshore seagrasses are not conspicuous in the Central and Western Gulf; however, fairly extensive beds may be found in estuarine areas behind the barrier islands throughout the Gulf as discussed in Section III.B.1.c. Seagrasses would be continuous around the entire periphery of the Gulf if it were not for the adverse effects of turbidity and low salinity of the Mississippi River effluent from the delta to Galveston (Humm, 1973).

Benthic fauna include the infauna (animals that live in the substrate, such as burrowing worms and mollusks) and epifauna (animals that live on the substrate, such as mollusks, crustaceans, hydroids, sponges, and echinoderms). Shrimp and demersal fish are closely associated with the benthic community. Substrate is the single most important factor in the distribution of benthic fauna (Defenbaugh, 1976), although temperature and salinity are also important in determining the extent of faunal distribution. Other lesser important factors include illumination, exposure to air, nutrient availability, currents, tides, and wave shock. Defenbaugh (1976) states that depth and/or distance from shore should also be considered as major influences on the benthic faunal distribution.

In general, the vast majority of the benthos of the Central and Western Gulf consists of soft, muddy bottoms dominated by polychaetes. Benthic habitats that are at the most risk to potential impacts from oil and gas operations are those of the topographic features, discussed in Section III.B.2.c. below, and the pinnacle trend live bottom, discussed in Section III.B.2.a. below.

Although not in the planning area for these proposed sales, the Florida Middle Ground is probably the best known and most biologically developed of the Eastern Gulf live bottoms, with extensive inhabitation by hermatypic (reef building) corals and related communities. This area is 160 km (87 nmi) west-northwest of Tampa and has been designated as a Habitat Area of Particular Concern (HAPC) by the Gulf of Mexico Fishery Management Council (50 CFR 638). Within the HAPC, bottom longlines, traps and pots, and bottom trawls are prohibited. The taking of any coral is prohibited except as authorized by permit from the National Marine Fisheries Service (NMFS).

The Florida Middle Ground represents the northernmost extent of coral reefs and their associated assemblages in the Eastern Gulf (Bright and Jaap, 1976; Rezak and Bright, 1981). The Middle Ground is similar to the Flower Garden Banks off Texas--typical Caribbean reefal communities--although both are depauperate in terms of the number of species present, probably because it is considered to be at the northern limit of viable existence for these types of coral communities (Bright, personal comm., 1975; Hopkins et al., 1977). Coral reef communities are exceedingly complex and have been treated at length by Bright and Jaap (1976) and Faulkner and Chesher (1979). It is sufficient to state that, in general, hermatypic corals require temperatures of 18°-30°C, with the optimum at about 26°C; salinities from 36-40 ppt, with the optimum at 36 ppt; little pollution and nutrient load; and adequate light (i.e., little turbidity). In the Caribbean they may grow as deep as 80 m, while in the Gulf they seem to be limited to a depth of about 40 m (Bright and Jaap, 1976). The Middle Ground reefs rise essentially from a depth of 35 m, and the shallowest portions are about 25 m deep. Significantly productive areas comprise about 12,126 ha (29,943 ac).

The Florida Middle Ground supports numerous Caribbean fish, corals, and invertebrates. This is probably due to the intrusion of the Loop Current, short periods of low temperatures, and high organic productivity.

A total of 197 species of fish, with largely tropical West Indian affinity, have been reported at the Middle Ground (Rezak and Bright, 1981). The benthos of the Florida Middle Ground is composed of hard and soft corals, sponges, and algae. The hard corals include *Madracis decactis, Porites divaricata, Dichocoenia stellaris,* and *Dichocoenia stokesii*. Octocorals, relatively minor components of other Gulf reefs, are prominent at the Middle Ground. Dominant octocorals include *Muricea elongata, M. laxa, Eunicea calyculata,* and *Plexaura flexuosa*. The biota of the Middle Ground is sensitive to environmental change, as documented by Rezak and Bright (1981).

Although also not in the planning area for these proposed sales, the Florida Keys comprise an important shallow-water, tropical, coral-reef ecosystem that is unique on the continental shelf of North America. Coral reefs are closely interrelated and interdependent with other marine and terrestrial communities that compose the coastal ecosystem. Energy, chemical constituents, and mobile species move between the reefs and other communities, including mangrove, seagrass, sedimentary, and hardground communities. In addition, the coral reefs of the Keys are important to the economy of Florida. Commercial and recreational fishing, as well as such nonconsumptive uses as boating, scuba diving, snorkeling, and educational and natural history activities are big businesses (Jaap and Hallock, 1990a).

Jaap and Hallock (1990) have recently reviewed the Florida Keys ecosystem. A brief summary of that work may be found in Section III.B.2. of the Final EIS for Sales 131, 135, and 137 (USDOI, MMS, 1990a).

In addition to their ecological, recreational, and commercial importance, the Keys have a certain intrinsic value aesthetically. This value, while difficult to quantify, is certainly significant and is partly recognized by the establishment of three National Marine Sanctuaries in the Keys. Looe Key and Key Largo are popular recreational sites with active educational programs. The large Florida Keys National Marine Sanctuary has recently been designated, and a management plan for it is currently under development. These, along with the potential designation of the Flower Garden Banks as a Marine Sanctuary, demonstrate the commitment of the nation to preserve the important and relatively rare coral reef ecosystems.

Continental Slope and Deep Sea

The deep-sea area of the northern Gulf of Mexico is much less known than the shelf. Pequegnat (1983) reported observations based on 264 oceanographic stations between 150 and 3,850 m in an area including the DeSoto and Alaminos Canyons, the Mississippi Trough and Fan, and the Sigsbee Abyssal Plain. There are some remarkable biotal differences in the deep ecosystem of the Gulf. In fact, the biotal differences justify referring to the Western Gulf (corresponds to WPA and CPA) as the "true" Gulf and the Eastern Gulf (corresponds to EPA) as a divergence of the Atlantic Ocean via the Caribbean Sea (Pequegnat, 1983; LGL Ecological Research Associates, Inc. and Texas A&M University, 1986).

The highest values of surface primary production are found in the upwelling area north of the Yucatan Channel and in the region around surface DeSoto Canyon. In the oceanic region, the Western Gulf is, in general, more productive than the Eastern Gulf. It is generally assumed that, perhaps except for brief periods during major plankton blooms, the zooplankton consume all the phytoplankton produced. In turn, they excrete a high percentage of their food intake as feces that sink to the bottom. Most of the herbivorous zooplankters are copepods, with calanoids the dominant group (Pequegnat, 1983).

The topographic and physical oceanographic conditions present at East Breaks in the Western Gulf are such that a nutrient-rich upwelling could be expected in the vicinity. The NMFS has reported that the area is an important recreational billfishing area. The upwelling may contribute to this fishery.

Beneath the euphotic zone and extending to within a meter or so of the bottom is a huge mass of water that beyond the shelf is largely devoid of sunlight. This is the aphotic zone where photosynthesis cannot occur and where the processes of food consumption, biological decomposition, and nutrient regeneration take place in the cold and dark waters. The lowermost layer is the bottom itself together with the contiguous water a meter or so in thickness. This is the benthic zone, repository of sediments from above, where nutrient storage and regeneration take place in association with the solid and semisolid substrate (Pequegnat, 1983).

The slope is a transitional environment influenced by processes on the shelf and the abyssal Gulf. This transition applies both to the pelagic and the benthic realm. The general conclusions that may be reached are as follows: (a) the shelf phyto- and zooplankton are more abundant, more productive, and seasonally more variable than the deep Gulf plankton; (b) in these respects, the slope plankton are intermediate but closer to the condition of the deep Gulf; and (c) each of the three regions is characterized by some planktonic species that are more or less specific to a particular zone. Some east-west differences have been noted, especially among the diatom species. These species have also been interpreted as representing the differences between normal Gulf waters and those influenced by Mississippi River water (Pequegnat, 1983).

Most of the benthic fauna of the deep slope and abyssal plain are restricted to these depths and are not found elsewhere. The 450-m isobath defines the truly deep-sea fauna. The deep-water benthic fauna have been characterized into seven faunal assemblages by Pequegnat (1983) and confirmed by LGL Ecological Research Associates, Inc. and Texas A&M University (1986):

> The Shelf/Slope Transition Zone (150-450 m) is a very productive part of the benthic environment. Demersal fish are the dominant species, many of them reaching their maximum populations in the zone. Asteroids, gastropods, and polychaetes are common.
>
> The Archibenthal Zone - Horizon A Assemblage is located between 475 and 750 m. Although less abundant, the demersal fish are a major constitutent of the fauna, as are gastropods and polychaetes. Sea cucumbers are more numerous. Horizon B, located at 775-950 m, represents a major change in the number of species of demersal fish, asteroids, and echinoids, which reach maximum populations here. Gastropods and polychaetes are still numerous.
>
> The Upper Abyssal Zone is located between 975 and 2,250 m. Although the number of species of demersal fish drops, the number that reaches maximum populations dramatically increases. This indicates a group uniquely adapted to the environment. Sea cucumbers exhibit a major increase, and gastropods and sponges reach their highest species numbers here.
>
> The topographic and physical oceanographic conditions present at East Breaks in the Western Gulf are such that a nutrient-rich upwelling could be expected in the vicinity. The NMFS has reported that the area is an important recreational billfishing area. The upwelling may contribute to this fishery.
>
> At the onset of the Mesoabyssal Zone - At Horizon C (2,275-2,700 m) a sharp faunal break occurs. The number of species reaching maximum populations in the zone drops dramatically for all taxonomic groups.
>
> The Mesoabyssal Zone - Horizon D Assemblage, located at 2,725-3,200 m, coincides with the lower part of the steep continental slope in the Western Gulf. Since the Central Gulf is dominated at these depths by the Mississippi Trough and Mississippi Fan, the separation of Horizon C and D assemblages is not as distinct in the Central Gulf. The assemblages differ in species constitution.
>
> The Lower Abyssal Zone is the deepest of the assemblages at 3,225-3,850 m. Megafauna is depauperate. The zone contains an assemblage of benthic species not found elsewhere.

Chemosynthetic communities of the deep sea are discussed in Section III.B.2.b. below.

a. Live Bottoms (Pinnacle Trend)

The northeastern portion of the Central Gulf of Mexico exhibits a region of topographic relief, the "pinnacle trend," between 67 and 110 m (220 and 360 ft) depth. The pinnacles appear to be carbonate reefal structures in an intermediate stage between growth and fossilization (Ludwick and Walton, 1957). The region contains a variety of features from low to major pinnacles, as well as ridges, scarps, and relict patch reefs. It has been postulated that these features were built during lower stands of the sea during the rise in sea level following the most recent ice age. The heavily indurated pinnacles provide a surprising amount of surface area for the growth of sessile invertebrates and attract large numbers of fish.

The pinnacles are found at the outer edge of the Mississippi-Alabama shelf between the Mississippi River and DeSoto Canyon. The bases of the pinnacles rise from the seafloor between 50 and 100 m with vertical relief occasionally in excess of 20 m. These features exist in turbid water and contain limited biotal coverage. Pinnacles photographed in 1985 showed biota similar to the transitional antipatharian-zone assemblage described by Rezak (CSA, 1985). These pinnacles may provide structural habitat for a variety of pelagic fish. Schroeder et al. (1988) have noted the diversity of habitat types in the offshore waters of Mississippi-Alabama. The MMS, through the studies program, is further studying the extent and importance of the pinnacle area.

With the exception of the region defined as the pinnacle-trend areas, the substrate in waters shallower than 67 m of the Central Gulf is a mixture of mud and/or sand (Vittor and Associates, Inc., 1985). The live-bottom surveys required by MMS and conducted in the eastern portions of the area have also revealed sand or mud substrate. These areas are not conducive to "live-bottom" community growth since a hard substrate is needed for epifaunal attachment. As the substrate grades to carbonate sand in the Eastern Gulf, the potential for "live bottoms" increases.

The following description of the pinnacle-trend region is taken from the Mississippi-Alabama Marine Ecosystems Study (MAMES), as described by Brooks et al. (1989).

> Biological assemblages dominated by tropical hard-bottom organisms and reef fishes occupy a variety of topographic features that exist between 60 and 110 m in the northeastern Gulf of Mexico between the Mississippi River and DeSoto Canyon. The origins of the carbonate features vary. Some are small, isolated, low to moderate reefal features or outcrops of unknown origin. Some appear to be hard substrates exposed by erosion during sea level still-stands along late Pleistocene shorelines. Others appear to be small reefs that existed near these shorelines. The largest features appear to have been offshore reefs. Formation of the largest features probably occurred prior to the Holocene Transgression. Some additional growth of these features and growth of other smaller reefs on exposed substrates may have taken place during the early transgressional period. The structure of the summits of some reefs may also have been modified by Holocene erosional events following their initial period of growth (namely, the flat-topped reefs). Most currently appear to be deteriorating under the influence of bioerosional processes.
>
> The hermatypes that contributed to the development of these structures probably included coralline algae, reef-building corals, bryozoans, foraminiferans, and molluscs, among others. Present-day production of calcium carbonate is probably limited to an impoverished calcareous algae population on features above 70-75 m. Features below this depth can most likely be considered completely drowned reefs.
>
> The topographic features in the northeastern Gulf may be of similar age and origin to those that exist in a number of areas along the Gulf of Mexico OCS and the east coast of the United States. The depth ranges of many of these features are similar, and most are non-growing reefs inhabited by tropical to warm temperate, hard-bottom organisms most commonly found below the depths of living coral reefs.
>
> Present-day biological assemblages on features in the northeastern Gulf are dominated by suspension feeding invertebrates. Populations are depauperate on features of low topography, those in habitats laden with fine sediments and at the base of larger features (where resuspension of sediments limits community development). On larger features, the diversity and development of communities appears to depend on habitat complexity; that is, containing extensive reef flats on their summits, there are rich assemblages distinguished by a high relative abundance of sponges, gorgonian corals (especially sea fans), crinoids, and bryozoans. Due to the generally accordant depth of flat-topped reefs (62-63 m), coralline

algae are also in abundance. Other organisms on reef flats include holothurians, basket stars, and myriads of fish (mostly the roughtongue bass, *Holanthias martinicensis*). On reefs lacking this reef-flat habitat, as well as on reef faces of flat-topped features, the benthic community is characterized by a high relative abundance of ahermatypic corals (both solitary and colonial scleractinians). Other frequently observed organisms on these rugged, often vertical reef faces include crinoids, gorgonians, sea urchins, and basket stars.

Human impact in these environments appears to be minimal at present. Discarded debris, though present at many sites, was not abundant and, therefore, poses little threat to the environment. Cables and ropes can affect shallower reef communities, but probably have little impact at these depths once they become tangled on or lodged against reefal structures. Fishing pressure on these relatively small features may reduce the population of the larger, commercially important species, and may explain the abundance of smaller individuals of unprofitable species on heavily fished reefs.

b. Deep-water Benthic Communities

Chemosynthetic clams, mussels, and tube worms, similar (but not identical) to the hydrothermal vent communities of the eastern Pacific (Corliss et al., 1979) have been discovered in the deep waters of the Gulf and have been the subject of numerous MMS site-specific reviews. These cold-water communities are associated with seismic wipe-out zones and hydrocarbon seep areas between water depths of 400 and 1,000 m (Kennicutt and Gallaway, 1985; Brooks et al., 1986a). Clams of the genus Calyptogena, probably C. ponderosa, were identified from the Gulf seep communities. Chemosynthetic worms from the family Lamellibrachiidae and a new undescribed family were found in the Gulf seep communities. The seep communities are characterized by white bacterial mats; large dense beds of tube worms, clams, and mussels; numerous small gastropods; and galatheid crabs (Kennicutt and Gallaway, 1985; LGL Ecological Research Associates, Inc. and Texas A&M University, 1986).

After the initial discovery of the chemosynthetic organisms in the Central Gulf, 12 trawls were conducted by Texas A&M University in the Green Canyon Area in 300- to 500-m water depth. Chemosynthetic organisms were collected at most of these trawl transects. Additionally, through separately funded studies, phototransects documented the location of chemosynthetic organisms at various widespread locations in the Green Canyon Area in water depths from 450 to 950 m. The Offshore Operators Committee funded a study through Texas A&M University (Brooks et al., 1986b) to determine the extent of these communities in the Gulf and their correlation with hydrocarbon seepage. This study included 39 stations located between 180- and 900-m water depth and included the East Breaks, Garden Banks, Green Canyon, Ewing Bank, Atwater Valley, and Mississippi Canyon lease areas. Thirty of the stations sampled exhibited shallow seismic wipe-out zones. (Wipe-out zones are characteristic of gas-charged, hydrate-containing, and oil-stained sediments.) Of the 39 stations sampled, 28 yielded chemosynthetic organisms. Only two of the nonchemosyntheticstations exhibited conditions where chemosynthetic communities might be expected, that is, wipe-out zones, oil-stained sediments, gas pockets, or sediment H_2S odor. The study indicates that there is a strong correlation between seismic wipe-out zones and the occurrence of chemosynthetic communities. Chemosynthetic organisms can thus be expected to occur on or near these wipe-out zones throughout the Gulf where water depths are comparable to the study area. Additionally, chemosynthetic organisms are widespread throughout the deep slope, although normally concentrated in very sparse concentrations of less than one animal per m^2 (Brooks et al., 1986b).

In late 1986, LGL Ecological Research Associates, Inc., and Texas A&M University conducted further surveys as part of the MMS deep-sea study using the research submersible Johnson-Sea Link I. The surveys discovered a surprisingly large and diverse community of chemosynthetic tube worms and mussels at a site of natural petroleum and gas seepage, over a salt diapir, in Green Canyon Block 185. The seep site, dubbed Bush Hill, is a small knoll that rises about 40 m above the surrounding seafloor of about 540-m water depth. The following description of this community, the densest and most diverse so far discovered, is from Brooks et al. (1989):

The sediment in this area consists of silty-clay and is of considerable thickness, although much of the sedimentary facies have been wiped out by rising gas and liquid and by in situ formation of authigenic carbonate and sulfides.

The sediments of the depauperate periphery are pale ochre with an easily disturbed flocculent layer. Traces of fish are seen, including burrows and shallow depressions and mounds, but very few organisms are seen. Carbonate outcroppings can be seen, ranging from rubble to prominent boulders. The larger boulders are topped by gorgonians, which are in turn frequently encrusted by large ophiuroids. Large colonies of the scleractinian coral Lophelia sp. are also seen attached to the exposed portions of the boulders. Filigreed patches of bacteria can be observed on the sediments. Closer to regions of greater community density, the bacteria patches increase in area and are interspersed with the slender (3.5 mm) black tubes of a pogonophoran tube worm. The most prominent feature of the dense area of the community are bushes of tube worms.

Two species of vestimentiferan tube worms have been collected from Bush Hill. An undescribed mytilid mussel forms discrete beds on both soft sediments and among carbonate outcroppings. Mussels and tube worms have been observed together; however, the larger mussel beds usually contain only stunted tube worms, if any. The beds are irregular in shape, often in close proximity to each other, and range in area from less than 1 m^2 to approximately 20 m^2.

Streams of bubbles, primarily methane, can be observed escaping from the substrate, both within the mussel beds and in their immediate vicinity. Some of these bubble streams are intermittent releases; others continued throughout the period of observation. Disturbance of the bottom in the vicinity of methane streams can cause the release of large oil globules, which float upward. Such releases of oil can also be observed in other locations, usually as a result of some disturbance of the bottom. A dense orange-colored mat of bacteria often covers the oily sediments.

A diverse assemblage of common slope fauna has been observed at Bush Hill. Bathypelagic organisms include tunicates, squid, and trichiurid fishes. Crustaceans include decapod crabs, shrimp, and a giant isopod (Bathynomous gigas).

Other chemosynthetic sites have similar biota, although none known are so dense and diverse as Bush Hill.

Investigations into these new and interesting areas continue. Brooks et al. (1987) showed that the worms, clams, and mussels contain autotrophic bacterial symbionts. The worms and clams contain intracellular sulphur bacterial symbionts, while the mussel symbionts are methane based. Evidence for the presence of nitrogen-fixing bacteria in the community was also presented. Kennicutt et al. (1988) demonstrated the relationship between the chemical environment induced by hydrocarbon seepage (H_2S, CH_4, and oil) and chemosynthetic processes on the deep slope. These environments are closely linked to the massive seepage of oil and gas (and can be detected in the geophysical record by the presence of "wipe-out" zones) and the resulting anaerobic, H_2S-rich sedimentary conditions. The natural seepage of hydrocarbons may represent a significant source of hydrocarbons to the deep oceans, and chemosynthetic biomass appears to be an important component of the slope ecology in the areas studied. MacDonald et al. (1989) demonstrated a very close relationship between the density of tube worms and mussels and concentration of organic material derived from the seep. Brooks et al. (1989) described the chemosynthetic communities studied by their group at Texas A&M University, including Bush Hill, described above.

Similar communities have also been discovered in the Eastern Gulf, at the base of the Florida Escarpment, in 3,270-m water depth (Paull et al., 1984). These, too, have been shown to rely on chemosynthesis for organic production (Paull et al., 1985). A full description of these scarp communities may be found in Hecker (1985).

Cary et al. (1989) have shown that although the vestimentiferan worm and the mussel live contiguously, they rely on different substrates for chemoautotrophy. A variety of analytical methods indicate that the tube worm relies on sulfide oxidation and the seep mussel on methane oxidation for growth.

Chemosynthetic communities have been a source of controversy over the past few years, in part because of the unusual environmental requirements and the hypothesized sensitivity of the communities to oil and gas activities. The MMS requires site-specific surveys of bottom-disturbing actions in water depths greater than 400 m in order to judge the potential of the region for supporting chemosynthetic organisms. Figures III-2 and III-3 delineate the regions of the Gulf of Mexico in which these reviews have been made. The review of site-specific activities has been accomplished since 1984, with over 80 blocks examined to date. NTL 88-11, issued by the MMS, Gulf of Mexico OCS Regional Office in late 1988 and effective on February 1, 1989, formalized the process. The NTL was published and mailed to all affected leaseholders.

c. Topographic Features

The shelf and shelf edge of the Central and Western Gulf are characterized by topographic features that are inhabited by benthic communities (Figure III-4). The habitat created by the topographic features is important in several respects: they support hard-bottom communities of high biomass, high diversity, and high numbers of plant and animal species; they support, either as shelter, food, or both, large numbers of commercially and recreationally important fishes; they are unique to the extent that they are small, isolated areas of such communities in vast areas of much lower diversity; they (especially the East and West Flower Garden Banks) provide a relatively pristine area suitable for scientific research; and they have an aesthetically attractive intrinsic value.

The benthic organisms on these features are temperature and light limited. The 16°C-isotherm is stressful for most coral and is considered the lower limit for coral growth (Rezak et al., 1983). Elevated temperatures can also cause thermal stress by causing the corals' zooxanthellae to be expelled. Where light is limited, coral growth is inhibited. Therefore, coral growth is limited by water depth and by distance from surrounding substrate and nepheloid layer. Because the coral communities must be close enough to the surface of the water for adequate light penetration and yet removed from the seafloor to escape the effects of the nepheloid layer, the topographic features (or banks) present the proper conditions for coral growth.

Rezak et al. (1983 and 1985) identified seven distinct biotic zones on the banks of the Gulf. None of the banks contain all of the seven zones. The zones are divided into the following four categories dependent upon the degree of reef-building activity in each zone.

Zones of Major Reef Building and Primary Production

Diploria-Montastrea-Porites Zone

This zone is characterized by 18 hermatypic coral species. The dominant species of the zone in order of dominance are *Montastrea annularis*, *Diploria strigosa*, *Montastrea cavernosa*, *Colpophyllia* spp., and *Porites asteroides*. The biotic zone was named before the order of dominance was known; therefore, the name does not reflect the true order of dominance. Coralline algae are abundant in the *Diploria-Montastrea-Porites* Zone, adding substantial amounts of calcium carbonate to the substrate. Leafy algae are sparse, probably due to grazing. Typical sport and commercial fish that frequent the *Diploria-Montastrea-Porites* Zone include grouper, hind, amberjack, barracuda, red and vermilion snapper, cottonwick, porgy, and creole fish. This high-diversity coral-reef zone is found only at the East and West Flower Garden Banks in water depths less than 36 m.

Madracis Zone and Leafy Algae Zone

The *Madracis* Zone is dominated by the small branching coral *Madracis mirabilis*, which produces large amounts of carbonate sediment. In places, large (possibly ephemeral) populations of leafy algae dominate the *Madracis* gravel substratum (Leafy Algae Zone). The *Madracis* Zone appears to have a successional relationship with the *Diploria-Montastrea-Porites* Zone. Madracis remains build up the substrate and allow the successional species to grow. The zone occurs at the Flower Gardens on peripheral parts of the main reefal structure between 28 and 46 m.

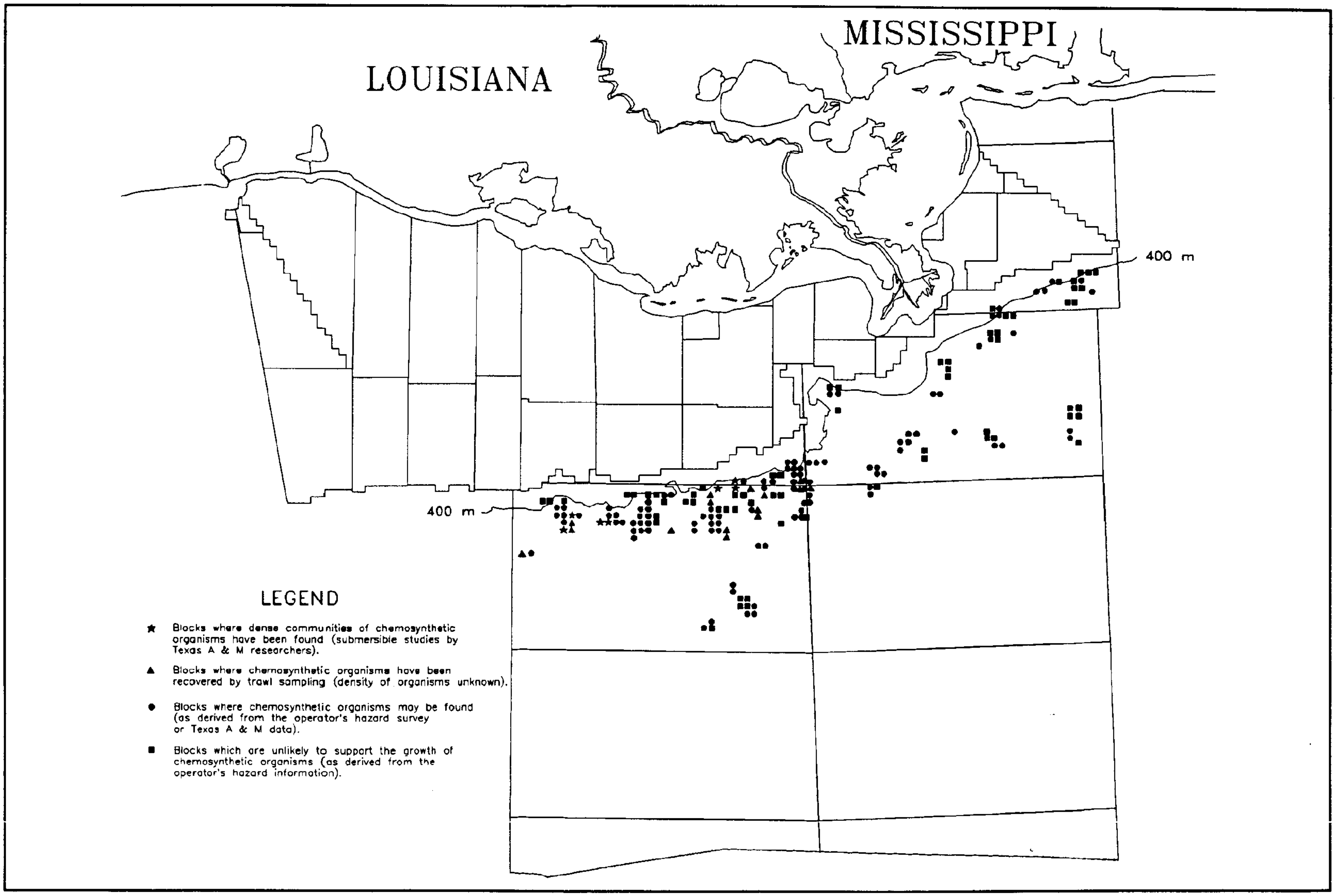


Figure III-2. Location and Description of Chemosynthetic Communities in the Central Gulf of Mexico.

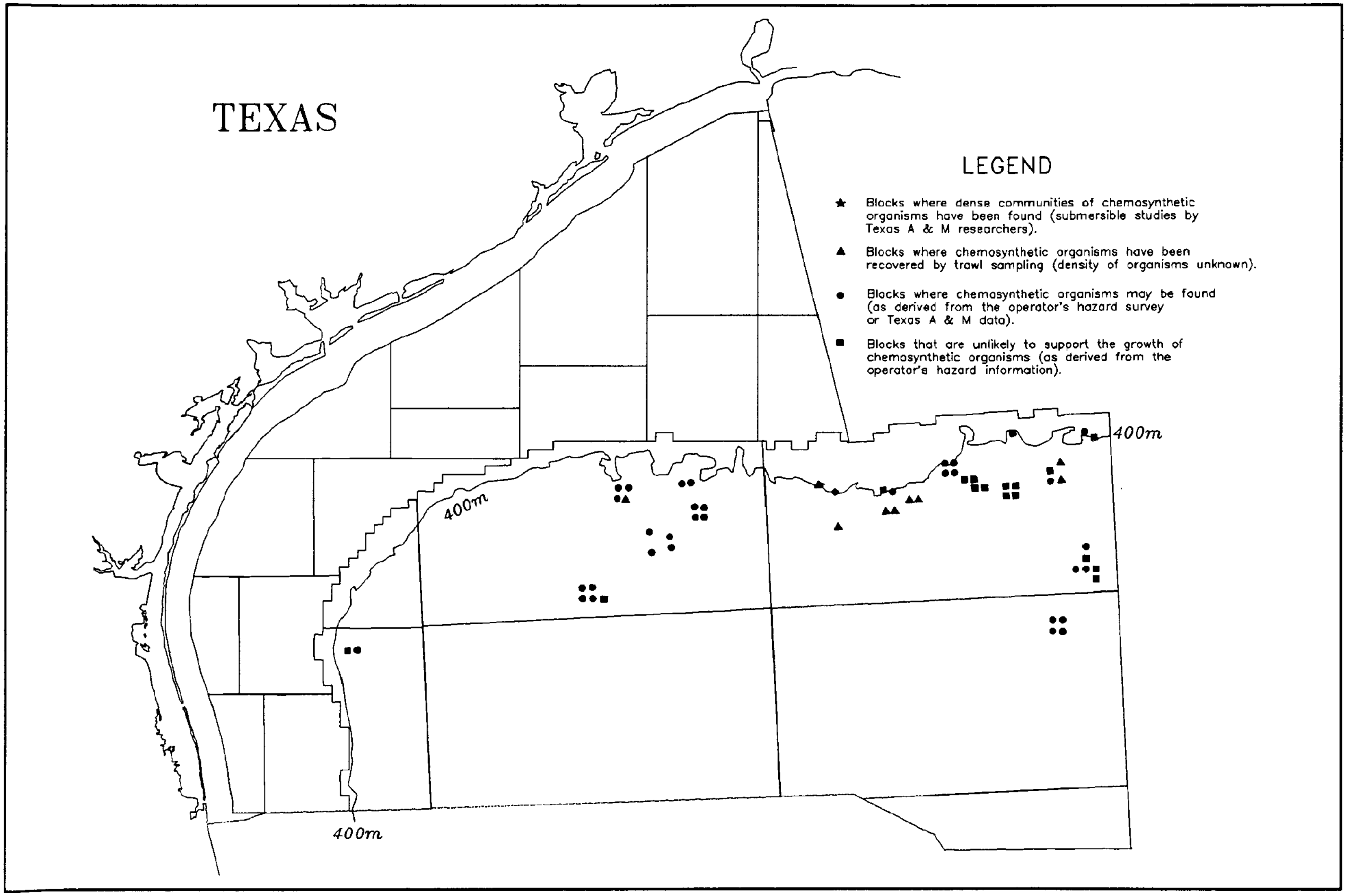


Figure III-3. Location and Description of Chemosynthetic Communities in the Western Gulf of Mexico.

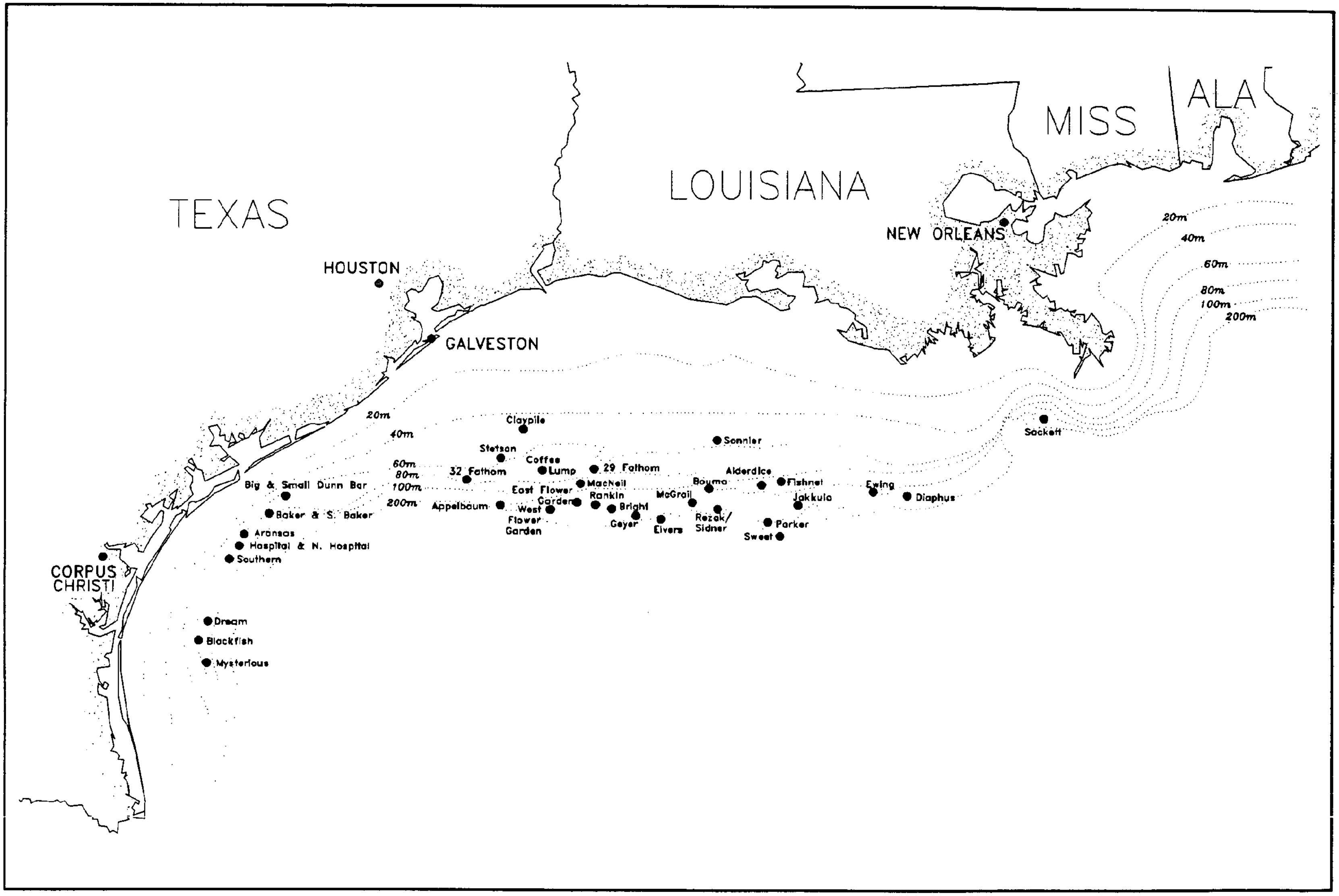


Figure III-4. Location of Topographic Features.

Stephanocoenia-Millepora Zone

The *Stephanocoenia-Millepora* Zone is inhabited by a low-diversity coral assemblage of 12 hermatypic corals. The eight most conspicuous corals in order of dominance are *Stephanocoenia michelinii, Millepora* sp., *Montastrea cavernosa*, *Colpophyllia* spp., *Diploria* sp., *Agaricia* spp., *Mussa angulosa*, and *Scolymia* sp. The assemblages associated with the *Stephanocoenia-Millepora* Zone are not well known. Coralline algae are most conspicuous in this zone. Reef fish populations are less diverse. The American thorny oyster (*Spondylus americanus*) appears numerous in the zone. The lower diversity coral reefs are found at the Flower Gardens, McGrail Bank, and Bright Bank. The depth range of this zone is between 36 and 52 m.

Algal-Sponge Zone

The Algal-Sponge Zone is the largest of the reef-building zones in terms of area. The dominant organisms of the zone are the coralline algae, which are the most important carbonate-nodule producers. The algae nodules range from 1-10 cm in size and cover 50-80 percent of the bottom. The depth range of this zone at each bank varies depending on the conditions at the bank, but generally the range is between 55 and 85 m. The habitat created by the algae nodules supports communities that are probably as diverse as the coral-reef communities. Most of the leafy algae found on the banks occur in this zone and contribute large amounts of food to the surroundingcommunities. In addition to the coralline algae, calcareous green algae (*Halimeda* and *Udotea)* and several species of hermatypic corals are major contributors to the substrate. Deep-water alcyonarians are abundant in the lower Algal-Sponge Zone. Sponges, especially Neofibularia nolitangere, are conspicuous. Echinoderms are abundant and also add to the carbonate substrate. Small gastropods and pelecypods are also abundant. Gastropod shells are known to form the center of some of the algal nodules. Characteristic fish of the Algal-Sponge Zone are yellowtail reeffish, sand tilefish, cherubfish, and orangeback bass.

Partly drowned reefs are a major biotope of the Algal-Sponge Zone. They are defined as those reefal structures covered with living crusts of coralline algae with occasional heads of hermatypic corals. In addition to the organisms typical to the rest of the Algal-Sponge Zone, the partly drowned reefs are also inhabited by large anemones, large comatulid crinoids, basket stars, limited crusts of *Millepora*, and infrequent small colonies of other hermatypic species.

Zone of Minor Reef Building

Millepora-Sponge Zone

The *Millepora*-Sponge Zone occupies depths comparable to the *Diploria-Montastrea-Porites* Zone on the claystone-siltstone substrate of the Texas-Louisiana midshelf banks. One shelf-edge carbonate bank, Geyer Bank, also exhibits the zone but only on a bedrock prominence. Crusts of the hydrozoan coral, *Millepora*, sponges, and other epifauna occupy the tops of siltstone, claystone, or sandstone outcrops in this zone. Scleractinian coral heads and coralline algae are rare.

Transitional Zone of Minor to Negligible Reef-Building

Antipatharian Zone

This transitional zone is not distinct but blends in with the lower Algal-Sponge Zone. It is characterized by an abundance of antipatharian whips growing with the algal-sponge assemblage. With increased water depth, the assemblages of the zone become less diverse, characterized by antipatharians, comatulid crinoids, few leafy or coralline algae, and limited fish (yellowtail redfish, queen angelfish, blue angelfish, and spotfin hogfish). Again, the depth of this zone varies at the various banks but extends generally to 90 m.

Zone of No Reef Building

Nepheloid Zone

High turbidity, sedimentation, and resuspension occur in this zone. Rocks or drowned reefs are covered with a thin veneer of sediment. Epifauna are scarce. The most noticeable are comatulid crinoids, octocoral whips and fans, antipatharians, encrusting sponges, and solitary ahermatypic corals. The fish fauna are different and less diverse than those of the coral reefs or partly drowned reefs. These fish species include red snapper, spanish flag, snowy grouper, bank butterflyfish, scorpionfishes, and roughtongue bass. This zone occurs on all banks, but its depth differs at each bank. Generally, the Nepheloid Zone begins at the limit of the Antipatharian Zone and extends to the surrounding soft bottom.

Figure III-4 depicts the location of the topographic features in the Western and Central Gulf. Table III-4 describes the biotic zones found or expected at each bank and gives the depths of the bank crest and surrounding seafloor.

Of the topographic features depicted in Figure III-4, 16 are located in the Central Gulf:

Shelf-Edge Banks	Midshelf Banks
Bright Bank	Sonnier Bank
McGrail Bank	29 Fathom Bank
Rankin Bank	Fishnet Bank
Alderdice Bank	
Rezak Bank	
Sidner Bank	
Ewing Bank	
Jakkula Bank	
Bouma Bank	
Parker Bank	
Sackett Bank	
Diaphus Bank	
Sweet Bank	

(Rankin and 29 Fathom Banks are located along the dividing line between the Central and Western Gulf and, therefore, are considered on both.)

The shelf-edge banks generally exhibit the zonation exhibited at the Flower Garden Banks at comparable depths.

Three of the Central Gulf banks are classified as midshelf banks: Sonnier, 29 Fathom, and Fishnet Banks. Because their midshelf location results in lowered light penetration and temperature minimum, the biotic zones do not correspond to the same zones at similar depths on the Flower Gardens. Instead of the high-diversity coral-reef zone found at the Flower Gardens, the midshelf banks at similar depths exhibit the lower diversity *Millepora*-Sponge Zone. This zone is evident at Sonnier Bank in the Central Gulf. Figure III-5 depicts the location of Sonnier Bank in relation to the lease blocks and the protective zonation locations in the Topographic Features Stipulation proposed for these proposed sales (Sections II.A.1.c.(1) and II.B.1.c.(1)).

Table III-4

Biotic Zones of Topographic Features
with Bank Crest and Seafloor Depth in Meters

	Millepora-Sponge	Diplora Montastrea-Porites	Madracis	Stephanocoenia	Algal-Sponge	Transitional	Antipatharian-Nepheloid	Seafloor
Shelf-Edge Banks								
East Flower Garden		15	x	x	x	x	x	100-120
West Flower Garden		20	x	x	x	x	x	110-130
Bright				37	x	x	x	110
McGrail				45	x	x	x	110-130
Gever	37				x	x	x	190-210
Rankin					52	x	x	110-140
Alderdice					55	x	x	84-90
Rezak					60	x	x	120
Sidner					55	x	x	150
Ewing					56	x	x	85-100
Jakkula					59	x	x	120-140
Bouma					60	x	x	90-100
Elvers					60	x	x	180
Parker					60	x	x	100
MacNeil					62	x	x	86-94
Sackett					67	x	x	100
Diaphus						73	x	110-130
Sweet					75	x	x	130-200
Appelbaum					76	x	x	100-120
Phleger							122	200
Low-Relief								
Midshelf Banks								
Claypile	40						x	50
32 Fathom						52	x	55
Coffee Lump						62	x	70
Midshelf Banks								
Sonnier	18						x	50
Stetson	20						x	60
29 Fathom						52	x	72
Fishnet						66	x	78
Low-Relief								
South Texas Banks								
Sebree							31	37
Big Dunn Bar						61	x	67
Small Dunn Bar						63	x	67
Big Adam						60	x	64
Small Adam						60	x	66
Blackfish						60	x	70-74
Mysterious						70	x	74-86
South Texas Banks								
Baker						56	x	70-74
Aransas						57	x	70-72
Southern						58	x	80
North Hospital						58	x	68-70
Hospital						59	x	70-78
South Baker						59	x	80-84
Dream						62	x	80

Sources: Rezak and Bright, 1981; Rezak et al., 1983.

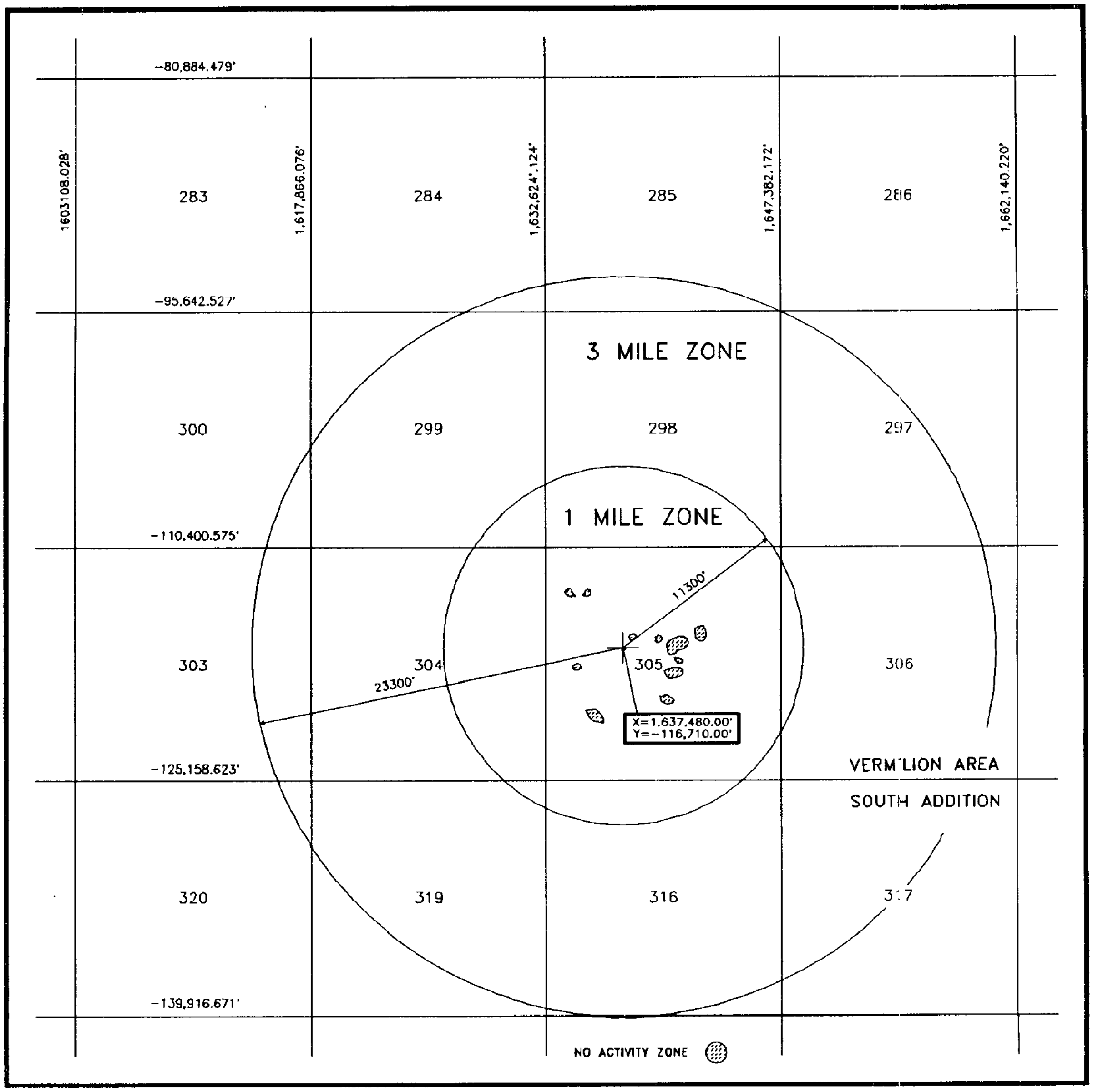


Figure III-5. Sonnier Bank and Protective Zones as Proposed by the Biological Lease Stipulation.

Of the topographic features depicted in Figure III-4, 23 are located in the Western Gulf:

Shelf-Edge Banks

East Flower Garden Bank
West Flower Garden Bank
Geyer Bank
Rankin Bank
Elvers Bank
MacNeil Bank
Appelbaum Bank

Midshelf Banks

Claypile Lump
32 Fathom Bank
Coffee Lump
Stetson Bank
29 Fathom Bank

South Texas Banks

Big Dunn Bar
Small Dunn Bar
Blackfish Ridge
Mysterious Bank
Baker Bank
Aransas Bank
Southern Bank
North Hospital Bank
Hospital Bank
South Baker Bank
Dream Bank

The shelf-edge banks generally exhibit the zonation that is exhibited at the Flower Garden Banks at comparable depths. Of interest is Geyer Bank, which crests at 37 m, within the depth that the high-diversity coral-reef zone is expected. However, at this bank, the *Millepora*-Sponge Zone is evident. The *Millepora*-Sponge Zone is found elsewhere in the Gulf only at the midshelf banks.

Three of the midshelf banks contain the *Millepora*-Sponge Zone: Sonnier Bank in the Central Gulf and Stetson and Claypile Banks in the Western Gulf. Claypile Bank, with only 10 m of relief, is considered a low-relief bank and is often enveloped by the nepheloid layer. Thus, the level of development of the *Millepora*-sponge community is lowest at Claypile Bank. Two other midshelf banks in the Western Gulf (32 Fathom Bank and Coffee Lump) have reliefs less than 10 m and are considered to be low-relief banks.

The South Texas banks are geographically/geologically distinct from the shelf-edge banks. Several of the South Texas banks are also low-relief banks. These banks exhibit a reduced biota and have relatively low relief, few hard-substrate outcrops, and a thicker sediment cover than the other banks. Sebree Bank is a low-profile feature located in 36.5 m (120 ft) of water. The highest area of the bank is about 31 m (102 ft) deep. The bank appears composed of large boulders mostly veneered by fine sediments. The low relief of the bank and the fine sediments covering the bank indicate that Sebree Bank frequently exists in turbid conditions. The biota of the bank appears sparse due to these conditions. Specimens of *Oculina diffusa* have been located. The bank attracts abundant nektonic species including red snapper (Tunnel, 1981).

3. Terrestrial and Marine Mammals

a. Marine Mammals

This section contains a brief description of the cetaceans of the Gulf of Mexico; more detailed description, found in the Final EIS for Sales 131, 135, and 137 (Sections III.B.3.c. and III.B.4., pages III-59 and III-61), is hereby incorporated by reference.

(1) Nonendangered and Nonthreatened Species

Thirty-three species of cetaceans have been identified in the Gulf of Mexico (Table III-5). By an order of magnitude, the bottlenose dolphin is the most common marine mammal in this area. Its distribution and movement suggest that there are several distinctive populations in the Gulf. Scott et al. (1989) and Fritts et

Table III-5

Marine Mammals of the Gulf of Mexico

Order Cetacea		
Suborder Mysticeti (baleen whales)		
Family Balaenidae		
Eubalaena glacialis	northern right whale	R*
Family Balaenopteridae		
Balaenoptera musculus	blue whale	R*
Balaenoptera physalus	fin whale	R*
Balaenoptera borealis	sei whale	R*
Balaenoptera edeni	Bryde's whale	R
Balaenoptera acutorostrata	minke whale	R
Megaptera novaeangliae	humpback whale	R*
Suborder Odontoceti (toothed whales)		
Family Physeteridae		
Physeter macrocephalus	great sperm whale	C*
Kogia breviceps	pygmy sperm whale	C
Kogia simus	dwarf sperm whale	U
Family Ziphiidae		
Mesoplodon bidens	North Sea beaked whale	E
Mesoplodon densirostris	Blainville's beaked whale	R
Mesoplodon europaeus	Antillian beaked whale	U
Ziphius cavirostris	goosebeaked whale	U

C = common, U = uncommon, R = rare, E = extralimital record, I = introduced, Ex = extinct, * = endangered

Table III-5. Marine Mammals of the Gulf of Mexico (continued)

Order Cetacea *(continued)*		
Family Delphinidae		
Orcinus orca	killer whale	R
Pseudorca crassidens	false killer whale	U
Feresa attenuata	pygmy killer whale	U
Globicephala macrorhynchus	short-finned pilot whale	C
Grampus griseus	grampus/Risso's dolphin	U
Peponocephala electra	melon-headed whale	R
Tursiops truncatus	Atlantic bottlenose dolphin	C
Delphinus delphis	saddleback dophin	R
Steno bredanensis	rough toothed dolphin	R
Stenella coeruleoalba	striped dolphin	C
Stenella attenuata	pantropical spotted dolphin	R
Stenella clymene	short-snouted spinner dolphin	U
Stenella frontalis	Atlantic spotted dolphin	C
Stenella longirostris	long-snouted spinner dolphin	U
Order Carnivora		
Suborder Pinnipedia (seals, sea lions)		
Family Otariidae		
Zalophus californianus	California sea lion	I, R
Family Phocidae		
Monachus tropicalis	Caribbean (West Indian) monk seal	Ex
Order Sirenia		
Family Trichechidae		
Trichechus manatus	West Indian manatee	C*

Source: Schmidly and Scarborough, 1990.

C = common, U = uncommon, R = rare, E = extralimital record, I = introduced, Ex = extinct,
* = endangered

al. (1983) noted that the majority of bottlenose dolphin sightings occurred between water depths of 18 and 50 m (69 and 164 ft). Gruber (1981) and Irvine et al. (1981) noted that highest densities were found near dredged and natural channels. Information on the distribution, abundance, movements, and behavior of the other species is sketchy or nonexistent.

(2) Endangered and Threatened Species

Six endangered cetacean species have been reported in the Gulf of Mexico. They include the sperm, blue, sei, fin, right, and humpback whales. All are uncommon, and only the sperm, fin, and sei whales have been seen in the Central and Western Gulf of Mexico in recent years. Schmidly suggested that the sperm and fin whales have a resident population in the Gulf and that other species are occasional migrants or vagrants (Tucker & Associates, Inc., 1990). Current information on the distribution, abundance, and movements of great whales in the Gulf is sketchy or nonexistent.

The blue whale (*Balaenoptera musculus*) is the largest and rarest of the great whales. Historical records suggest that it infrequently passed through the Gulf of Mexico. There have been only two recorded sightings: one off Louisiana in 1924 and another off Texas in 1940. The latter identification is questionable (Schmidly, 1981).

The fin whale (*Balaenoptera physalus*), the second largest of the baleen whales, feeds on krill and small schooling fish. Schmidly (1981) reported five strandings and four sightings in the northern Gulf, and the NMFS made several sightings off the Mississippi delta in 1989.

Humpback whales (*Megaptera novaengliae*) are a coastal species and feed primarily on krill and fish. Humpbacks have been sighted in the Central Gulf in 1952 and 1957. They have also been found in the Eastern Gulf near the mouth of Tampa Bay in 1962 and 1983, and near Seahorse Key, Florida, in 1983 (Schmidly, 1981; Gainesville Sun, 1983). There are no records suggesting that the humpback whale was ever more than an infrequent transient in the Gulf.

Right whales are the most endangered cetacean in the Western Hemisphere. Their population in the northwestern Atlantic Ocean is estimated at 250-350 individuals. The right whale has rarely been sighted in the Gulf of Mexico, the most recent observations occurring offshore of Brazoria County, Texas, in 1972 (Lowery, 1974).

Sei whales (*Balaenoptera borealis*) have been reported from the Gulf in 1956, 1973, and 1989. They usually travel in groups of two to five individuals. Their population is unknown and they feed on copepods, krill, and small schooling fish.

The sperm whale (*Physeter macrocephalus*), the most abundant great whale in the Gulf of Mexico, has been sighted during all seasons by Fritts et al. (1983) and the DOC (USDOC, NMFS, 1988). Watkins (1977) noted that it inhabits offshore waters deeper than 1,000 m (3,281 ft). In the northern Gulf, it is most frequently sighted along the continental shelf break (Tucker & Associates, Inc., 1990).

b. Alabama, Choctawhatchee, and Perdido Key Beach Mice

The Alabama, Choctawhatchee, and Perdido Key beach mice, subspecies of the old field mouse (*Peromyscus polionotus*), occupy restricted habitats in the mature coastal dunes of Florida and Alabama. Their population has declined as a result of tropical storms and the loss of habitat from coastal development. Their range is chiefly in Perdido Key State Preserve (Florida), Grayton Beach State Recreational Area (Florida), St. Andrews State Recreation Area (Florida), Gulf Islands National Seashore (Alabama), and Gulf State Park (Alabama). Portions of these areas have been designated critical habitat. The beach mice feed nocturnally on the lee side of the dunes and remain in burrows during the day. Seeds are the major item of their diet (USDOI, FWS, 1987).

4. Marine Turtles

This section contains a brief description of the sea turtles of the Gulf of Mexico; more detailed description, found in the Final EIS for Sales 131, 135, and 137 (Section III.B.3.a. and b., pages III-58 and III-59), is hereby incorporated by reference.

The green turtle (*Chelonia mydas*) population in the Gulf once supported a commercial harvest in Texas and Florida, but the population has not completely recovered since the collapse of the fishery around the turn of the century. Reports of nesting in the northern Gulf are isolated and infrequent. The closest nesting aggregations are on the Florida east coast and the Yucatan Peninsula. Green turtles prefer depths of less than 20 m (66 ft), where seagrasses and algae are plentiful (NRC, 1990).

Leatherbacks (*Dermochelys coriacea*), the most oceanic of the marine turtles, occasionally enter shallow water in more northern areas. Their nesting is concentrated on coarse-grain beaches in the tropical latitudes (Ogren et al., 1989), but there are rare occurrences on the Panhandle and Flagler County coasts in Florida. They feed primarily on jellyfish but also consume crustaceans, fish, and some algae.

The hawksbill (*Eretmochelys imbricata*) is the least commonly reported marine turtle in the Gulf. Texas is the only Gulf State where stranded turtles are regularly reported (Ogren et al., 1989), and these tend to be either hatchlings or yearlings. Northerly currents may carry them from Mexico, or their nesting range may be expanding northward into Texas. They are more frequent in the tropical Atlantic, Gulf of Mexico, and Caribbean. Hawksbills prefer reefs and water less than 15 m deep where marine invertebrates are abundant.

The Kemp's ridley sea turtle (*Lepidochelys kempi*) is the most imperiled of the world's marine turtles. The population of nesting females has dwindled from an estimated 47,000 in 1947 to less than 1,000 today (NRC, 1990). An estimated 800 nests are laid annually (NRC, 1990), primarily on a 17-km (10.5-mi) stretch of beach in Rancho Nuevo, Vera Cruz, Mexico (Thompson, 1988). Nesting in the United States occurs infrequently on Padre and Mustang Islands in south Texas from May to August (Thompson, 1988). Natural nesting is supplemented by a NMFS hatching and rearing program on Padre Island National Seashore. Hatchlings appear to disperse offshore to seek refuge in sargassum mats (Collard and Ogren, 1989). The distribution of the neritic life stages is associated with the abundance of portunid crabs. Female Kemp's ridleys appear to inhabit nearshore areas, and congregations of Kemp's have been recorded off the mouth of the Mississippi River (Byles, 1989). Although most Kemp's ridleys inhabit the Gulf of Mexico, they range along the Atlantic Coast to Massachusetts. However, there is speculation that young turtles swept out of the Gulf of Mexico are lost to the population (NRC, 1990).

The loggerhead sea turtle (*Caretta caretta*) occurs worldwide in depths ranging from estuaries to the continental shelf. It has been reported throughout the Atlantic from Newfoundland to Argentina (NRC, 1990). Nesting also occurs worldwide. The largest nesting concentration in the United States is on the southeast Florida coast from Volusia to Broward Counties (Brook-VanMeter, 1987). In the Gulf of Mexico, recent surveys indicate that the Florida Panhandle accounts for approximately one-third of the nesting on the Florida Gulf Coast. In the Central Gulf, loggerhead nesting has been reported on Gulf Shores and Dauphin Island, Alabama; Ship Island, Mississippi; and the Chandeleur Islands, Louisiana. Nesting in Texas occurs primarily on North and South Padre Islands, although occurrences are recorded throughout coastal Texas. Hildebrand (1982) noted that banks offshore the central Louisiana coast and near the Mississippi Delta are also important marine turtle feeding areas. Hatchlings appear to have a pelagic phase followed by a movement inshore and associated benthic, omnivorous feeding (Nelson, 1988). Adults are frequently found in association with concentrations of portunid crabs.

The recently designated Archie Carr National Wildlife Refuge in Brevard and Indian River Counties, Florida, hosts the largest concentration of nesting loggerheads and green sea turtles in the United States and is the second most important nesting beach for loggerheads in the world.

5. Coastal and Marine Birds

a. Nonendangered and Nonthreatened Species

This section contains a brief description of Gulf coastal and marine birds of the Gulf of Mexico; more detailed description, hereby incorporated by reference, can be found in the Final EIS for Sales 131, 135, and 137 (Section III.B.5., page III-63).

Those birds most susceptible to oiling either raft at sea, such as gulls and terns, or dive when disturbed, such as cormorants and boobies. The death of coastal area birds caused by OCS-related oil and gas activities makes a strong visual impact that heightens publicity (Clapp et al., 1982a; NRC, 1985).

Migrant and nonmigrant coastal and marine birds populate the beaches and wetlands of the northern Gulf of Mexico. This broad category consists of three main groups: waterfowl, wading birds, and marine birds. Feeding habitats include the waters and coastal shores of the open Gulf, bays and estuaries, brackish and freshwater wetlands, as well as coastal farmlands and landfills.

Waterfowl consist mainly of ducks and geese. The majority of waterfowl found in the northern Gulf of Mexico's coastal wetlands are overwintering migrants. The major waterfowl habitats are brackish and freshwater marshes, but species of resident waterfowl inhabit swamp forests and marshes in all Central and Western Gulf states (Portnoy, 1977; Clapp et al., 1982a and b). Some species feed and congregate in open waters, often clustered in dense rafts. These most commonly include members of the the Pochards (canvasback, redhead, and scaups), sea ducks (bufflehead, goldeneyes, and mergansers), and the ruddy duck (Madge and Burn, 1988). Waterfowl journey to Gulf feeding grounds using specific flight corridors that run the length of the continental U.S. and terminate in distinct localities along the Gulf Coast. Some waterfowl exhibit a limited degree of coastal movement within their terminal locality, but do not cross planning areas (Bellrose, 1968).

Wading birds of the coastal Gulf of Mexico consist of herons, egrets and bitterns, storks and cranes, and ibis and spoonbills. They occupy a very diverse array of feeding habitats, and thus demonstrate similarly diverse feeding strategies based on a species' morphology and physiological adaptation in relation to the availibility of prey (Kushlan, 1978). The most abundant species are tricolor herons, snowy egrets, and cattle egrets (Fritts et al., 1983). Texas reported approximately 200,000 wading birds at 387 colony sites in its 1988 colonial waterbird census (Texas Parks and Wildlife Department, 1989). Resident wading bird populations are augmented during the winter by migrants from as far away as southern Canada. The Mississippi Delta divides migrating birds into distinct east-west groups in the Gulf. Migrating adults of each group terminate and remain in distinct localities along the Gulf Coast, while juveniles usually continue migration outside the country. Migration by Eastern Gulf juveniles begins in southern Florida and terminates in the Caribbean or on the Yucatan Peninsula. Juvenile migration in the Western Gulf begins and continues southwestward along the Gulf Coast, terminating in Mexico and Central America (Byrd, 1978; Ogden, 1978; Ryder, 1978). Although their range extends to barrier islands, very few wading birds are seen offshore in the Gulf.

Marine birds include both seabirds and shorebirds. Seabirds are defined as those species whose normal habitat and food source is the sea, whether they be coastal, offshore, or pelagic. Within the Gulf of Mexico, this group is composed primarily of gulls and terns, yet also includes some petrels and shearwaters, storm-petrels, tropicbirds, pelicans, gannets and boobies, cormorants, frigatebirds, phalaropes, skuas (jaegers), skimmers, loons, and grebes (Harrison, 1983). Some of these species are entirely pelagic, i.e., both feed and roost offshore, though the majority of seabirds return to shore to roost. Seabirds exploit a wide variety of feeding habitat, and their distribution within marine and coastal ecosystems relates to the distribution of productivity and biomass within these ecosystems (Hunt and Schneider, 1987). Shorebirds are closely associated with coastal and nearshore habitats. Many species are highly migratory and seasonally congregate along select coastal areas, often in great numbers. Within the Gulf of Mexico, this group consists of some oystercatchers; stilts and avocets; plovers; and sandpipers, snipes, and allies (Hayman et al., 1986). In its 1988 colonial waterbird census, Texas reported approximately 300,000 marine birds, of which approximately 115,000 were terns and 137,000 gulls (Texas Parks and Wildlife Department, 1989). Migrants from as far away as the North American Arctic Circle augment resident seabird and shorebird populations during the winter. Some species overwinter in discrete localities within a single planning area of the Gulf of Mexico Region, while other species are split into distinct groups east or west of the Mississippi Delta. Some species of marine birds may continue migration. Those few species in the Central Gulf that do, migrate nonstop at high altitude from the Mississippi Delta to the Yucatan Peninsula and/or northern Central America. Those in the Western Gulf continue southwestward along the Gulf Coast to Mexico and Central America, those in the Eastern Gulf to the Caribbean. Those that remain on the Gulf Coast exhibit a limited degree of coastal movement within their terminal locality, but do not cross planning areas (Clapp, 1982a and b; Fritts et al., 1983).

b. Endangered and Threatened Species

This section contains a brief description of the coastal and marine birds of the Gulf of Mexico; more detailed description, found in the Final EIS for Sales 131, 135, and 137 (Sections III.B.3.d.-g., pages III-59 and III-60), is hereby incorporated by reference.

The piping plover is endangered in the Great Lakes watershed and threatened elsewhere. Market hunting decimated its historic populations, which have remained depressed because of losses to their beach and nesting habitat. Habitat loss is primarily the result of damming, channelization, beach armoring, and shoreline development (USDOI, FWS, 1988). The plover has three distinct breeding populations: the Atlantic Coast, the Great Plains, and the Great Lakes. Only the Great Lakes and Great Plains populations migrate south in the fall to winter on the Gulf Coast, in Mexico, and the Caribbean. The Great Lakes population, consisting of 17 pairs, is the most depleted; the Great Plains population has 1,258-1,326 pairs (Nicholls, personal comm., 1990). On the Gulf Coast, Texas and Louisiana have the largest numbers and highest wintering densities. There, the plover prefers intertidal flats and beaches for its habitat. The birds are thought to roost on secluded beaches just above the wrack line. Piping plovers are susceptible to contact with spilled oil because of their preference for feeding in intertidal areas, a susceptibility documented by the oiling of plovers in Texas.

The whooping crane breeding population (130 individuals) winters along the Texas coast from November to April, occupying the coastal marshes of Aransas, Calhoun, and Matagorda Counties. Portions of these counties and all of the Aransas National Wildlife Refuge have been designated as critical habitat for the whooping crane. The birds feed on blue crabs and clams in tidal flats (USDOI, FWS, 1986). The conversion of wetlands and prairie to agriculture, and other encroachments by man, have the greatest impact on the whooping crane. A rapid recovery of the population is unlikely because of delayed sexual maturity and small clutch sizes. Mortality from inclement weather, predation, fire, and collisions with powerlines and aircraft also inhibit the birds' recovery.

The Arctic peregrine falcon is a subspecies of the peregrine falcon, which breeds in the North American tundra. A portion of the population migrates along the Central, Mississippi, and Eastern flyways to winter on the U.S. and Mexican Gulf coasts. The birds concentrate along beaches and barrier islands. Their population decline has been attributed to reproductive failure resulting from the ingestion of prey containing chlorinated hydrocarbons.

Bald eagles are found throughout the Gulf States. Bald eagles actively nest in upland and wetland areas 30-50 mi from the coast throughout the Gulf. Bald eagles inhabit areas near water although they rarely nest on the coast. They prey on birds, fish, and small mammals. Nesting occurs in September followed by egg laying from October to December. Their population decline is primarily the result of habitat alteration and reproductive failure from the ingestion of prey containing chlorinated hydrocarbons.

Historically, two nestings have occurred along the Mississippi coast. In northwestern Florida, coastal nesting occurs at St. Vincent, St. Marks, and Lower Suwannee National Wildlife Refuges. Brown pelicans have been removed from the Federal endangered species list in Alabama and Florida but remain listed as endangered in Mississippi, Louisiana, and Texas. Their decline is primarily the result of hatching failure caused by ingestion of fish containing pesticides. Nesting occurs in colonies on coastal islands. Six brown pelican rookeries have been documented in Louisiana: on Queen Bess, North, Last, Calumet-Timbalier, and Grand Gosier Islands, and at South Pass (Martin, written comm., 1990). There is also a small rookery on Pelican Island in Nueces County, Texas. Unsuccessful nesting has occurred on Sunset Island in Matagorda Bay, and 40 hatchlings have been reintroduced to San Bernard National Wildlife Refuge (USDOI, FWS, 1989). Brown pelicans inhabit the coast, rarely venturing into freshwater or flying more than 32 km (20 mi) offshore. They feed by plunge-diving to catch fish near the surface.

6. Fish Resources

a. Nonendangered and Nonthreatened Species

The Gulf of Mexico supports a great diversity of fish resources that are related to variable ecological factors, such as salinity, primary productivity, bottom type, etc. These factors differ widely across the Gulf of Mexico and between the inshore and offshore waters. Characteristic fish resources are associated with the various environments and are not randomly distributed.

High densities of fish resources are associated with particular habitat types (e.g., east Mississippi Delta area, Florida Big Bend seagrass beds, Florida Middle Ground, mid-outer shelf, and the DeSoto Canyon area). Approximately 46 percent of the southeastern United States wetlands and estuaries important to fish resources are located within the Gulf of Mexico (Mager and Ruebsamen, 1988). Consequently, both finfish and shellfish resources that are estuary-dependent species dominate the fisheries.

The life history of estuary-dependent species involves spawning on the continental shelf; transporting eggs, larvae, or juveniles to the estuarine nursery grounds; growing and maturing in the estuary; and migrating of the young adults back to the shelf for spawning. After spawning, the adult individuals generally remain on the continental shelf. Movement of adult estuary-dependent species is essentially onshore-offshore with no extensive east-west or west-east migration.

Estuary-related species of importance include menhaden, shrimps, oyster, crabs, and sciaenids. Estuary communities are found from east Texas through Louisiana, Mississippi, Alabama, and northwestern Florida. Darnell et al. (1983) and Darnell and Kleypas (1987) found that the density distribution of fish resources in the Gulf was highest nearshore off the central coast. For all seasons the greatest abundance occurred between Galveston Bay and the Mississippi River. The abundance of fish resources in the far western and eastern Gulf of Mexico is patchy. The high salinity bays of the Western Gulf contain no distinctive species, only a greatly reduced component of the general estuary community found in lower salinities (Darnell et al., 1983). High salinity bays and sounds in the Eastern Gulf contain species amenable to shell, coral sand, and coral silt bottoms. These include pink shrimp, rock shrimp, and stone crab (Darnell and Kleypas 1987).

Estuaries of the Gulf of Mexico export considerable quantities of organic material, thereby enriching the adjacent continental shelf areas (Darnell and Soniat, 1979). Populations from the inshore shelf zone (7-14 m) are dominated seasonally by Atlantic croaker, spot, drum, silver seatrout, southern kingfish, and Atlantic threadfin. Populations from the middle shelf zone (27-46 m) include sciaenids, but are dominated by longspine porgies. The blackfin searobin, Mexican searobin, and shoal flounder are dominant on the outer shelf zone (64-110 m).

Natural reefs and banks, located mainly between the middle and outer shelf zones support large numbers of grouper, snapper, gag, scamp, and seabass. Reef fish occur on the continental shelf wherever hard/live bottoms with rocks, holes, or crevices are available (USDOC, NOAA, 1986). In the Western and Central Gulf, natural reefs are scattered along the 200-m isobath. Numerous offshore petroleum platforms, believed to act as artificial reefs, augment the hard substrate of natural reefs in this area (Linton, 1988). In the Eastern Gulf, prominent reef complexes such as the Florida Middle Ground provide reef fish habitat (USDOC, NOAA, 1986).

Hard substrates with some vertical relief act as important landmarks for pelagic species. Coastal pelagics such as mackerels, cobia, bluefish, amberjack, and dolphin move seasonally within the Gulf of Mexico. In spring, king and Spanish mackerels leave their wintering grounds in the southeastern Gulf and move northward along the continental shelf to their spawning and summering areas in the northwestern Gulf (USDOC, NOAA, 1986). Their nursery area is probably the shallow portion of the shelf at high nutrient areas near river plumes (Grimes, 1988).

Oceanic species such as yellowfin and bluefin tuna are mainly found beyond the continental shelf during winter and spring, but after spawning they move through the Florida Straits into the Atlantic Ocean. Billfishes (black marlin, white marlin, sailfish, and swordfish) spawn in the northeastern Gulf, mostly in areas beyond the continental shelf (State of Florida Marine Fisheries, written comm., 1988).

Competition between large numbers of fishermen, between fishing operations employing different methods, and between commercial and recreational fishermen for a given resource, as well as natural phenomena such as weather, hypoxia, and red tides, may reduce standing populations. Fishing techniques such as trawling, gill netting, or purse seining, when practiced nonselectively, may reduce the standing stocks of the desired target species as well as substantially affect fish resources other than the target. Finally, hurricanes may affect fish resources by destroying oyster reefs, damaging gear and shore facilities, and changing physical characteristics of inshore and offshore ecosystems.

The majority of fish species in the Gulf of Mexico are believed to be in serious decline from overfishing. Continued fishing at the present levels are likely to result in eventual failure of certain fisheries. Standing stocks of traditional fisheries such as shrimp and red snapper, and of recent fisheries, such as black drum, shark, and tuna, have declined and are thought to be in danger of collapse (Angelovic, written comm., 1989; USDOC, NOAA, 1986).

The degradation of inshore water quality and loss of Gulf wetlands as nursery areas are considered significant threats to fish resources in the Gulf of Mexico (Christmas et al., 1988). Loss of wetland nursery areas in the north-central Gulf is believed to be the result of channelization, river control, and subsidence of wetlands (Turner and Cahoon, 1987). Loss of wetland nursery areas in the far western and eastern Gulf is believed to be the result of urbanization and poor water management practices (Texas Parks and Wildlife, written comm., 1989; USEPA, 1989).

Finfish

Finfish resources are linked both directly and indirectly to the vast estuaries that ring the Gulf of Mexico. Finfish are directly dependent when the population relies on low salinity brackish wetlands for most of their life history, such as during the maturation and development of larvae and juveniles. Even the offshore demersal species are indirectly related to the estuaries because they influence the productivity and food availability on the continental shelf (Darnell and Soniat, 1979; Darnell, 1988).

Gulf menhaden spawn near the water surface in a localized area of the middle continental shelf proximate to the Mississippi River Delta from fall to spring (mid-October through March). Planktonic larvae are transported via currents to estuary nursery areas. Larvae enter estuaries when 3-5 weeks old. After the larvae grow and transform into juveniles in the shallow portions of the estuary, they move to open and deeper estuarine waters. Juvenile and adult Gulf menhaden inhabit estuaries throughout the year (Christmas et al., 1982). Some first-year juveniles may overwinter in estuaries. However, most Gulf menhaden move from estuaries into offshore marine waters in late fall and winter. There is evidence that older fish move toward the Mississippi River Delta (Shaw et al., 1985; Vaughan et al., 1988). Sexual maturation is completed after two growing seasons. Immature and spent adult menhaden migrate to estuarine waters from spring to fall (April to October). Mature menhaden are sexually inactive in the estuary, but gonads mature for spawning in marine waters (Christmas and Waller, 1975).

Schooling is apparently an inborn behavioral characteristic beginning at the late larval stage and continuing throughout the remainder of life. Their occurrence in dense schools, generally by species of fairly uniform size, is an outstanding characteristic that facilitates mass production methods of harvesting menhaden. The seasonal appearance of large schools of menhaden in the inshore Gulf waters from April to November dictates the menhaden fishery (Nelson and Ahrenholz, 1986).

Larval menhaden feed on pelagic zooplankton in marine and estuarine waters. Within the estuary, the mouthparts of the larvae transform, and juvenile and adult Gulf menhaden become filter-feeding omnivores that primarily consume phytoplankton, but also ingest zooplankton, detritus, and bacteria. As filter-feeders, menhaden form a basal link in estuarine and marine food webs and, in turn, are prey for many species of larger fish (Vaughan et al., 1988).

Members of the Sciaenidae family such as croaker, red and black drum, and spotted seatrout have similar life histories. Throughout the Gulf, sciaenids have a protracted spawning season over the spring and summer or fall and winter. The inception of spawning is variable and dependent on raising or falling water temperatures. There is no consensus on the preferred spawning habitat. Large schools of spawning red drum congregate around major passes in relatively shallow water during late summer and fall. Croaker prefer deeper, high salinity waters for spawning. Planktonic larvae develop in nearshore areas and with the help of prevailing currents actively seek protected areas of estuaries and inshore bays with slightly muddy bottoms. Sciaenids move to deeper waters of bays during their first year. After the first year there is gradual movement of sciaenids into the Gulf during cold weather and a pronounced movement back into bays and estuaries in early spring. When mature, older fish move offshore to assemble and spawn. Sexual maturation in seatrout occurs after 5 years and continues until 5 or 6 years of age. Sexual maturation in croaker occurs after 5 years and continue for up to 15 years. Sciaenids are opportunistic carnivores whose food habits change with size. Larval sciaenids feed selectively on pelagic zooplankton, especially copepods. Juveniles feed upon invertebrates, changing to a more piscivorous diet as they mature (Perret et al., 1980; Sutter and McIlwain, 1987; USDOC, NOAA, 1986).

About 10 percent of finfish in the Gulf of Mexico are not directly dependent on estuaries during their life history. This group can be divided into demersal and pelagic species. Demersal species are associated with live bottoms, reef complexes, hard-bottom banks, and patch reefs. Pelagic species are associated with high-salinity open water beyond the direct influence of coastal systems.

Snappers are nonestuary-dependentdemersal fish associated with natural reefs, hard bottom, and artificial reefs of the mid-outer continental shelf. Called reef fish, snappers remain close to underwater structures and exhibit little or no movement. Snappers spawn offshore in groups over unobstructed bottoms adjacent to reef areas. Juvenile snapper form loose aggregates, while adults form schools during the day and disperse at night. Snappers do not migrate or travel away from their reef environment and the surrounding areas. There is a tendency for larger, older snappers to occur in deeper water than juveniles. Seasonal spawning patterns vary among snapper species, but generally, once they attain sexual maturity, they have a protracted spawning period with seasonal peaks. There is a decline in spawning activity among snappers during the winter. Juveniles inhabit shallow nearshore and estuarine waters and are most abundant over sand or mud bottoms. Snappers feed along the bottom on fishes and benthic organisms such as tunicates, crustaceans, and mollusks. Juveniles feed on zooplankton, small fish, crustaceans, and mollusks (Bortone and Williams, 1986; USDOC, NOAA, 1986).

Coastal pelagics are open-water fish widely distributed throughout the Gulf of Mexico. Pelagic species such as king and Spanish mackerel move seasonally in response to water temperature and oceanographic conditions. Mackerels are found from the shore to a 200-m depths. Spanish mackerel frequent the coastal areas while king mackerel stay farther offshore. King mackerel move from the eastern to the north-central and western Gulf in the spring. During cooler fall seasons, they move back into the warmer waters of the southeastern Gulf. A contingent of large solitary adult king mackerel can be found in a localized area of the north-central Gulf during part of the winter. Spanish mackerel spread over the northern Gulf during the summer and are mainly found in southeastern coastal areas in the fall and winter. Mackerels spawn offshore over the continental shelf during the spring and summer. Spawning may occur more than once per season. Juvenile mackerel utilize nearshore areas of high salinity as nurseries. Mackerel feed throughout the water column on other fishes, especially herrings, and on shrimp and squid. Mainly a schooling fish, larger king mackerel occur in small groups or singly (Godcharles and Murphy, 1986; USDOC, NOAA, 1986).

Shellfish

To a greater degree, estuaries determine the shellfish resources of the Gulf of Mexico. Life history strategies are influenced by tides, lunar cycles, maturation state, and estuarine temperature changes. Very few individuals live more than a year, and the majority are less than six months old when they enter the extensive inshore and nearshore fishery. Year-to-year variations in shellfish populations are frequently as high as 100 percent and are most often a result of extremes in salinity and temperature during the period of larval development. Shellfish resources in the Gulf range from those located only in brackish wetlands to those found mainly in saltmarsh and inshore coastal areas. Life history strategies reflect estuary relationships, ranging from total dependence on primary productivity to opportunistic dependence on benthic organisms. Gulf shellfish resources are an important link in the estuary food chain between benthic and pelagic organisms (Darnell et al., 1983; Darnell and Kleypas, 1985; Turner and Brody, 1983).

A total of nine species of penaeid shrimp utilize the coastal and estuarine areas in the Gulf of Mexico. Brown, white, and pink shrimp are the most numerous. Pink shrimp have an almost continuous distribution throughout the Gulf but are most numerous on the shell, coral sand, and coral silt bottoms off southern Florida. Brown and white shrimp occur in both marine and estuarine habitats and have similar life histories. Adult shrimp spawn offshore in high salinity waters; the fertilized eggs become free-swimming larvae. After several molts they enter estuarine waters as postlarvae. Wetlands within the estuary offer both a concentrated food source and a refuge from predators. After growing into juveniles the shrimp larvae leave the saltmarsh to move offshore where they become adults. The timing of immigration and emigration, spatial use of a food-rich habitat, and physiological and evolutionary adaptations to tides, temperature , and salinity differ between the two species (Muncy, 1984; Turner and Brody, 1983; USDOC, NOAA, 1986).

Brown shrimp spawn in shallow offshore marine water in spring and early summer. Postlarval brown shrimp move into estuaries from January through June with peaks in early spring. Four to six weeks after entering the estuarine nurseries, brown shrimp postlarvae transform into juveniles. Juveniles remain in shallow estuarine areas near the marsh-water interface, which provides both feeding habitat and protection from predators. With maturation they move into deeper saltmarsh bays and finally to the outer continental shelf (Turner and Brody, 1983).

White shrimp spawn in shallow nearshore waters from spring to fall. Spawning activity is probably correlated with a rapid change in bottom temperature. Recruitment of postlarval white shrimp occurs from early summer to fall. Some young white shrimp move from estuaries to nearshore marine waters during late fall to overwinter and move back to estuaries in early spring when the water temperatures rise. In nursery grounds, juvenile white shrimp move further up waters courses than brown shrimp. White shrimp leave Gulf embayments as waters cool from fall through early winter (Muncy, 1984).

Active feeding stages of both brown and white shrimp are omnivorous. Larvae feed in the water column on both phyto- and zooplankton. After moving into estuarine nursery areas, postlarvae become demersal and feed at the vegetation-water interface. Developing larvae ingest the top layer of sediment, which contains primarily marsh plant detritus, algae, and microorganisms. When shrimp move to deeper embayments they become more predaceous (USDOC, NOAA, 1986).

A total of eight species of blue crab utilize the coastal and estuarine areas in the Gulf of Mexico. There is only one species, however, that is located throughout the Gulf and comprises a substantial fishery. Blue crabs occur on a variety of bottom types in fresh, estuarine and shallow offshore waters. Spawning grounds are areas of high salinity such as saltmarshes and nearshore waters. Spawning occurs from March to November in the northern Gulf and year-round in the warmer waters of the southern Gulf. Larval blue crabs occur throughout the water column. Movement during the larval stages is governed by tidal action and coastal currents. Female blue crabs move into areas of lower salinity to mate, then to higher salinities to spawn. Mature crabs usually remain in the same estuary until, after mating, males move into lower salinities as females head for the Gulf. During cold periods, blue crabs move into deeper water or burrow into the mud. A benthic omnivore with a high degree of variability in food habits, the blue crab feeds on annelids, mollusks, crustaceans, and other benthic invertebrates, fishes, carrion, and some detritus (Steele and Perry, 1990).

Vast intertidal reefs constructed by sedentary oysters are prominent biologically and physically in estuaries of the Gulf of Mexico. Finfishes, crabs, and shrimp are among the animals using the intertidal reefs while they are submerged for refuge and also as a source of food, foraging on the many reef-dwelling species. Reefs, as they become established, modify tidal currents and this, in turn, affects sedimentary patterns. Further, the reefs contribute to the stability of bordering marsh (Kilgen and Dugas, 1989).

Oysters spawn from late spring through summer and fall in the Gulf of Mexico. A rapid change in water temperature triggers mass spawning over localized areas of reefs. Oysters may spawn several times during a season. Oyster larvae are transported throughout estuarine systems by tidal action. After several weeks, free-swimming larvae attach in clusters to shell reefs, firm mud/shell bottoms, and other hard substrates. Oysters filter-feed principally on small unicellular algae and incidentally on suspended detrital particles (Burrell, 1986).

b. Gulf Sturgeon

The Gulf sturgeon was accepted as a threatened species for protection under the Endangered Species Act on October 30, 1991. The Gulf sturgeon is a subspecies of the Atlantic sturgeon. It historically spawned in the major rivers of Alabama, Mississippi, and the Florida panhandle. Its present spawning is limited to rivers from the Pearl to the Suwannee Rivers. The largest spawning population occurs in the Suwannee River (Barkuloo, 1988). Food-habit studies suggest that the Gulf sturgeon feeds on benthic invertebrates over sand, hard-bottom, and seagrass substrates. Fish up to 3 years of age inhabit their river of origin or its estuary year-round. Older fish move offshore to feed and return to the river only during the summer. During the riverine stage, adults cease feeding, undergo gonadal maturation, and migrate upstream to spawn. Spawning occurs over coarse substrate in deep holes. The decline of the Gulf sturgeon is due to overfishing and habitat destruction, primarily the damming of coastal rivers and the degradation of water quality.

C. OTHER RELEVANT ACTIVITIES AND RESOURCES

1. OCS Oil and Gas Industry

The Gulf of Mexico OCS oil and gas industry has experienced dramatic changes over recent years. "Restructuring of the oil industry has featured centralization of management, finance, and business services, and the use of computer technology to reduce the number of field operating units. The result is streamlined organizations with fewer personnel in regional divisions like New Orleans and exploration and production districts like Lafayette, Louisiana." (Baxter, 1990). International and domestic policy is shaping the immediate future of the industry. Domestic policy ramifications include the stringent drilling moratoria on most Federal OCS areas, with the exception of the Central and Western Gulf of Mexico and the Alaska offshore areas, and the future OCS lease sale schedule.

Figures III-6 through III-8 illustrate the trends in Federal offshore mobile rig utilization, leased Federal OCS acreage, and U.S. hydrocarbon wellhead prices, respectively. These graphs, which cover the period from 1974 through the second quarter of 1991, reflect the volatility of the offshore industry from 1981 to mid-1991. While leased acreage appears the most stable of indicators graphed on the figures, the incremental change in leased Federal OCS acreage over the years would mirror the demand curve associated with mobile rig use.

In Figure III-6, Mobile Rig Use, the supply curve represents the total number of mobile drilling rigs available in the Gulf of Mexico. The demand curve represents only those rigs working in OCS waters. Federal offshore mobile rig demand decreased significantly between the end of 1981 and mid-1983. In the midst of this decline, however, industry continued to expand its capacity in response to earlier years of growth.

Following the institution of the areawide Federal offshore leasing program in mid-1983, the declining oil and gas industry experienced some improvement. The total amount of leased OCS acreage jumped from 11.7 million ac (4.7 million ha) in the second quarter of 1983 to 19 million ac (7.7 million ha) in the fourth quarter of 1984. Coincidentally, offshore rig use increased dramatically from mid-1983 through the fourth quarter of 1984.

By the first quarter of 1985, the recognition of a continued excess supply of oil and gas worldwide halted the growth of offshore drilling activity in the Gulf of Mexico. Wellhead prices of oil and gas showed a declining trend throughout 1985, before plummeting to about 50 percent of the 1985 year-end prices by the second quarter of 1986. Despite the continuation of offshore Federal areawide lease sales in the Gulf of Mexico, offshore drilling decreased drastically through 1985 and 1986. The latter quarters of 1987 and early quarters of 1988 saw a steady increase in the demand for mobile rigs in response to the slight upward trend in oil prices at that time. However, offshore mobile rig use in the first two quarters of 1989 once again declined to early 1987 levels. This decline was primarily attributed to a prior reduction in the wellhead price of oil. During the latter quarters of 1989 through the earlier part of 1991, mobile rig use has continued to fluctuate, and a sizable gap continues to exist between supply and demand.

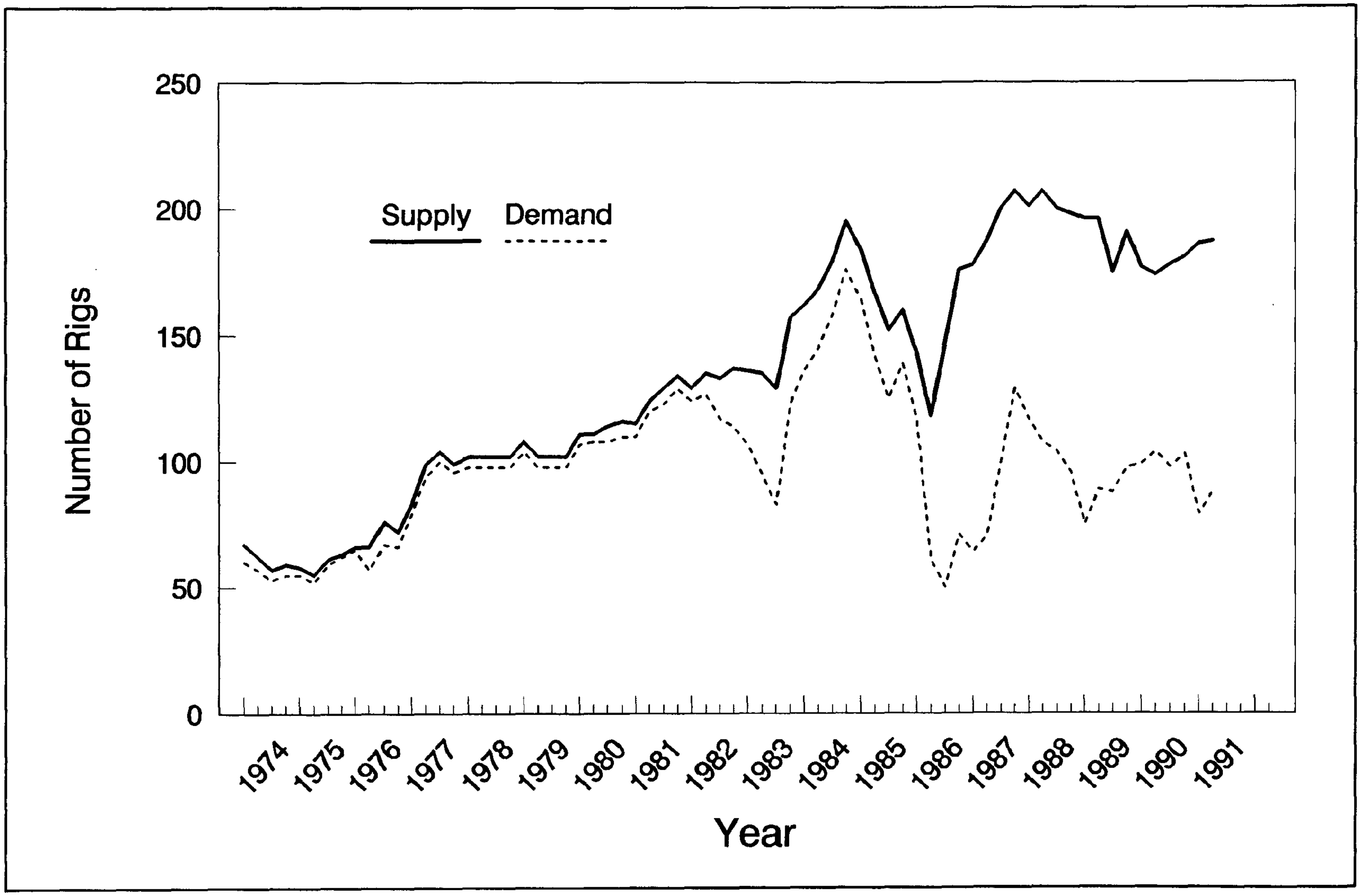


Figure III-6. Mobile Rig Utilization (USDOI, MMS, 1974-1991a and b).

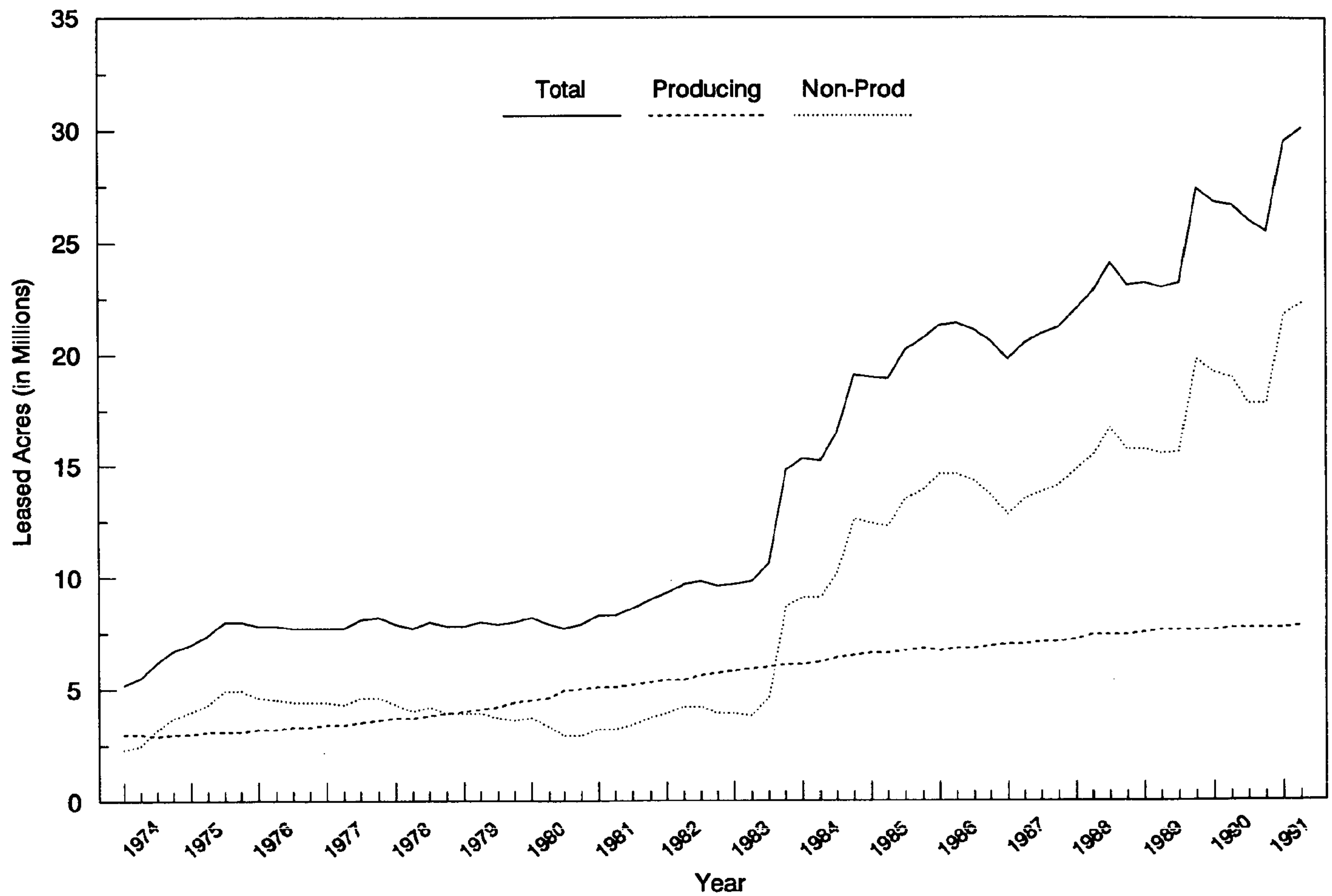


Figure III-7. Leased Acreage (USDOI, MMS, 1974-1991b).

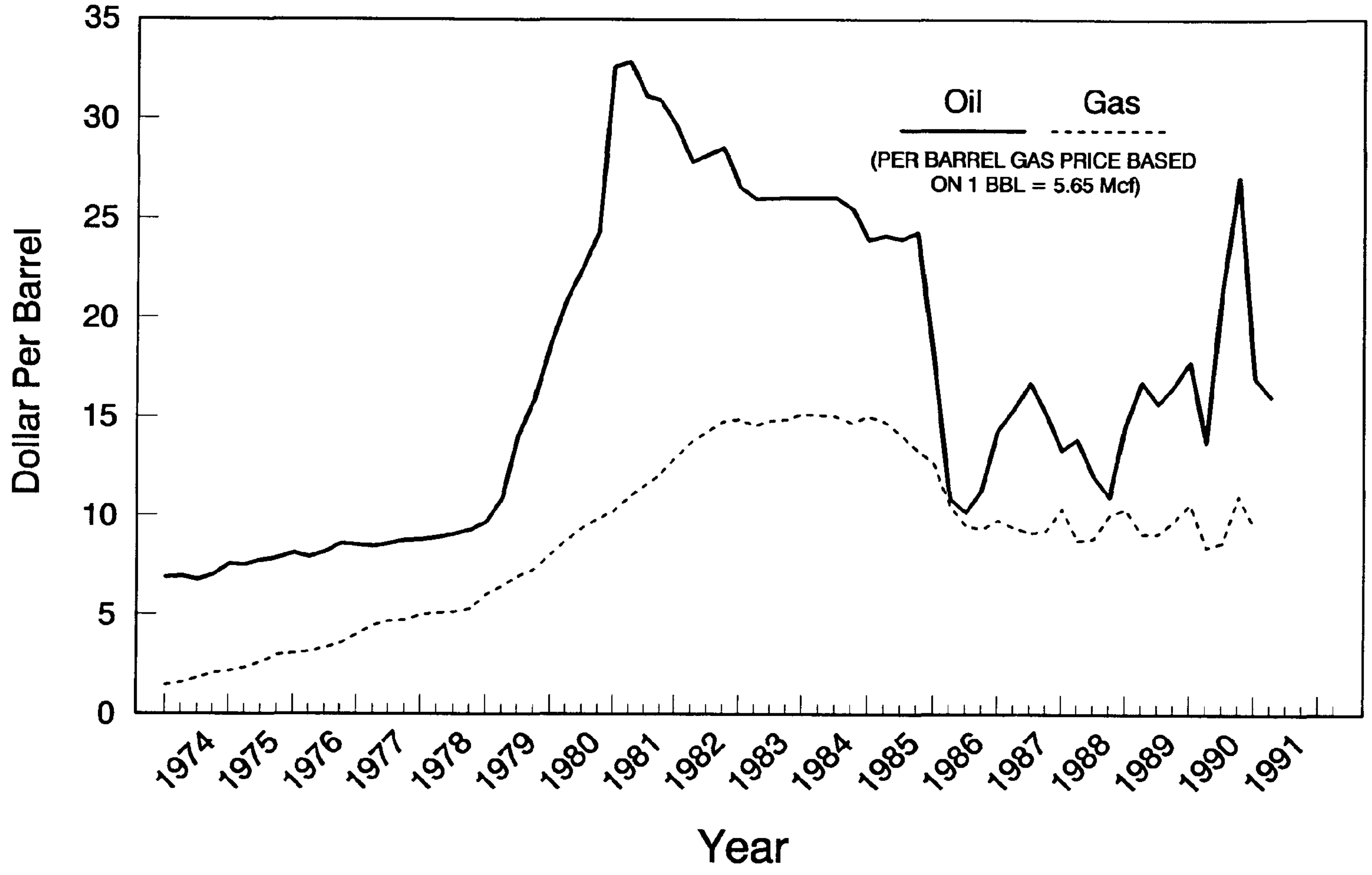


Figure III-8. Oil and Gas Wellhead Prices (U.S. Dept. of Energy, Environmental Information Administration, 1991 a and b).

Although there have been fluctuations in mobile rig use and hydrocarbon-wellhead prices, producing leased OCS acreage has increased steadily since 1974. As of the second quarter of 1991, a total of 30.1 million ac (12.2 million ha) were under lease; and approximately 26 percent of this total, 7.8 million ac (3.2 million ha), were producing. The composition of leased acreage has moved seaward during the last decade, with more tracts leased in deep water than ever before.

In summary, the current situation is an offshore sector that has a significant capacity in idle equipment, some of which is obsolete, and unemployed labor, some of which lacks the required skills. This idle capacity and the low levels of drilling are expected to continue until the wellhead price of oil and gas stabilizes.

Figures III-9 and III-10 graphically illustrate the production and production value of oil and natural gas offshore Louisiana and Texas. It is interesting to note that oil and condensate production peaked in 1972 at 389.3 MMbbl, while the production value of oil and condensate reached its highest level, $10.2 billion, in 1984. Oil and condensate production actually decreased from 1972 to 1980, while the production value increased during that same period. From 1980 to 1985, production increased steadily; from 1985 to 1988, the production value stabilized somewhat and then decreased. In 1990, both production and the production value of oil increased. Natural gas production in Louisiana and Texas reached its highest level in 1981 at 4,836.3 Bcf; the production value of natural gas peaked in 1984 at $12.7 billion. While the value of gas production declined from 1985 through 1989, the volume of gas production fluctuated during that time period. In 1990, both the production and production value of natural gas increased.

2. Socioeconomic Conditions

a. Population, Labor, and Employment

The Gulf of Mexico impact area for population, labor, and employment is defined as that portion of the Gulf of Mexico coastal zone whose social and economic well-being (population, labor, and employment) is directly or indirectly affected by the OCS oil and gas industry. Counties and parishes in the Eastern, Central, and Western Gulf comprise the Gulf of Mexico impact area. However, for purposes of this discussion, the coastal impact area will consist only of those 51 counties and parishes in the Central and Western Gulf of Mexico because the proposed 1993 sales involve the offering of the CPA and WPA. This coastal impact area is displayed on Visual No. 2.

The coastal counties and parishes in the impact area extend from Cameron County in southernmost Texas to Baldwin County in Alabama. Inland counties and parishes are included where offshore oil and gas support activities are known to exist; where offshore-related petroleum industries are established; and where one or more counties or parishes with a Standard Metropolitan Statistical Area (SMSA) on the coast, to account for all counties and parishes within the SMSA.

There are 12 SMSA's in the impact area of the Central and Western Gulf Region:

<u>Central Gulf of Mexico</u>

Alabama	-	Mobile
Mississippi	-	Pascagoula, Biloxi-Gulfport
Louisiana	-	New Orleans, Baton Rouge, Lafayette, Lake Charles

<u>Western Gulf of Mexico</u>

Texas	-	Beaumont-Port Arthur, Corpus Christi, Houston-Galveston-Brazoria, Victoria, Brownsville-Harlingen

The most populated SMSA's across the two regions are New Orleans in Louisiana and Houston-Galveston-Brazoria in Texas. The least populated SMSA's are Pascagoula in Mississippi and Victoria in Texas.

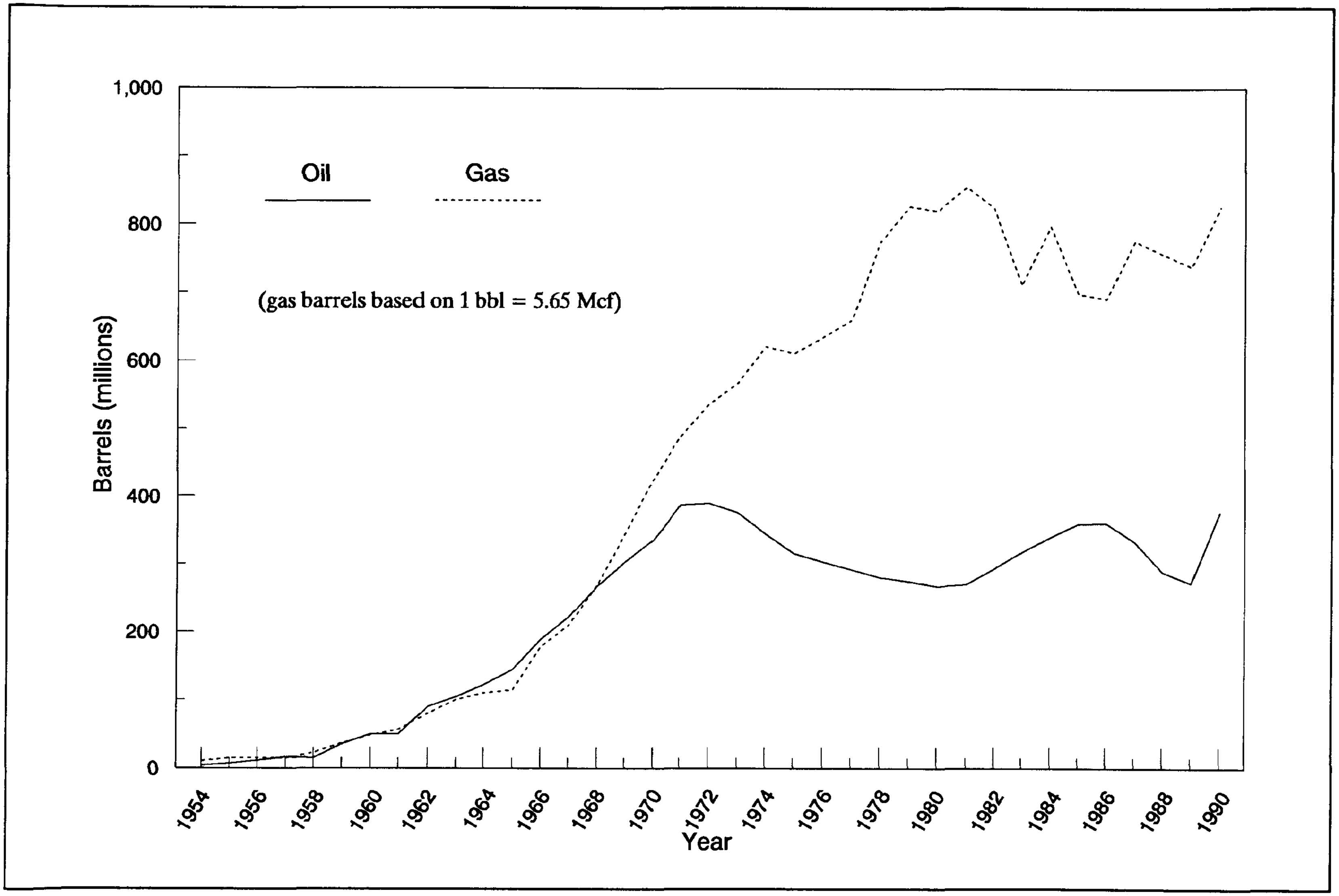


Figure III-9. Oil and Gas Production Offshore Louisiana and Texas, 1954 to 1990 (USDOI, MMS, 1984a; preliminary unpublished data through 1990).

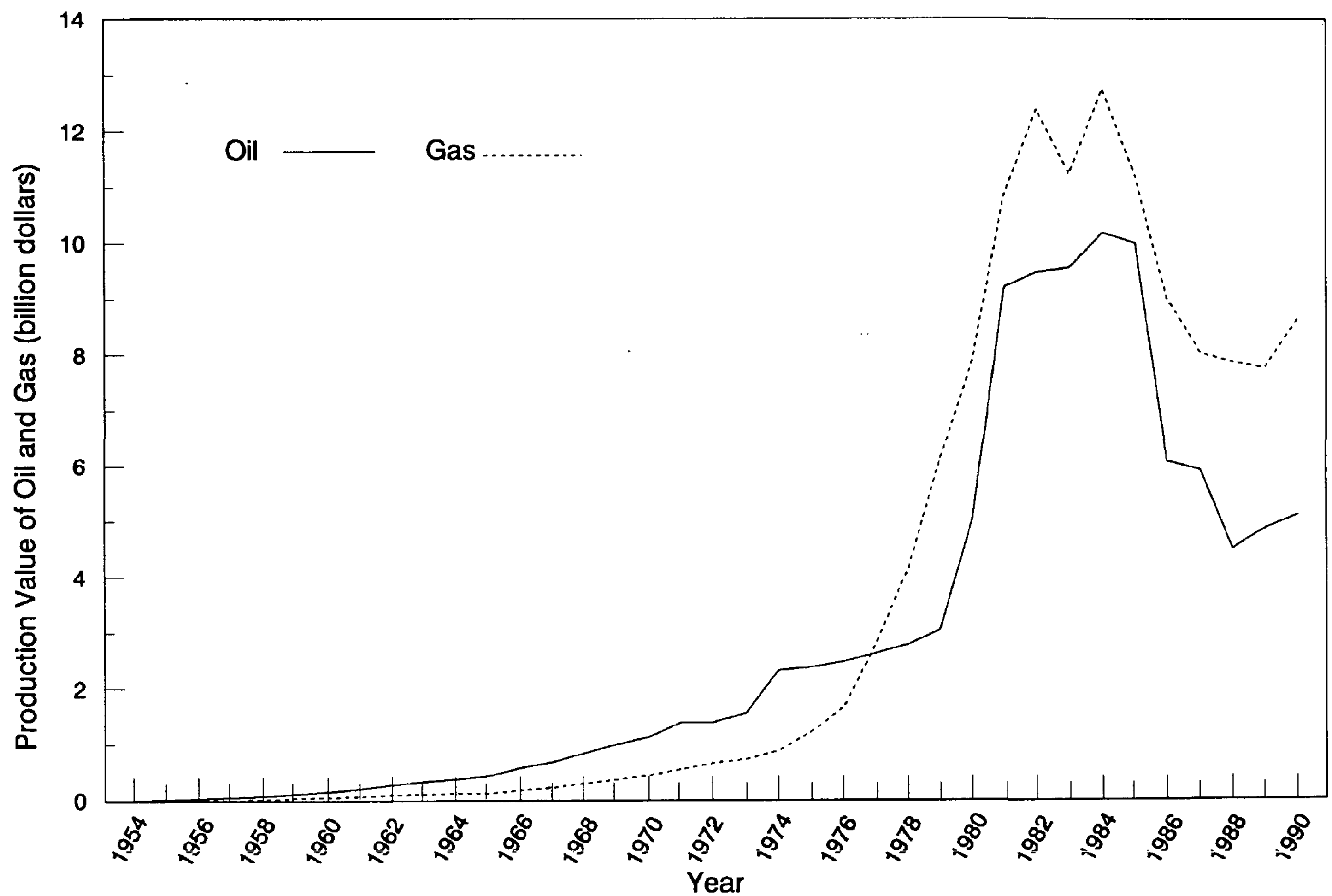


Figure III-10. Oil and Gas Production Values Offshore Louisiana and Texas, 1954 to 1990 (USDI, MMS, 1984a; preliminary unpublished data through 1990).

For planning purposes, the counties and parishes in the impact area are classified in two planning areas: the CPA and WPA. Each planning area is subdivided into coastal subareas: C-1 through C-4 in the CPA, and W-1 through W-2 in the WPA. The counties and parishes within the planning areas and coastal subareas are shown in Figure IV-1.

A Historical Perspective

Table III-6 lists population and net migration statistics for coastal subareas in the impact area for the years 1970, 1980 through 1988, and 1990. Strong population growth was experienced in all coastal subareas prior to 1983, after which the growth rate declined rather significantly. The statistics on net migration also reveal a considerable population outflow during these later years.

A study sponsored by the MMS University Initiative Program at the University of New Orleans has demonstrated a high correlation between drilling activity in the Gulf of Mexico and net migration (Spain et al., 1990). Drilling rig use is a widely used measure of economic activity in the oil and gas industry. Many large-scale oil- and gas-related business decisions are made on the basis of drilling activity in the Gulf. In fact, rig use is not only considered a barometer for activity in the oil and gas industry, but in other marine industries as well (Phillips and James, 1988).

As Figure III-6 shows, drilling rig activity in the Gulf of Mexico took a sharp downturn between the end of 1981 and mid-1983. An even greater decline in the demand for mobile drilling rigs was later experienced in 1985 and 1986. The population and net migration statistics in Table III-2 parallel these fluctuations in mobile drilling rig activity. Population growth rates for all coastal subareas were relatively high prior to 1983, as families moved to the Gulf looking for work in the booming oil and gas industry. As oil and gas activity began its decline in 1982, drilling rig use also declined, reaching its first low point in 1983. Lower rates of population growth accompanied the decline in drilling activity as workers were laid off and left the area in search of work elsewhere. After 1983 all subareas experienced several years of net migration outflow. The impact on population continued as the demand for mobile rigs declined its steepest from 1984 through 1986, to its lowest level in over a decade. Significant net migration out of the region began during the three years leading to the 1986 collapse in oil prices. "When oil prices plummeted in 1986, the effects went far beyond the energy industry . . . . Texas lost 230,000 jobs. Louisiana lost 9 percent of its work force, larger than the national percentage during the Great Depression" (Washington Post, October 16, 1990).

Even though net migration statistics are not available for 1987 through 1990, population growth rates during those years seem to reflect net out migration in all coastal subareas. Coastal Subarea C-2, which includes several blue-collar oil towns such as Morgan City, experienced a significant population decline in 1987, following the 1986 oil price collapse (Baxter, 1990). Population in the Gulf counties of Alabama and Mississippi (C-4) do not reflect a high correlation with OCS drilling activity because these States have a much lower concentration of oil and gas infrastructure than do Louisiana and Texas.

Table III-7 depicts the historic indicators for the labor force and unemployment in the coastal impact area of the Gulf region over the last 30 years. (Because the State of Texas amended its data collection methodology and adjusted related historic labor force figures at the county level back to 1980 only, 1970 labor force and unemployment indicators are not available for the Western Gulf of Mexico and the Gulf region). In 1970, the CPA unemployment rate was about 1.5 percentage points higher than the unemployment rate for the United States. By 1980, the unemployment rate for both the Central and Western Gulf of Mexico was below the national average. However, with the downturn in oil prices, the trend from 1986 to the present indicates an unemployment rate for the Gulf region that surpassed national levels and a labor force growth rate that dropped significantly from previous times. Gulf Region population levels have also experienced similar trends over this time period.

All coastal subareas of the Central Gulf experienced peak levels of unemployment in 1986, followed by a slight decline in the labor force between 1986 and 1990. Coastal Subarea C-1, with parishes whose industrial make-up is more directly dependent on offshore oil and gas extraction than those of all other coastal subareas, experienced the most noticeable decline in labor force, particularly between 1986 and 1988. Coastal Subarea C-2, with parishes whose industrial composition is highly dependent on activity indirectly associated with oil and

Table III-6

Population Statistics by Offshore Subarea*

	1970	1980	1981	1982	1983	1984	1985	1986	1987	1988	1990
Central Planning Area											
C-1											
Population	363,793	438,786	453,600	468,700	476,200	475,100	477,000	476,700	468,900	465,000	461,900
% Change		2.1%	3.4%	3.3%	1.6%	-0.2%	0.4%	-0.1%	-1.6%	-0.8%	-0.3%
Net Migration	-2,425	3,058	7,259	8,627	1,018	-7,084	-3,840	-5,861			
C-2											
Population	720,341	906,656	935,900	959,600	977,500	984,700	993,200	993,800	984,300	977,100	961,100
% Change		2.6%	3.2%	2.5%	1.9%	0.7%	0.9%	0.1%	-1.0%	-0.7%	-0.8%
Net Migration	2,081	8,849	13,421	10,651	4,804	-5,657	-4,237	-11,233			
C-3											
Population	1,071,034	1,213,122	1,234,700	1,254,700	1,267,700	1,269,600	1,273,200	1,275,200	1,262,100	1,248,100	1,185,600
% Change		1.3%	1.8%	1.6%	1.0%	0.1%	0.3%	0.2%	-1.0%	-1.1%	-2.5%
Net Migration	749	4,014	6,459	8,052	1,097	-9,764	-7,942	-9,220			
C-4											
Population	624,735	753,469	762,800	782,000	788,900	792,700	802,600	822,700	827,900	829,100	802,500
% Change		2.1%	1.2%	2.5%	0.9%	0.5%	1.2%	2.5%	0.6%	0.1%	-1.6%
Net Migration	-3,099	5,333	-374	11,547	-656	-3,264	2,956	13,209			
Western Planning Area											
W-1											
Population	577,582	712,633	737,300	767,000	787,700	794,300	800,700	812,300	812,800	806,700	793,200
% Change		2.3%	3.5%	4.0%	2.7%	0.8%	0.8%	1.4%	0.1%	-0.8%	-0.8%
Net Migration	-9,727	3,930	10,615	18,206	9,184	-4,224	-4,022	1,319			
W-2											
Population	2,591,896	3,573,398	3,753,200	3,960,200	4,064,600	4,087,400	4,101,600	4,120,900	4,097,300	4,102,200	4,181,900
% Change		3.8%	5.0%	5.5%	2.6%	0.6%	0.3%	0.5%	-0.6%	0.1%	1.0%
Net Migration	29,448	64,468	121,014	153,276	49,530	-30,549	-38,634	-31,987			

Notes: Net migration for 1970 is the annual average over the period 1960-1970.
Net migration and % population change for 1980 are annual averages over the period 1970-1980.

*See Figure IV-1.

Sources: Applied Technology Research Corporation, 1990.
USDOC, Bureau of the Census, 1990.

Table III-7

Labor Force and Unemployment Statistics for the Central and Western Gulf Coastal Subareas*
(average annual data--thousands)

	1970	1980	1986	1987	1988	1989	1990
Central Gulf							
C-1							
Unemployment	8.8	11.3	33.5	29.6	23.0	15.4	12.3
Labor Force	133.1	199.5	219.8	210.8	206.6	206.5	206.2
Unemployment Rate	6.6	5.7	15.2	14.0	11.1	7.5	6.0
C-2							
Unemployment	16.2	24.7	61.3	55.0	47.0	33.1	27.8
Labor Force	260.8	401.2	457.0	447.8	448.1	447.2	446.5
Unemployment Rate	6.2	6.2	13.4	12.3	10.5	7.4	6.2
C-3							
Unemployment	24.3	31.1	63.0	57.7	54.0	40.0	33.5
Labor Force	410.9	538.7	584.4	574.0	567.4	566.1	558.1
Unemployment Rate	5.9	5.8	10.8	10.0	9.5	7.1	6.0
C-4							
Unemployment	11.1	22.7	35.9	34.7	31.0	30.0	25.0
Labor Force	216.9	310.6	359.6	359.8	353.7	356.1	355.2
Unemployment Rate	5.1	7.3	10.0	9.7	8.8	8.4	7.0
Total							
Unemployment	60.4	89.9	193.7	177.0	154.9	118.4	98.6
Labor Force	1,021.7	1,449.9	1,620.8	1,592.4	1,575.8	1,575.9	1,565.9
Unemployment Rate	5.9	6.2	12.0	11.1	9.8	7.5	6.3
Western Gulf							
W-1							
Unemployment	NA	21.1	45.0	41.6	35.2	31.4	27.8
Labor Force	NA	302.9	347.4	344.9	344.8	347.6	350.0
Unemployment Rate	NA	7.0	13.0	12.0	10.2	9.0	7.9
W-2							
Unemployment	NA	81.0	215.5	190.1	148.9	131.6	115.5
Labor Force	NA	1,846.2	2,017.4	2,016.3	2,043.2	2,085.1	2,100.5
Unemployment Rate	NA	4.4	10.7	9.8	7.3	6.3	5.5
Total							
Unemployment	NA	102.1	260.5	231.7	184.1	163.0	143.3
Labor Force	NA	2,149.1	2,364.8	2,361.2	2,388.0	2,432.7	2,450.4
Unemployment Rate	NA	4.8	11.0	9.8	7.7	6.7	5.8
Central and Western Gulf							
Unemployment	NA	192.0	454.2	408.6	339.0	281.4	241.8
Labor Force	NA	3,598.9	3,985.6	3,953.6	3,963.8	4,008.5	4,016.3
Unemployment Rate	NA	5.3	11.4	10.3	8.6	7.0	6.0
United States							
Unemployment	3,640.0	7,585.0	8,237.0	7,245.0	6,700.0	6,520.0	6,799.0
Labor Force	82,700.0	106,821.0	117,835.0	119,865.0	121,668.0	123,846.0	124,775.0
Unemployment Rate	4.4	7.1	7.0	6.2	5.5	5.3	5.4

*See Figure IV-1.

Sources: Alabama Dept. of Industrial Relations, Research and Statistics, 1990.
Louisiana Department of Labor, 1990.
Mississippi State Employment Service, 1990.
Texas Employment Commission, 1990.

gas extraction (e.g., refining and gas processing) and has a high blue-collar involvement, experienced a small decline in labor force during the same time period. The urban and suburban New Orleans composition of coastal Subarea C-3, which has a strong tie to offshore oil and gas development but also a somewhat more diversified economy, experienced a moderate decline in labor force since the downturn in oil prices of 1986. Coastal Subarea C-4, consisting of the coastal counties of Mississippi and Alabama, experienced the smallest impact, with only a modest decline in labor force since 1986. The decline observed in the labor force of the Central Gulf coastal subareas is consistent with the net migration experienced in the area over the same time period, particularly from 1986 to 1988. Thus, the unemployment rate of the Central Gulf impact area has declined steadily from 1986 to 1990.

The coastal subareas of the Western Gulf also experienced peak unemployment levels in 1986; however, labor force estimates for the area indicate only a modest decline in 1987. By 1988, the labor force of the Western Gulf impact area was once again on the rise. In fact, the Western Gulf of Mexico experienced an overall increase in labor force from 1986 to the present, in part due to the diversification efforts pursued by the State of Texas. The Western Gulf's unemployment rate has also decreased from its 1986 peak level. Coastal Subarea W-1, consisting of the southern Texas coastal counties, experienced a fairly stable civilian labor force and a strong decrease in unemployment during that time. Coastal Subarea W-2, dominated by the Houston metropolitan area, experienced a significant growth in labor force and a decrease in unemployment since the 1986 downturn in the oil and gas industry.

Current Statistics

Currently, about one-half the United States population resides in coastal areas. The Gulf of Mexico region accounted for 13 percent of that coastal population in 1988 (USDOC, NOAA, 1990). The Central and Western zones of the Gulf Region vary substantially in socioeconomic patterns, ranging from low-density, undeveloped rural areas to high-density, highly developed urban centers.

Current population statistics for the coastal impact area are shown in Table III-6. Coastal Subarea C-3, which includes the New Orleans SMSA, has the greatest level of population in the CPA. Coastal Subarea W-2, which includes the highly populated Houston-Galveston-Brazoria SMSA, has over three times as many inhabitants as C-3.

The current population density of counties and parishes in the coastal impact area is displayed in Visual No. 2. According to 1988 statistics, the most densely populated parish in the CPA was Orleans Parish in coastal Subarea C-3. In the Central Gulf, coastal Subarea C-3 had the highest population density at almost 425 people per square mile; and C-1 had the lowest, at slightly over 100 people per square mile. In the WPA, Harris County in coastal Subarea W-2, at over 1,600 people per square mile, exhibited the highest population density during 1988.

Table III-8 reflects the 1987 industrial composition of the coastal subareas. Coastal Subarea C-1, with parishes whose industrial make-up is most directly dependent on offshore oil and gas extraction, had 6.7 percent of employment in the mining category, with 88 percent of mining employment related to oil and gas extraction. Services was the largest employer industry for coastal Subarea C-1, accounting for the highest percentage payroll as well.

While the service industry was also the largest employer for coastal Subarea C-2, the manufacturing sector contributed the largest percentage payroll. Specifically, the manufacturing sector contributed 14.6 percent of employment and 25 percent of payroll for coastal Subarea C-2 in 1987. Over 14 percent of manufacturing employment was associated with the standard industrial classifications of petroleum refining, oil field machinery and equipment, pipelines, and gas production and distribution. Mining contributed 2.2 percent of total employment and 2.8 percent of total payroll. In coastal Subarea C-3, the largest employer industry as of 1987 was the service industry. Mining contributed almost 3 percent of total employment, but over 6 percent of total payroll.

The industry that contributed most significantly to the payroll of coastal Subarea C-4 was manufacturing, accounting for 23.5 percent of total employment for 1987. Over 4 percent of the manufacturing industry was associated with oil and gas activity for that area. Mining played a minor role, contributing less than 1 percent to both employment and payroll.

Table III-8

Industrial Composition of Central and Western Gulf Coastal Subareas* for 1987

	Total	Mining	Manufacturing	T.& P.U.	Wholesale Trade	Agric. Serv. Foresty & Fisheries	Contract Construction	Retail Trade	F.I.R.E.	Services	Unclassified Establishments
Central Gulf											
C-1											
Employment	131987.5	8780.0	16908.5	11235.0	8887.0	703.5	7897.0	33259.0	7942.0	36016.0	359.5
Percent in category	100.0	6.7	12.8	8.5	6.7	0.5	6.0	25.2	6.0	27.3	0.3
Payroll ($000)	2353002.0	218972.0	451122.0	254805.0	186889.0	8229.0	139021.0	318381.0	150872.0	618154.0	6557.0
Percent Payroll in cat.	100.0	9.3	19.2	10.8	7.9	0.3	5.9	13.5	6.4	26.3	0.3
C-2											
Employment	260034.5	5592.0	37953.0	20451.0	17682.0	917.5	30524.0	61849.0	18283.0	65871.0	912.0
Percent in category	100.0	2.2	14.6	7.9	6.8	0.4	11.7	23.8	7.0	25.3	0.4
Payroll ($000)	4873106.0	135857.0	1219109.0	470648.0	378678.0	10640.0	577515.0	659033.0	349987.0	1058236.0	13403.0
Percent Payroll in cat.	100.0	2.8	25.0	9.7	7.8	0.2	11.9	13.5	7.2	21.7	0.3
C-3											
Employment	413481.0	12002.0	37265.0	36636.0	28056.0	951.0	25907.0	103450.0	32959.0	134968.0	1287.0
Percent in category	100.0	2.9	9.0	8.9	6.8	0.2	6.3	25.0	8.0	32.6	0.3
Payroll ($000)	7670783.0	484029.0	935659.0	927936.0	654768.0	14398.0	514692.0	1067489.0	736303.0	2311644.0	23865.0
Percent Payroll in cat.	100.0	6.3	12.2	12.1	8.5	0.2	6.7	13.9	9.6	30.1	0.3
C-4											
Employment	220725.0	390.5	51901.0	14107.0	13024.0	938.0	15076.0	56322.0	13305.0	54998.0	663.5
Percent in category	100.0	0.2	23.5	6.4	5.9	0.4	6.8	25.5	6.0	24.9	0.3
Payroll ($000)	3645096.0	8560.0	1250283.0	295521.0	251337.0	9313.0	249145.0	553231.0	235468.0	784259.0	7979.0
Percent Payroll in cat.	100.0	0.2	34.3	8.1	6.9	0.3	6.8	15.2	6.5	21.5	0.2
Total											
Employment	1026228.0	26764.5	144027.5	82429.0	67649.0	3510.0	79404.0	254880.0	72489.0	291853.0	3222.0
Percent in category	100.0	2.6	14.0	8.0	6.6	0.3	7.7	24.8	7.1	28.4	0.3
Payroll ($000)	18541987.0	847418.0	3856173.0	1948910.0	1471672.0	42580.0	1480373.0	2598134.0	1472630.0	4772293.0	51804.0
Percent Payroll in cat.	100.0	4.6	20.8	10.5	7.9	0.2	8.0	14.0	7.9	25.7	0.3
Western Gulf											
W-1											
Employment	190880.0	5622.0	26194.5	11939.0	13017.0	1187.5	13750.0	53061.5	12413.0	52931.5	764.0
Percent in category	100.0	2.9	13.7	6.3	6.8	0.6	7.2	27.8	6.5	27.7	0.4
Payroll ($000)	2792111.0	141430.0	613520.0	285783.0	24813.0	17127.0	219804.0	515969.0	220758.0	737730.0	15177.0
Percent Payroll in cat.	100.0	5.1	22.0	10.2	0.9	0.6	7.9	18.5	7.9	26.4	0.5
W-2											
Employment	1461021.0	47290.5	212953.0	115337.5	112490.0	7997.0	126868.0	305724.0	119413.0	408319.0	4629.0
Percent in category	100.0	3.2	14.6	7.9	7.7	0.5	8.7	20.9	8.2	27.9	0.3
Payroll ($000)	32557637.0	1897650.0	6766402.0	3161667.0	3165425.0	114977.0	2713398.0	3410756.0	3115982.0	8119757.0	91623.0
Percent Payroll in cat.	100.0	5.8	20.8	9.7	9.7	0.4	8.3	10.5	9.6	24.9	0.3
Total											
Employment	1651901.0	52912.5	239147.5	127276.5	125507.0	9184.5	140618.0	358785.5	131826.0	461250.5	5393.0
Percent in category	100.0	3.2	14.5	7.7	7.6	0.6	8.5	21.7	8.0	27.9	0.3
Payroll ($000)	35349748.0	2039080.0	7379922.0	3447450.0	3190238.0	132104.0	2933202.0	3926725.0	3336740.0	8857487.0	106800.0
Percent Payroll in cat.	100.0	5.8	20.9	9.8	9.0	0.4	8.3	11.1	9.4	25.1	0.3
Central and Western Gulf											
Employment	2678129.0	79677.0	383175.0	209705.5	193156.0	12694.5	220022.0	613665.5	204315.0	753103.5	8615.0
Percent in category	100.0	3.0	14.3	7.8	7.2	0.5	8.2	22.9	7.6	28.1	0.3
Payroll ($000)	53891735.0	2886498.0	11236095.0	5396360.0	4661910.0	174684.0	4613575.0	6524859.0	4809370.0	13629780.0	158604.0
Percent Payroll in cat.	100.0	5.4	20.8	10.0	8.7	0.3	8.2	12.1	8.9	25.3	0.3

*See Figure IV-1.

Source: USDOI, MMS analysis of data from USDOC, Bureau of the Census, 1989.

The 1987 industrial composition for the Western Gulf of Mexico coastal subareas--W-1 and W-2--was remarkably similar. In both coastal subareas the largest employer industries for 1987 were services and retail trade. The industries providing the largest payroll were services and manufacturing. Manufacturing employment related to oil and gas activity in W-1 accounted for almost 11 percent of all manufacturing employment in the area. About 5 percent of all employment for coastal Subarea W-2 in 1987 can be directly or indirectly attributed to the oil and gas extraction industry.

The Gulf area in 1990 reflects a modest to significant recovery from the high unemployment levels experienced after the 1986 downturn of the oil and gas industry. Ironically, the Gulf Coast is experiencing a shortage of skilled labor in the oil and gas industry due to "the restructuring of the oil industry to centralize management, finance, and business services, and the use of computer technology" (Baxter, 1990). The Central Gulf of Mexico's unemployment rate of 6.3 percent is still somewhat over the national average. Of all coastal subareas in the Gulf, coastal Subarea W-1 experienced the highest unemployment rate through July 1990, but that rate still exhibited a marked improvement from earlier 1986 levels. Coastal Subarea W-2, also in the Western Gulf, exhibited the lowest unemployment rate for 1990, only 0.1 percentage points higher than the national average.

In relation to oil and gas activity in the Gulf of Mexico, the exploration and production of crude oil and gas is classified as a primary industry. Classified as secondary industries are activities associated with the processing of crude oil and gas in refineries, natural gas plants, and petrochemical plants. While detailed employment information strictly related to offshore activity in the Gulf of Mexico is not readily available, data for selected Standard Industrial Classification (SIC) codes from the annual U.S. Bureau of the Census County Business Patterns can be used to estimate such employment and related economic effects on the coastal region. The results of the most recent MMS Gulf of Mexico OCS Region offshore-employment analysis, using 1987 data from the latest issue of County Business Patterns, are discussed in the following paragraph.

The specific SIC codes used in the analysis include the following:

13	-	oil and gas extraction
29	-	petroleum and coal products
3533	-	oil field machinery
46	-	petroleum pipelines
492	-	gas production distribution
517	-	petroleum and petroleum products

These SIC codes can be used to further identify the extent of direct and indirect employment in the oil and gas industry. SIC 13, which is the code that includes crude oil and gas production, is the primary industry from which direct-employment estimates are obtained. The other codes listed identify secondary industries that form the base for estimating indirect employment. Excluded from this analysis are some SIC codes that include OCS-related industries within broader categories of data (i.e., SIC 3731 includes shipbuilding and mobile rig fabrication). Finally, numerous tertiary industries are not shown above but are affected by both direct and secondary industry employment. Induced employment resulting from such tertiary industry activity, however, is included in the calculation of OCS Program employment.

The production of OCS oil and gas, particularly offshore Louisiana, has been a major source of revenue in the study area since 1954. Data from the 1987 Census show that the average annual payroll associated with oil and gas activities amounts to approximately $2.2 billion for the Gulf of Mexico Region ($1.7 billion for the Central Gulf, $0.6 billion for the Western Gulf, and $2.2 million for the Eastern Gulf). Average annual tax dollars generated per employee in the offshore oil and gas program are estimated at 8 percent of payroll revenues. Thus, State and local taxes generated annually by the Federal offshore oil and gas program are estimated at $134.7 million from the Central Gulf, $44.3 million from the Western Gulf, and $0.2 million from the Eastern Gulf.

Job estimates as of June 1991 show that 83,400 jobs are directly or indirectly dependent on the offshore program. Approximately 80 percent of these jobs are associated with activity in the Central Gulf and 20 percent are related to the Western Gulf. Nearly all offshore-related employment in the Central Gulf is due to activity offshore Louisiana; in addition, offshore activity in other areas of the Gulf also generates employment in Louisiana. Estimates of direct employment offshore are 30,000 workers in the Central Gulf, and 7,500 workers in the Western Gulf.

Projections

Table III-9 contains population and employment projections for the coastal subareas of the Central and Western Gulf impact area. Projections for 1991 through 2010 are based on a population forecast made by National Planning Association Data Services, Inc. (NPA), an economic forecasting firm located in Washington, D.C. (NPA Data Services, Inc., 1991). Projections through the year 2027 were extrapolated from NPA's county level population growth rates for the later years of their forecast.

Regionally, growth is expected to continue to be relatively stronger in the South and West of the United States (NPA Data Services, Inc., 1991) As coastal population in the South continues to grow, the quality of living standards that initially attracted residents to the area will likely diminish. The population of counties and parishes in the Central and Western Gulf impact area is expected to increase approximately 20 percent from 1990 population levels by the year 2010. The Gulf of Mexico Region is one of the less densely populated coastal regions in the country, second only to the Pacific Region, which includes Alaska's vast territory. The population density of coastal Texas has historically been the highest in the region and is expected to continue ahead of other Gulf Coast States in this respect. Louisiana and Mississippi are expected to continue experiencing steady population growth through the year 2010. Alabama, which was once as densely populated as coastal Texas, is expected to have the lowest population density of states in the Gulf of Mexico Region by 2010.

Projections by NPA of "Hot Spots" for population growth in the Gulf of Mexico region include several counties and parishes in Texas and Louisiana. Harris County, Texas, leads the Gulf Region in net population change by the year 2010, with a projected increase of nearly 900,000--approximately one-third of the county's current population. Fort Bend and Montgomery Counties, which neighbor the Houston area, are also expected to exhibit high population growth rates. In Louisiana, East Baton Rouge and Jefferson Parish are projected to add about 79,000 and 67,000 persons to their current population counts, respectively.

Table III-9 also provides employment projections for the coastal subareas of the Central and Western Gulf. The largest employment increase in the Gulf Region is expected in Harris County, Texas (coastal Subarea W-2), which is projected to add approximately 752,000 employees by the year 2010. In Louisiana, both Jefferson Parish (coastal Subarea C-3) and East Baton Rouge Parish (coastal Subarea C-2) are anticipated to experience sizeable increases in employment levels. By the year 2027, the largest employers will continue to be coastal Subarea W-2 in the WPA and coastal Subarea C-3 in the CPA. Because these baseline projections assume the continuation of existing social, economic, and technological trends, they also include employment resulting from the continuation of current patterns in OCS leasing activity.

b. Public Services and Infrastructure

Public services and infrastructure, as used here, include commonly provided public, semi-public, and private services and facilities, such as education, police and fire protection, sewage treatment, solid-waste disposal, water supply, recreation, transportation, health care, other utilities, and housing. The geographic area that could be directly affected by the proposals include coastal parishes and counties in the Central and Western Gulf of Mexico.

Table III-9

Population and Employment Projections for the Central and Western Gulf Coastal Subareas*

		1990	1991	1992	1995	2000	2010	2027
Central Planning Area								
C-1								
	Population	461,908	462,861	465,856	474,956	489,544	516,207	564,909
	% Growth		0.21%	0.65%	0.65%	0.61%	0.53%	0.53%
	Employment	240,032	237,622	242,009	255,663	274,405	302,675	357,578
	% Growth		-1.00%	1.85%	1.85%	1.42%	0.99%	0.99%
C-2								
	Population	961,127	966,286	977,572	1012,229	1059,78	1142,073	1296,901
	% Growth		0.54%	1.17%	1.17%	0.92%	0.75%	0.75%
	Employment	457,709	451,778	460,964	489,658	527,104	583,188	692,563
	% Growth		-1.30%	2.03%	2.03%	1.48%	1.02%	1.02%
C-3								
	Population	1,185,552	1,182,956	1,186,429	1,196,909	1,220,673	1,282	1,393,410
	% Growth		-0.22%	0.29%	0.29%	0.39%	0.49%	0.49%
	Employment	638,991	628,053	637,035	663,245	705,263	781,893	931,753
	% Growth		-1.64%	1.35%	1.35%	1.24%	1.04%	1.04%
C-4								
	Population	802,474	795,929	800,084	812,678	840,683	888,337	975,630
	% Growth		-0.82%	0.52%	0.52%	0.68%	0.55%	0.55%
	Employment	389,003	383,948	389,759	407,723	432,354	471,115	545,149
	% Growth		-1.31%	1.51%	1.51%	1.18%	0.86%	0.86%
Total								
	Population	3,411,061	3,408,032	3,429,941	3,496,772	3,610,680	3,828,617	4,230,849
	% Growth		-0.09%	0.64%	0.65%	0.64%	0.59%	0.59%
	Employment	1,725,762	1,701,878	1,729,766	1,816,289	1,939,126	2,138,871	2,527,043
	% Growth		-1.38%	1.64%	1.64%	1.32%	0.99%	0.99%
Western Planning Area								
W-1								
	Population	793,178	764,844	764,333	762,801	793,549	851,257	959,154
	% Growth		-3.57%	-0.07%	-0.07%	0.79%	0.70%	0.70%
	Employment	346,498	341,686	347,675	366,279	392,264	434,554	517,172
	% Growth		-1.39%	1.75%	1.75%	1.38%	1.03%	1.03%
W-2								
	Population	4,181,915	4,261,973	4,339,436	4,580,377	4,907,483	5,480,708	6,613,008
	% Growth		1.91%	1.82%	1.82%	1.39%	1.11%	1.11%
	Employment	2,300,203	2,291,671	2,349,323	2,531,129	2,800,245	3,246,055	4,174,519
	% Growth		-0.37%	2.52%	2.52%	2.04%	1.49%	1.49%
Total								
	Population	4,975,093	5,026,817	5,103,769	5,343,178	5,701,032	6,331,965	7,572,162
	% Growth		1.04%	1.53%	1.54%	1.31%	1.06%	1.06%
	Employment	2,646,701	2,633,357	2,696,998	2,897,408	3,192,509	3,681,104	4,691,690
	% Growth		-0.50%	2.42%	2.42%	1.96%	1.44%	1.44%

* See Figure IV-1.

Source: NPA Data Services, Inc., 1991.

Infrastructure and public service development in the area of consideration have tracked population growth and community development. Population changes in the area are discussed in Section III.C.2.a. The Gulf Coast physiography has strongly influenced population distribution and community growth. Much of the land in the area is low and characterized by a water table at or near the surface for much of the year. The Louisiana coastal area includes broad expanses of coastal marshes and swamps interspersed with ridges of higher, well-drained land along the courses of modern and extinct river systems. Most of the larger urban centers in coastal Louisiana are located along major navigable rivers and/or along the landward edge of the coastal zone (i.e., Lafayette and Lake Charles). To a lesser extent, this pattern continues into Texas where urban centers such as Houston and Beaumont are located at the heads of navigation of estuaries. In Mississippi and Alabama, much of the population resides along the immediate coastal fringe and along the shores of navigable estuaries between Gulfport, Mississippi, and Mobile, Alabama.

The characteristics of the regional landscape have promoted the growth of population centers keyed to the development of natural resources that occur in the area (oil and gas and other minerals) or to agricultural, forestry, and fisheries resources suited to the regional land and climatic conditions. Rice and sugar cane have become primary crops planted along the coast, sometimes associated with crawfish aquaculture. Forestry has long been an important activity along the coast, in earlier days using swamp and riparian hardwoods, and today mainly pine plantations. The abundant fisheries resources of the open Gulf and nearshore waters have promoted a large fishing fleet and associated seafood processing facilities. The most important resource that has affected community infrastructure changes in the Gulf area, however, has been oil and gas development, both within State jurisdiction and on the Federal OCS.

The area's natural resource-based economy has influenced the development of the particulars of the infrastructure distribution in the area. One interstate highway (I-10) traverses the area along the inner margin of the coastal zone. For the most part, only secondary highways penetrate longitudinally into the coastal areas. A similar pattern applies to railroads. The agricultural, forestry, and mineral products exported from the area could be largely shipped in bulk by water transport, pipeline, or spur rail line, and an elaborate network of improved highways was not needed. Similarly, most communities are scattered throughout the region and are based on extracting, growing, or processing area resources.

Public services and infrastructure depend heavily on levels of population and employment. Population growth and migration patterns in the area have affected the infrastructure and public service institutions in the area. The most important factor in this regard has been the oil and gas industry, particularly in Louisiana and Texas. Oil and gas production began on land and in nearshore waters.

Cumulative production from the Louisiana coastal areas from 1954 through 1982 exceeded production from the Gulf of Mexico Federal OCS by 72 percent for oil and condensate and by approximately 50 percent for gas production. Annual production from the State coastal area consistently exceeded production from the OCS until 1974 (USDOI, MMS, 1984b). Since 1974, however, the hydrocarbon production from the Gulf of Mexico OCS has surpassed onshore and nearshore coastal production. The northern Gulf of Mexico OCS has yielded 9-12 percent of the crude oil and 10-20 percent of the natural gas produced in the United States from 1973 to 1981. By 1981, the northern Gulf of Mexico was the most developed offshore area in the world (Gramling and Freudenburg, 1990).

Following years of relatively stable prices, the average annual price of oil began to rise in 1973, initially in response to the Arab Oil Embargo and later as a result of the increasing marketing effectiveness of the Organization for Petroleum Exporting Countries (OPEC). The price increase stimulated oil and gas exploration on the OCS, and with the increase in OCS oil and gas exploration and development came a concomitant increase in population in the coastal parishes and counties of the Central and Western Gulf of Mexico, due, in part, to in-migration. Therefore, it is assumed that the in-migration to the subareas is due, in large part, to the increase in oil and gas activity resulting from the increase in the world oil price.

According to Table III-6, the average annual percent of population change in the Central Gulf subareas (C-1, C-2, C-3, and C-4) from 1970 to 1980 was between 1.3 and 2.6 percent. Average annual net migration into the subareas at the same time was between 3,058 and 8,849. The population increase in Western Gulf subareas (W-1 and W-2) mirrored those of the Central Gulf. The average annual percent of population change in the Western Gulf subareas from 1970 to 1980 was between 2.3 and 3.8 percent. Average annual net migration into the subareas at the same time was between 3,930 and 64,468.

In 1981, 1982, and 1983 most of the Central Gulf subareas experienced population increases. The sole exception to this was Subarea C-4, which experienced net out-migration in 1981 and in 1983. Percent change in population over these years varied from 0.9 percent to 3.4 percent. The greatest percent change in population occurred in Subarea C-1 in 1981. In the Western Gulf, as in the Central Gulf, population continued to increase from 1981 to 1983. The percent change in population in the two subareas ranged from 2.6 to 5.5 percent. Average annual net migration into these areas was between 9,184 and 153,276. The greatest population increase occurred in Subarea W-2 in 1982.

Cyclic fluctuation as it relates to oil and gas development in the Gulf of Mexico has been commented on by Gramling and Freudenburg (1990), Gramling and Brabant (1986), and Gramling (1984). The rural and relatively isolated nature of the coastal parishes in Louisiana meant that increases in population resulted in greater responsibilities for public service agencies and a need for improved infrastructure in these parishes.

The rapid increase in population was associated with an increase in the demand for housing and public services. There was also a strain on transportation networks caused by the population increase and by the need for offshore workers and supplies to reach offshore activity staging areas.

The downturn in world oil prices that characterized the mid-1980's was reflected in a decreasing amount of oil and gas activity in the Central and Western Gulf, which, in turn, resulted in greater unemployment and underemployment in the coastal parishes and counties. During the downturn, public and private public service agencies were called upon to provide families and individuals with food, shelter, and other forms of assistance. High unemployment rates and net out-migration from the area during much of the 1980's resulted in falling real estate values and financial problems for individuals and financial institutions. State and local agencies also experienced difficulties in supporting and continuing those programs for upgrading infrastructure that had been started or planned during the earlier days of oil and gas industry expansion.

It may be seem that, as a response to fluctuations in the world oil price, the Central and Western Gulf coastal subareas experienced an extended period of high oil and gas activity followed by a period of diminished activity. (The Eastern Gulf coastal subareas have seen minimal oil and gas activity in the same period.) It should be noted that the oil and gas activity has occurred within both federally and State-regulated areas. In-migration of persons seeking employment occurred in the coastal parishes and counties of the Central and Western Gulf during the period of high oil and gas activity; out-migration occurred from most of the same areas during the downturn. As noted above, the Gulf area in 1990 reflects, at a minimum, a modest recovery from the high unemployment levels experienced after the downturn.

c. Social Patterns

The area that could be affected by the proposed action includes coastal parishes and counties in the Central and Western Gulf of Mexico (Section III.C.2.a.). The analysis area has been defined as those parishes or counties that are expected to be directly impacted by the proposal.

The Spanish, in the 16th and 17th centuries, were the earliest European explorers of the Gulf of Mexico. They discovered a population of Native Americans ranging from settled, agricultural chiefdoms to nomadic hunter-gatherers. Historic development along the northern Gulf of Mexico was associated with ports established by the Spanish and French. The Spanish developed Pensacola in 1698, the French Biloxi (1699), Dauphin Island (1699), Mobile Bay (1701), and New Orleans (1717). With the end of the Colonial period and the Texas Revolution, the number of ports along the northern Gulf of Mexico increased. Ports such as Tampa, Brownsville, Key West, and Pascagoula were founded in the 19th century (cf. Garrison et al., 1989).

The Native American cultures, with few notable exceptions (cf. Peterson, 1987), were absorbed or destroyed by the early 20th century. Remnants of the earlier, European cultures were found primarily in isolated areas along the Gulf margin. The Acadians, located in southwest Louisiana, were descendants of French-speaking Acadians displaced from the East Coast of Canada in 1755. The presence of French-speaking Louisiana to the south served to attract many of these people (now known as Cajuns). A roughly triangular area with the Mississippi Delta to the east; Alexandria, Louisiana, to the north; and Lake Charles, Louisiana, to the west is now known as the French Triangle (Rushton, 1979). Other isolated remnant cultures, such as the Isleños from the Canary Islands in St. Bernard Parish, Louisiana (cf. Guillot, 1980); Greeks in Tarpon

Springs, Florida; Dalmation Coast Yugoslavs in the delta of the Mississippi River; and Oriental immigrants in the southeast portion of Louisiana existed along the Gulf rim margin (Spitzer, 1987; Cohen, 1984). With the exception of the Orientals in southeast Louisiana, all of the above cultural enclaves are recognizable today.

Traditional occupations in the Gulf coastal parishes and counties include trapping and fishing. Louisiana produces more fur-bearing mammals from trapping than any other state in the country. A 10-year average (1976-1977 through 1985-1986 seasons) of comparative takes of fur animals in Louisiana reveals an average worth of $11,594,905.06 of pelts and meats (Calhoun, 1988). Traditionally, trappers and their families would enter the marsh in autumn and spend the fall and winter trapping. Today, many trappers run their traplines as a daily routine from their homes at the edge of the marsh (Hallowell, 1979). Trapping was usually practiced in association with other resource gathering activities, such as shrimping. These activities occurred as a seasonal round, with the trapper or shrimper sometimes spending time away from the family in pursuit of the resource.

Today, the Gulf of Mexico provides nearly 40 percent of the commercial fish landings in the continental U.S. Species that are commercially fished in the Central and Western Gulf include menhaden, shrimp, oyster, and blue crab. Traditional fisheries occupations may involve exploitation of the coastal marshes and bays as well as exploitation of offshore species. The fishermen frequently spend days or weeks at a time in pursuit of the resource, coming back to dock only to unload and take on fuel and provisions.

Other traditional occupations along the Gulf Coast, such as the gathering of Spanish moss in the coastal parishes of Louisiana and sponge diving off the coast of Florida, have diminished or disappeared as resources were diminished or depleted and preferred alternatives were developed.

Farming of sugarcane, rice, and other crops has also been a traditional occupation in the coastal subareas of the Gulf. Major crops produced in southwestern Louisiana include rice and soybeans. South-central Louisiana is the State's major sugarcane-producingarea. Around the Mississippi River delta region, vegetables and fruit are grown for consumption. In recent years, rice farming has frequently been combined with crawfish aquaculture. Other forms of aquaculture occurring in the coastal subareas of the Central and Western Gulf include alligator, catfish, and some saltwater species (red drum).

The exploration and development of oil and gas resources have occurred in the coastal parishes and counties of the Central and Western Gulf for the greater part of a century (Brantly, 1971). It can be argued that, after so long a period time, work in the oil and gas industry has become one of the traditional occupations of the coastal subareas in the Central and Western Gulf. The work scheduling associated with employment in the OCS oil and gas industry generally requires blocks of time at the location, followed by a block of time off. Differing schedules include seven days on followed by seven days off, two weeks on and two weeks off, and other variations on the theme. This work schedule allows for the part-time pursuit of the traditional occupations of trapping and fishing in the extended periods of off time.

3. Commercial Fisheries

The Gulf of Mexico continues to provide nearly 38 percent of the commercial fish landings in the continental United States. During 1990, commercial landings of all fisheries in the Gulf totaled nearly 1.6 billion pounds, valued at about $640 million (USDOC, NMFS, 1991Tablea).

Menhaden, with landings of 1.1 billion pounds, valued at $54.4 million, was the most important Gulf species in quantity landed during 1990. Shrimp, with landings of 249.5 million pounds, valued at $391 million, was the most important Gulf species in value landed during 1990 (USDOC, NMFS, 1991a). The 1990 Gulf oyster fishery accounted for 36 percent of the national total with landings of 10.6 million pounds of meats, valued at about $34 million. The Gulf blue crab fishery accounted for 18 percent of the national total with landings of 45.5 million pounds, valued at $17 million (USDOC, NMFS, 1991a).

Alabama ranked last among Central and Western Gulf states in total commercial landings for 1990 with 23 million pounds landed, valued at $36 million. Shrimp was the most important fishery landed, with 14.9 million pounds, valued at $30.9 million. In addition, during 1990, the following six species each accounted for landings valued at over $125,000: blue crab, shark, black mullet, red snapper, flounder, and the American oyster (USDOC, NMFS, 1991a). Alabama had about 4,000 commercial saltwater, licensed fishermen during 1990 (Lazauski, written comm., 1990).

Mississippi ranked second among Central and Western Gulf states in total commercial fishery landings for 1990, with 319.5 million pounds landed, valued at $42 million. Shrimp was the most important fishery, with 15.2 million pounds landed, valued at about $25.7 million. Menhaden landings were significant during 1990, with 275 million pounds landed, valued at $11.7 million. In addition, during 1989, the following four species each accounted for landings valued at over $200,000: red snapper, Vermilion snapper, American oyster, and black mullet (USDOC, NMFS, 1991a). In 1990, Mississippi had about 3,500 commercial saltwater, licensed fishermen (Quinn, written comm., 1990).

Louisiana ranked first among Central and Western Gulf states in total commercial fishery landings for 1990, with nearly 1.1 billion pounds landed, valued at $263 million. Menhaden was the highest quantity finfish, with 866 million pounds landed, valued at $41.7 million. Shrimp was the highest value shellfish, with 119.5 million pounds landed, valued at $153 million. In addition, during 1990, the following nine species each accounted for landings valued at over $1 million: black drum, red mullet roe, shark, red snapper, vermilion snapper, bluefin tuna, yellowfin tuna, blue crab, and the American oyster (USDOC, NMFS, 1991a). In 1990, Louisiana had about 24,000 commercial saltwater, licensed fishermen (Sharkey, written comm., 1990).

Texas ranked third among Central and Western Gulf states in total commercial fishery landings for 1990 with nearly 99 million pounds landed, valued at $182 million. In quantity and value, shrimp ranked first, with about 92 million pounds, valued at $17 million. In addition, during 1990, the following three species each accounted for landings valued at over $1 million: yellowfin tuna, blue crab, and American oyster (USDOC, NMFS, 1991a). In 1989, Texas had about 24,000 commercial saltwater, licensed fishermen (Clagett, written comm., 1990).

The Gulf of Mexico yielded the nation's largest regional commercial fishery by weight in 1990. The Gulf fisheries landings were 57 percent of the national total by weight and 20 percent by value. Most commercial species harvested from Federal waters of the Gulf of Mexico are considered to be at or near an overfished condition. Continued fishing at the present levels may result in rapid declines in commercial landings and eventual failure of certain fisheries. Commercial landings of traditional fisheries, such as shrimp, red snapper, and spiny lobster, have declined over the past decade despite substantial increases in fishing effort. Commercial landings of recent fisheries, such as shark, black drum, and tuna, have increased exponentially over the past five years, and those fisheries are thought to be in danger of collapse (Angelovic, written comm., 1989; USDOC, NMFS, 1991b).

Nearly all species significantly contributing to the Gulf of Mexico's commercial catches are estuarine dependent. The degradation of inshore water quality and loss of Gulf wetlands as nursery areas are considered significant threats to commercial fishing (Angelovic, written comm., 1989; Christmas et al., 1988; Gulf States Marine Fisheries Commission, 1988). In addition, conflicts between fishermen using fixed gear (traps) and mobile gear (trawls) continue to be a problem in some parts of the Gulf (Federal Fisheries News Bulletin, 1989a and b).

Fishery Management Plans (FMP's) are developed by the Gulf of Mexico Fishery Management Council (GMFMC) to assess and manage commercial species of fish that are harvested from Federal waters and in need of conservation. Since 1981, nine FMP's have been implemented for the following species in the Gulf of Mexico: shrimp, stone crab, spiny lobster, coastal pelagics, coral, reef fish, swordfish, red drum, and sharks. The GMFMC has initiated development of additional management plans for butterfish, swordfish, and black drum (Gulf of Mexico Fishery Management Council, 1989; Horst, 1989).

The Gulf of Mexico shrimp fishery is the most valuable in the United States accounting for 72 percent of the total domestic production (USDOC, NMFS, 1991a). Three species of shrimp--brown, white, and pink--dominate the landings. The status of the stocks are as follows: (1) brown shrimp yields are at or near the maximum sustainable levels; (2) white shrimp yields are beyond maximum sustainable levels with signs of overfishing occurring; and (3) pink shrimp yields are at or beyond maximum sustainable levels.

The shrimp fishery is facing a number of additional problems: an excessive number of vessels given available yields of shrimp; imports of less expensive shrimp from foreign countries accounting for 77.5 percent of domestic consumption; a 10 percent decline in ex-vessel price of domestic shrimp over the past five years; increases in interest rates to finance acquisition of equipment, vessels, and other related fishing needs; increases in fuel prices; excessive costs of marine casualty insurance; regulations regarding the use of turtle excluder devices; excessive bycatch of finfish; and conflicts with other targeted fisheries (Angelovic, written comm., 1989; Gulf States Marine Fisheries Commission, 1988). It has been estimated that for every pound of shrimp landed, over nine pounds of valuable finfish are killed and discarded as bycatch (Sport Fishing Institute, 1989a). In an attempt to lessen anticipated conflicts between commercial fishing for shrimp, spiny lobster, and stone crab, the GMFMC has closed areas in the Eastern Gulf to shrimp trawling during the traditional trap fishing seasons for lobster and stone crab.

The red drum fishery was closed to all harvest in Federal waters of the Gulf of Mexico on January 1, 1988. Stock assessment concluded that red drum were heavily fished prior to moving offshore to spawn and that those fish less than 12 years of age were poorly represented in the offshore spawning population. Continued harvest of adults from Federal waters would further reduce spawning stock and increase the risk of a collapse of the red drum fishery (USDOC, NMFS, 1989a).

Red snapper resources in the Gulf of Mexico are believed to be severely overfished from both directed and bycatch fisheries. Red snapper is the most important species in the reef fish complex managed under a FMP in terms of value and historical landings. The species is presently considered to be in worse condition than was red drum when that fishery was closed to all further harvest in Federal waters.

The major concern of the stone crab fishery is whether harvest has reached or exceeded maximum sustainable yield. Until recently, the fishery has been expanding in terms of increasing catch within traditional fishing areas and previously unfished or underfished regions. However, the total harvest has declined steadily over the past several years. The GMFMC is considering limitations on the number of fishermen and traps in the stone crab fishery.

Spiny lobster fishing is practiced exclusively in the Eastern Gulf of Mexico. It is believed that the stock is showing signs of growth overfishing. Fishing mortality is high due to the number of undersized lobsters used to bait lobster fishing traps and the number of traps in the fishery that far exceed that number required to harvest the present yield. Fishermen contend that the present fishery practices are the most optimal for their objectives. The GMFMC is considering limitations on the number of fishermen and traps in the spiny lobster fishery.

The coastal pelagic FMP addresses a number of species. Two of the more important species are king and Spanish mackerel. Both species have been extensively overfished and are now under a managed rebuilding program. Since the early 1980's there has been a marked absence of a strong year class of king mackerel. Spawning stock biomass has exhibited some gains and recruitment is stable at low levels. There is concern over the possible need for two management units for king mackerel within the Gulf of Mexico and with the impact of the increasing Mexican fishery. Spanish mackerel stocks are showing positive signs of recovery. Spawning stock biomass and recruitment appear to be increasing. Most of the Spanish mackerel catch is taken off Florida. Capture of 50-80 percent of the yearly commercial allocation within a period of three weeks by southeast Florida fishermen has raised questions of conflict with recreational fishermen who believe their allocation should be increased.

Commercial landings of swordfish have increased steadily over the past several years with serious implications for the future. The percentage of older fish and spawning biomass has declined significantly. The GMFMC is developing a number of alternatives to better manage this resource.

Blue marlin and white marlin are believed to be at or near the point of full exploitation. There is concern about the increasing mortality of marlin as bycatch associated with the escalating yellowfin tuna longline fishery (Sport Fishing Institute, 1989b). The tuna fishing industry has expanded at an alarming rate in the Gulf of Mexico over the past five years. Tuna are now included under the Magnuson Fishery Conservation and Management Act of 1976 (MFCMA), and the GMFMC can begin to manage the tuna fishing industry and address the marlin bycatch issue. For more information concerning the MFCMA, see Section I.B.4.g.

The taking of stony corals or gorgonian sea fans is prohibited. Fishing for soft coral octocorals is presently below the limits of maximum yield. There are significant concerns about the butterfish fishery in that butterfish trawlers allegedly destroy coral reef habitat and take a large number of snappers and groupers as bycatch. In addition, a newly formed fishery of "live rock" for the ornamental trade is receiving attention due to the allegation that "live rock" fishing may purposefully or inadvertently include the harvest of stony coral.

The present concern with the condition of the black drum fishery stems directly from the closure, of the red drum fishery. Almost immediately after closure, black drum were accepted as a substitute for red drum within the commercial market. The intensive fishing effort for red drum was switched to black drum without need to change fishing gear or technique. As a result, stocks of black drum are believed to be fast approaching a seriously depleted condition. Several Gulf States have instituted interim management measures in State waters to reduce black drum catches while an FMP is developed and implemented (Horst, 1989).

A strong market for shark has resulted in soaring catches over the past several years. Shark stocks are unable to sustain the present heavy fishing pressure, and without management, the fishery is expected to collapse within the near future. The GMFMC has requested that Gulf States consider interim management measures while an FMP is developed and implemented (Gulf Fishery News, 1989).

4. Recreational Resources and Activities

The northern Gulf of Mexico coastal zone is one of the major recreational regions of the United States, particularly for marine fishing and beach activities. Gulf Coast shorelines offer a diversity of natural and developed landscapes and seascapes. Major recreational resources include coastal beaches, barrier islands, estuarine bays and sounds, river deltas, and tidal marshes. Other resources include publicly owned and administered areas, such as national seashores, parks, beaches, and wildlife lands, as well as designated preservation areas, such as historic and natural sites and landmarks, wilderness areas, wildlife sanctuaries, and scenic rivers. Gulf Coast residents and tourists from throughout the nation, as well as from foreign countries, use these resources extensively and intensively for recreational activity. Commercial and private recreational facilities and establishments, such as resorts, marinas, amusement parks, and ornamental gardens, also serve as primary-interest areas.

Predominant among public recreation areas abutting the Gulf of Mexico are Padre Island National Seashore in the WPA and Gulf Islands National Seashore in the CPA. Over 20 years ago Congress set aside these outstanding examples of Gulf coastal beach and barrier island ecosystems to be managed by the National Park Service for the preservation, enjoyment, and understanding of their inherent natural, cultural, and recreational values. Combined, these seashores account for approximately 110 mi of exposed Gulf beachfront, which accommodates over 1.5 million recreational visits a year. Besides beaches these seashores contain nationally significant forts, shipwrecks, wetlands, lagoons and estuaries, seagrasses, fish and wildlife, and archaeological sites. In 1978, 1,800 ac on Horn and Petit Bois Islands, part of Gulf Islands National Seashore, were designated by Congress as components of the National Wilderness System.

Visual No. 2 provides a synoptic view of the location, extent, and components of all the designated recreational areas and major recreational beaches within the marine and coastal areas from Texas to Alabama. Approximately 40 million residents of the Gulf Coast States have a major interest in water-related and water-enhanced recreational activity. Gulf beaches and nearshore marine recreational waters are a major focus of coastal recreation activities. Approximately 13 percent of the nation's population resides in the Gulf Region, which harbors the lowest coastal population density of any region in the continental U.S. (USDOC, NOAA, 1990a).

The Office of Strategic Assessment of NOAA inventoried public recreation areas in coastal areas throughout the U.S. and determined 308 public agencies owned and/or managed outdoor recreation areas and facilities in Gulf coastal areas. The atlas developed by NOAA provides extensive data on public recreation lands and waters, as well as the number of boat ramps, boating slips, docks, fishing piers, campsites, artificial reefs, and miles of beach for every coastal county or parish associated with the Gulf of Mexico region (USDOC, NOAA, 1988c).

The Gulf States from Texas to Alabama count about 1.3 million registered motorboats and over 3.5 million paid fishing license holders. The two major recreational areas most directly associated with and potentially affected by offshore leasing are the offshore marine environment and the coastal shorefront of the adjoining states. The major recreational activity occurring on the OCS is offshore marine recreational fishing and diving. Studies, reports, and conference proceedings published by MMS and others have documented a substantial recreational fishery, including scuba diving directly associated with oil and gas production platforms (Witzig, 1986; Ditton and Auyong, 1984; Roberts and Thompson, 1983; Ditton and Graefe, 1978; Dugas et al., 1979; Reggio, 1989). The NMFS Marine Recreational Fisheries Statistics Survey for the Gulf and Atlantic Coasts (USDOC, NMFS, 1990a) and a special report by Schmied and Burgess (1987) indicates there are about 4 million resident participants in marine recreational fishing and over 2 million tourists who angle for Gulf marine species. According to NMFS, over 40 percent of the nation's marine recreational fishing catch comes from the Gulf of Mexico, and marine anglers in the Gulf made over 13 million fishing trips in 1989, exclusive of Texas (USDOC, NMFS, 1990a). Texas marine anglers using private boats expended over 7 million man-hours to land almost 3 million saltwater fish during the 1986-1987 fishing years (Osburn et al., 1988).

Table III-10 provides some indication of participation rates and trends in marine recreational fishing in all Gulf States except Texas. Marine recreational fishing trips and catch along the Atlantic and Gulf coasts have been declining in the last few years (USDOC, NMFS, 1990a). Speckled trout are the most sought sport fish in coastal marine waters, whereas snapper and mackerel are some of the more popular offshore sport fish. Gulf snapper landings have shown a precipitous downward trend over the last several years, and proposals have been made to limit severely the catch by recreational fishermen (Gulf of Mexico Fishery Management Council, 1990). Marine recreational fishing in the Gulf Region from Texas to Alabama is a major industry important to these States' economies. The recreational marine fishing industry accounts for an estimated $769 million in sales (equipment, transportation, food, lodging, insurance, and services) and employment for over 15,000 people, earning more than $158 million annually in the CPA and WPA (Table III-11) (Sports Fishing Institute, 1988).

The coastal shorelines of the CPA and WPA contain extensive public park and recreation areas, private resorts, and commercial lodging. Most of the outdoor recreational activity focused on the Gulf shorefront is associated with accessible beach areas. Beaches are a major inducement for coastal tourism, as well as a primary resource for resident recreational activity. However, recreational resources, activities, and expenditures are not constant along the Gulf of Mexico shorefront, but are focused where public beaches are close to major urban centers. Beach use is a major economic factor for many Gulf coastal communities, especially during peak-use seasons in the spring and summer.

Table III-10

Marine Recreational Fishing Trips
in the Gulf of Mexico (1984-1989)

-- thousands of trips --

	1984	1985	1986	1987	1988	1989
Louisiana	1,434	2,446	3,114	2,364	3,338	2,063
Mississippi	546	536	672	920	799	546
Alabama	512	603	675	548	1,104	499
Florida (Gulf Coast)	11,451	13,372	13,436	12,217	13,822	10,485
Texas	2,445	7,270	-	-	-	-
Gulfwide[1]	16,388	24,227	17,897	16,049	19,063	13,593

[1]Texas data for 1986-1989 are unavailable and some fishing modes were missing from the 1984-1985 Texas data collected by NMFS.

Source: Witzig, personal comm., 1990.

Table III-11

Economic Activity Associated with Marine Recreational Fishing in the Gulf of Mexico

	Sales	Employment (person years)	Number of Employees	Wages and Salaries	Capital Expenditures
Florida	$ 946,990,600	15,120	18,960	$194,857,800	$46,699,600
Alabama	42,703,800	682	855	8,787,000	2,105,900
Mississippi	37,958,900	606	760	7,810,600	1,871,900
Louisiana	173,223,100	2,766	3,468	35,643,300	8,542,300
Texas	514,853,500	8,221	10,308	105,939,000	25,389,300
Gulfwide	$1,715,729,900	27,395	34,351	$353,037,700	$84,609,000

Source: Sports Fishing Institute, 1988

5. Archaeological Resources

Archaeological resources are any prehistoric or historic site, building, structure, object, or feature that is manmade or modified by human activity. Significant archaeological resources are defined in 36 CFR 800, Section 60.6. The MMS has previously contacted the State Historic Preservation Officers for all Gulf Coast States and requested them to provide a list of those National Register of Historic Places that are in their State's coastal zones and that could potentially be affected by OCS leasing activities. These properties are depicted on Visual No. 2.

a. Historic

With the exception of the Ship Shoal Lighthouse, historic archaeological resources on the OCS consist of shipwrecks. A 1977 MMS archaeological resource baseline study for the northern Gulf of Mexico indicated that 2 percent of the pre-20th century shipwrecks and 10 percent of all wrecks reported lost between 1500 and 1945 have known and/or verified locations (CEI, 1977). Management of this resource was accomplished by establishing a high-probability zone (ARZ1) for the occurrence of historic shipwrecks. The use of geographic and cultural factors as indicators of high shipwreck potential delineated this zone. A recently completed study by Texas A&M University (Garrison et al., 1989) updated the shipwreck database. Statistical analysis of over 4,000 potential shipwrecks in the northern Gulf indicated that many of the OCS shipwrecks occur in clustered patterns related mainly to navigation hazards and port entrances. The study recommended significant changes to the ARZ1 as well as changes in the MMS historic shipwreck survey methodology, including tightening magnetometer survey linespacing intervals from 150 to 50 m.

On November 30, 1990, the MMS Gulf of Mexico OCS Region issued an LTL that redefined those blocks in the Gulf Region that are considered to have a high probability for the occurrence of historic period shipwrecks. The LTL reduced the total number of blocks on the Gulf of Mexico OCS with a high probability for historic shipwrecks from 3,410 to 2,263. The redefinition of the historic shipwreck high probability zone was based on the recommendations of the Texas A&M University study as well as in-house analyses of the study's conclusions and technical aspects of magnetometer survey. The redefined high-probability zone consists of three subzones--a zone defined as occurring from the shoreline to 10 km from shore; 21 0.5-degree square high-probability quadrats associated with cultural and geographic features (such as historic ports, barrier islands, reefs, etc.); and specific high-probability search polygons associated with shipwrecks located outside of the two aforementioned zones.

The Texas A&M University study also examined variables affecting the site formation process and shipwreck preservation potential. The study concluded that the eastern part of the CPA would have a high shipwreck preservation potential because of the thick Holocene deltaic sediments found there. This high degree of wreck preservation would not be expected in the most western part of the CPA, where sedimentation rates are slower. In the WPA, preservation potential is expected to be moderate to high throughout the area. Except for localized coastal areas with active sand deposition, shipwrecks in the EPA are not expected to have a high potential for preservation.

Remote-sensing surveys required by MMS have recorded evidence of approximately 57 potential shipwrecks, 80 percent of which are in ARZ1, which, according to the baseline study, is where the highest incidence of shipwrecks should occur.

b. Prehistoric

The advent of man into the Gulf of Mexico region is currently accepted to be around 12,000 B.P. (Aten, 1983). According to the sea-level curve proposed for the northern Gulf by Coastal Environments, Inc. (CEI, 1982), sea level at 12,000 B.P. would have been approximately 45 m below the present sea level. On this basis, the continental shelf shoreward of the 45-m bathymetric contour would have potential for prehistoric sites dating subsequent to 12,000 B.P. The 1977 baseline study (CEI, 1977) proposed that terrestrial sites of a given period will be analogous to area sites occurring on the now-submerged shelf. Remote-sensing surveys have been very successful in identifying the geographic features that have a high probability for associated prehistoric sites.

Regional geological mapping studies by MMS allow interpretations of specific geomorphic features and assessments of archaeological potential in terms of age, the type of system the geomorphic features belong to, and geologic processes that formed and modified them. The potential for site preservation must also be considered as an integral part of the predictive model. In general, sites protected by sediment overburden have a high probability for preservation from the destructive effects of marine transgression. The same holds true for sites submerged in areas subjected to low wave energy and for sites on relatively steep shelves during periods of rapid rise in sea level.

Though lease-block surveys have identified many specific areas in the Gulf as having a high potential for prehistoric sites, oil and gas development has generally avoided rather than investigated these high-probability areas for archaeological content.

Central Gulf of Mexico

Geomorphic features that have a high probability for associated prehistoric sites in the Central Gulf include barrier islands and back-barrier embayments, river channels and associated floodplains and terraces, and salt-dome features. Holocene deltaic deposits of the Mississippi River characterize the eastern part of the CPA. Deltaic geomorphic features, some with a high probability for preservation of prehistoric sites, are abundant in the area. The thickness of archaeologically sterile open-shelf Holocene marine sediments in some areas (generally closer to the active Mississippi Delta) may preclude recovery of site information in the underlying strata.

Holocene sediments form a thin veneer or are absent over the majority of the western part of the CPA (USDOI, MMS, 1984a). Many large, late Pleistocene fluvial systems (e.g., the Sabine-Calcasieu River Valley) are within a few feet of the seafloor in this area. A study funded by MMS to locate prehistoric archaeological sites in association with the buried Sabine-Calcasieu River Valley was completed in 1986 (CEI, 1986). Five types of relict landforms were identified and evaluated for archaeological potential. Coring of selected features was performed, and sedimentary analysis suggests the presence of at least two archaeological sites.

Lease-block surveys from other areas of the western part of the CPA have produced evidence of floodplains, terracing, and point-bar deposits in association with relict late Pleistocene fluvial systems. Prehistoric sites associated with these features would have a high probability for preservation. Salt diapirs with bathymetric expression have also been recorded during lease-block surveys in this area. Solution features at the crest of these domes would have a high probability for preservation of associated prehistoric sites. The Salt Mine Valley site on Avery Island is a Paleo Indian site associated with a salt-dome solution feature (CEI, 1977). The proximity of most of these relict landforms to the seafloor facilitates further investigation and data recovery.

Western Gulf of Mexico

The Western Gulf includes the same geomorphic features associated with prehistoric sites as occur in the Central Gulf. The western portion of the WPA contains Holocene deltaic deposits of the Colorado and Brazos Rivers. Holocene sediments west of 96°W longitude range from 4 to 44 m thick; sediments east of 96°W. longitude begin thinning. Lease-block surveys have recorded geomorphic features with a high probability for the occurrence and preservation of prehistoric archaeological sites. The thickness of archaeologically sterile open-shelf Holocene marine sediments in some area may preclude recovery of site information in the underlying strata.

The geologic conditions that affect prehistoric site occurrence and preservation in the most eastern part of the WPA are similar to those described above for the western part of the CPA. The McFaddin Beach site, in this part of the WPA, has produced late Pleistocene megafaunal remains and lithics from all archaeological periods.

6. Coastal Zone Management Plans

State Coastal Zone Management Programs

At the State level, a lead State agency oversees implementation of the CZM program and administers the Federal grant funds. Local governments are involved in the implementation of State CZM programs, either formally or informally. Federal agencies are involved in the development and implementation of State CZM programs. Once the programs are federally approved, Federal agencies must ensure that their actions are consistent to the maximum extent practicable with the enforceable polices of approved State programs. State and Federal agencies work together on joint planning and permitting, which reduces the regulatory burden on the public (USDOC, NOAA, 1989).

The role of the Federal agency includes State assistance, approval determination, review and approval of financial assistance, continued monitoring and formal evaluations, review and approval of program changes, mediation, and consistency appeals. Projects conducted under Section 306 of the CZMA, which funds State coastal management program implementation, include hazards protection, natural resource protection and development, public access, urban waterfront redevelopment, ports and marinas, and improved government operations. Section 306 program implementation funds are based on a formula set by State coastal population and shoreline mileage. In fiscal year 1990, 29 states and territories were scheduled to receive Section 306 grants totaling $35.3 million (USDOC, NOAA, 1990). States are required to match the Federal funds dollar for dollar for Section 306 grants. The State must submit Routine Program Implementations to the OCRM on a case-by-case basis, periodically or annually. On the average, at least three out of four of these are accepted. In the near future, NOAA is planning to conduct an investigative summary of all the RPI's and amendments that have been submitted to OCRM for approval. The NOAA evaluates the program changes, lack of Federal agency involvement in the State review process, early consultation with the OCRM, and the content of submissions. Amendments must by submitted by the Governor of a State or by the head of an agency. At least one public hearing must be held with a 30-day notice. Section 307 of the CZMA contains the Federal consistency provisions, which impose certain requirements on Federal agencies to comply with approved State CZM programs. Section 309, amended in 1990, does not require states to match Federal funding. A continuing review of the performance of States with approved CZM programs is required under Section 312 of the CZMA, as amended.

State of Alabama Coastal Area Management Program

The Alabama Coastal Area Board (CAB), acting pursuant to the Alabama Coastal Area Act (ACAA) of 1976, was formerly the principal agency responsible for the management of the Alabama coastal area. As a result of passage of the Alabama Act 82-612, the CAB was abolished. Its functions were divided between the Alabama Department of Community Affairs (ADECA) and the Alabama Department of Environmental Management (ADEM). The ADECA has overall responsibility for plan development, improvements, policy development and refinements, planning, research, and general oversight and all other nonpermit-related activities under the Alabama Coastal Area Management Program (ACAMP). All permit, enforcement, regulatory, and monitoring activities, and the adoption of rules and regulations to carry out ADECA policies are the responsibility of the ADEM. In July 1990, the Governor signed an executive order calling for an "Alabama Coastal Waters Initiative" to examine the various coastal programs and to develop a long-term coastal management plan. Outcomes may include revisions to the ACAMP.

The ADEM rules and regulations are divided into three categories: (a) general rules and regulations; (b) resource use rules and regulations for energy facilities, waste disposal, dredging, and public access; and (c) natural resource rules and regulations for water and air quality and nearshore and coastal environments.

The Alabama coastal counties are Baldwin and Mobile. Within the coastal zone, two areas--the Port of Mobile and the Mobile-Tensaw River Delta--have been designated as geographic areas of particular concern. The general rules and regulations are supplemented by special priority of use guidelines for geographic areas of particular concern.

The ACAA provides statutory authority to review all coastal resource uses and activities that have a direct and significant effect on the coastal area. Specifically, the ADEM must find specific uses or activities that require a State permit to be consistent with the coastal policies noted above and the more detailed rules and regulations promulgated as part of the ACAMP. Under the ACAA, State agency activities must be consistent with ACAMP policies and ADEM findings. Further, ADEM must make a direct permit-type review for uses that are not otherwise regulated at the State level (Code of Alabama, section 9-7-20). The ADEM also has authority to review local government actions and to assure that local governments do not unreasonably restrict or exclude uses of regional benefit. Ports and major energy facilities are designated as uses of regional benefit.

State of Mississippi Coastal Program

The Mississippi Coastal Program (MCP) is administered by the Mississippi Commission on Wildlife Conservation through the Bureau of Marine Resources (BMR). The primary coastal management statute is the Coastal Wetlands Protection Law (Mississippi Code, section 49-27-1). The authorities of certain other agencies are incorporated into the MCP pursuant to the Mississippi Code (section 57-16-6), which requires the coastal program to incorporate "all applicable constitutional provisions, laws and regulations of the State of Mississippi." The BMR, the Bureau of Pollution Control, the Bureau of Land and Water Resources, and the Department of Archives and History are identified collectively as the "coastal program agencies." The Mississippi Commission on Wildlife Conservation, acting through the BMR, consolidates authorities previously assigned to the Marine Resources Council and the Marine Conservation Commission, including authority to study and develop plans, proposals, reports and recommendations for the development and utilization of the coastal and offshore lands, waters, and marine resources of the State (Mississippi Code, sections 57-15-1 through 17). Other major features of the MCP include statutes related to fisheries (Mississippi Code, section 49-15-1 through 69), air and water pollution control (Mississippi Code, sections 49-17-1 through 43), surface and groundwater (chapters 3 and 4, Title 51 of Mississippi Code,) cultural resources (Mississippi Code, section 39-7-11), and the disposal of solid waste in marine waters (Mississippi Marine Litter Act of 1989, Senate Legislative Bill No. 2675.) The Marine Debris Act prohibits the disposal of any debris into coastal waters and establishes strict penalties up to $10,000 for violators. For the purposes of the coastal program, the boundary encompasses the three coastal counties of Hancock, Harrison, and Jackson and all coastal waters.

State of Louisiana Coastal Zone Management Program

The basis for the Louisiana Coastal Zone Management Program (LCZMP) is the State and Local Coastal Resources Management Act of 1978 (La. R.S. 49:213.1; Act 361). Former sections of Part II of Chapter 2, designated as R.S. 49:213.1 to 49:213.22, were redesignated as Subpart C. The LCZMP consists of R.S. 49:214.21 to 49:214.40, pursuant to Section 7 of Act 1989, 2nd Ex. Session, No.6, and on authority of R.S. 24:253. The Act puts into effect a set of State coastal policies and coastal use guidelines that apply to coastal land and water use decisionmaking. A number of existing State regulations are also incorporated into the program--those concerning oil and gas and other mineral operations; leasing of State lands for mineral operations and other purposes; hazardous waste and radioactive materials; management of wildlife, fish, other aquatic life, and oyster beds; endangered species; Superport; and air and water quality.

The Act also authorized establishment of Special Management Areas. Included or planned to be included as Special Management Areas are the Louisiana Superport (LOOP), Marsh Island, artificial barrier islands to protect deteriorating coastal areas, and freshwater and sediment diversion projects to offset land loss and saltwater encroachment. For purposes of the CZMA, only that portion of LOOP within Louisiana's coastal zone is part of the Special Management Area. In April 1989, the Louisiana Legislature passed Act 6, creating the Wetlands Conservation and Restoration Authority and establishing a Wetlands Conservation and Restoration Trust Fund to underwrite restoration projects. The Legislature also reorganized part of the Louisiana Department of Natural Resources (DNR) by creating the Office of Coastal Restoration and Management.

The DNR is the designated State agency for receiving and administering Section 306 awards. The Secretary delegated this authority to the Coastal Management Division. Several other agencies, including the

Department of Wildlife and Fisheries and the Department of Health and Human Resources, play a role in the LCZMP implementation. The Department of Environmental Quality carries out the State air and water quality programs.

The coastal use guidelines are based on seven general policies outlined in Act 361. They are implemented through coastal use permits and in-lieu permits. In-lieu permits provide for the use of permit requirements existing before the Act took effect to fulfill the role of coastal use permits, thereby avoiding duplicated permitting procedures.

Act 361 identified a number of State concerns subject to coastal use permitting requirements. State concerns, which are listed in Act 361, that could be relevant to a lease sale and its possible direct effects or associated facilities and nonassociated facilities are (a) any dredge and fill activity that intersects more than one water body, (b) projects involving the use of State-owned lands or water bottoms, (c) national interest projects, (d) pipelines, and (e) energy facility siting and development. Local governments (parishes) may assume management of uses of local concern by developing a local coastal program consistent with Act 361.

State of Texas Coastal Management Program

Of the States affected by the proposed sales, only Texas does not have a federally approved CZM plan. In May 1981, the State of Texas formally withdrew from the Federal CZM program. In 1989 the Texas legislature foresaw the need to reexamine the State's coastal resources and called for the creation of a Coastal Management Plan. Under the leadership of the Texas General Land Office, with the participation of State and Federal agencies, local officials, environmental representatives, the business community, and coastal citizens, a draft plan was developed and published in 1990. The plan identified eight issues, discussed solution strategies, and provided recommendations for action. Through a process of public input and consensus development, coastal erosion/dune protection, wetland loss, and beach access emerged as issues of primary importance. Other issues identified in the Texas Coastal Management Plan included marine debris, oil spills, hazardous waste, freshwater inflow into bays and estuaries, and nonpoint-source pollution. A final plan was published by the Texas General Land Office in January 1991.

Subsequent to publication of the above plan, the State decided to seek Federal approval of its CZM plan, which will focus on coastal public lands. The State estimates that it may take a year to a year and a half before a final set of guidelines and procedures are developed.

SECTION IV

ENVIRONMENTAL CONSEQUENCES

IV

IV. ENVIRONMENTAL CONSEQUENCES

A. PROPOSED ACTION SCENARIO

The Gulf of Mexico OCS Region has formulated development scenarios to provide a framework for detailed analyses of potential impacts of proposed OCS oil and gas lease sales in the CPA and WPA (proposed Sales 142 and 143, respectively). Each of the scenarios is a hypothetical framework of assumptions and estimates on the amounts, timing, and general locations for OCS exploration, development, and production activities and facilities, both offshore and onshore. Because each of them necessarily presents only approximate conditions that might be associated with a sale, the scenarios cannot be used to predict future oil and gas activities. These activities are unpredictable prior to a sale; they do not become clear until offshore and onshore development proceeds from lease through production. For example, factors such as the contemporary economic marketplace and available support facilities and pipeline capacities at the time of future infrastructure development are all unknowns. Notwithstanding these unpredictable factors, the scenarios represent best assumptions and estimates on a set of future conditions that are considered reasonably foreseeable and suitable for presale impact analyses. It should also be noted that these development scenarios do not represent an MMS recommendation, preference, or endorsement of any level of leasing or offshore operations or of the types, numbers, and/or locations of any onshore operations or facilities.

1. Resource Estimates, Timetables, and Subarea Descriptions

The Base Case and High Case described in this section are used to assess the sale-specific impacts of the proposed actions. These scenarios are based on recent trends in the following factors:

- the amount and location of leasing, exploration, and development activity;
- existing offshore and onshore oil and/or gas infrastructure;
- industry-practice information;
- oil and gas technologies, and the economic considerations and environmental constraints of these technologies; and
- the estimates of undiscovered, unleased oil and gas resources in the planning areas.

The resource estimates used for the Base Case and High Case are based on two factors: (a) the conditional estimates of undiscovered, unleased oil and gas resources in the planning area; and (b) estimates of the portion or percentage of these resources assumed to be leased, discovered, developed, and produced as a result of the proposed actions. The resource estimates for the Base Case and High Case differ as follows: the Base Case estimates are based on the mean or "expected" case values of total undiscovered, unleased resources; the High Case estimates, which are based on the high or 5 percent values, correspond to a 5 percent chance of that amount or more occurring.

The Base Case--because it is based on the mean or "expected" resource estimates--is used for the principal impact analyses of the proposed actions, including the Cumulative analyses. The High Case is used to provide a supplementary analysis of the effects that could occur if a greater, though much less likely, amount of resources was discovered and developed. Tables IV-1 through IV-6 provide a summary of major elements of the Base Case and High Case and some of the related impact-producing factors for each proposed action.

Central Gulf Sale 142: The estimated amounts of oil and gas resources expected to be developed--as well as the total number of exploration and delineation wells, production platforms, and development wells, and the total miles of offshore pipeline needed to develop and produce the estimated resources--are included in Tables

IV-1 and IV-2 for the Base Case and High Case. These tables also include estimates of the major impact-producing factors or agents related to the estimated levels of exploration, development, and production activity. Table IV-2 shows the disaggregation of these factors to the various offshore subareas in the CPA, and Figure IV-1 depicts the location of the four offshore subareas in the Central Gulf.

For purposes of analysis, the life of the proposed action is assumed to be 35 years. Proposed Sale 142 will occur in March 1993. Under the Base Case, exploratory activity takes place over an 11-year period (1994-2004). The most intense level of exploratory activity occurs from 1998-1999, development activity begins in 1995 with the installation of the first production platform and ends in 2017 with the drilling of the last development wells, and production of oil and gas takes place from 1995-2026. Under the High Case, exploratory activity takes place over an 11-year period (1994-2004). The most intense level of exploratory activity occurs from 1997 to 1999, development activity begins in 1995 and ends in 2018, and production of oil and gas extends through 2026. By the end of 2027, all platforms associated with the proposed action will be removed.

Western Gulf Sale 143: The estimated amounts of oil and gas resources expected to be developed--as well as the total number of exploration and delineation wells, production platforms, and development wells, and the total miles of offshore pipeline needed to develop and produce the estimated resources--are included in Tables IV-1 and IV-3 for the Base Case and High Case. These tables also include estimates of major impact-producing factors or agents related to the estimated levels of exploration, development, and production activity. Table IV-3 shows the disaggregation of these factors to the various offshore subareas in the WPA, and Figure IV-1 depicts the location of the three offshore subareas in the Western Gulf.

For purposes of analysis, the life of the proposed action is assumed to be 35 years. Proposed Sale 143 will occur in August 1993. Under the Base Case, exploratory activity takes place over an 11-year period (1994-2004). The most intense level of exploratory activity occurs from 1997-1998, development activity begins in 1995 with the installation of the first production platform and ends in 2016 with the drilling of the last development wells, and production of oil and gas takes place from 1995-2026. Under the High Case, exploratory activity takes place over an 11-year period (1994-2004), development activity begins in 1995 and ends in 2019, and production of oil and gas extends through 2026. By the end of 2027, all platforms associated with the proposed action will be removed.

In order to properly analyze impact-producing factors over the life of a proposed action for the Base Case and High Case and the OCS Program analysis, each planning area was subdivided into offshore subareas. Estimates of resources, facilities required, and peak annual facilities were redistributed into each offshore area. The following is a brief description of the geologic characteristics and resource potential of each offshore subarea.

Central Gulf of Mexico Offshore Subareas C-1, C-2, C-3, and C-4

C-1: This subarea encompasses mostly the Miocene and Pliocene Trend of the Louisiana Shelf and consists of a thick sequence of sand and shale producing both oil and gas.

C-2: This subarea encompasses the Pleistocene Trend located on the shelf and upper slope offshore Louisiana. The area is also characterized by thick sequences of sand and shale similar to the sediments of Subarea C-1, producing both oil and gas. Continued interest along the eastern extension of the Flexure Trend can be expected.

C-3: This subarea represents an area comprised of several trends predominantly affected by the delta at the mouth of the Mississippi River. The area around the mouth of the river is comprised of sands and shales of a deltaic environment with ages of production ranging from Miocene to Pleistocene. Both oil and gas production is expected. In the northern portion of C-3, the area becomes gas prone. Here shallow accumulations of gas are located within the "Miocene Bright Spot Trend."

C-4: This subarea is a portion of the Cenozoic Deepwater Trend located to the south of Subareas C-2 and C-3. With the possibility of sediment being deposited in deep water and the existence of large structures, oil and gas can be expected. A large portion of this area is considered to have a low probability of producing economic quantities of hydrocarbons.

Table IV-1

Expected Oil and Gas Production in the Gulf of Mexico Over the Life of the Proposed Action (1992-2027)

	Total to Date / 1990 Annual	Projected (total/peak annual): Sale (Base Case)	All OCS Sales	Sale (High Case)
Central Gulf of Mexico (Sale 142)				
Reserve/Resource Projection				
Oil (Bbbl)	7.858 / 0.245	0.140 / 0.007	5.460 / 0.239	0.310 / 0.015
Gas (tcf)	80.276 / 3.447	1.400 / 0.069	50.290 / 3.267	2.930 / 0.144
Western Gulf of Mexico (Sale 143)				
Reserve/Resource Production				
Oil (Bbbl)	0.253 / 0.025	0.050 / 0.002	1.210 / 0.041	0.130 / 0.006
Gas (tcf)	13.508 / 1.422	0.740 / 0.036	22.500 / 1.077	1.820 / 0.089
Eastern Gulf of Mexico				
Reserve/Resource Production				
Oil (Bbbl)	0 / 0	NA / NA	0.190 / 0.008	NA / NA
Gas (tcf)	0 / 0	NA / NA	1.050 / 0.042	NA / NA

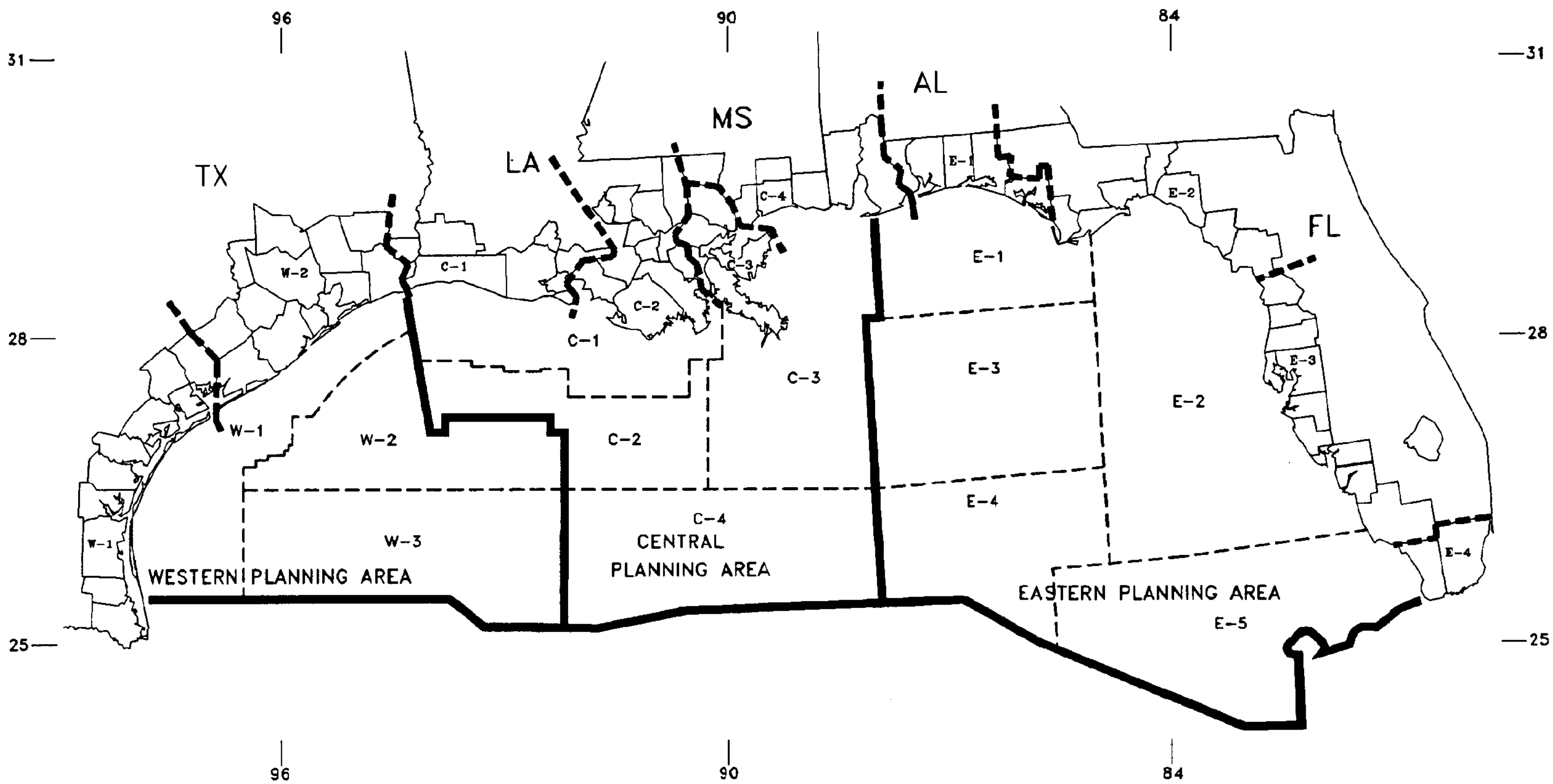
Table IV-2

Offshore Scenario Information Related to Sale 142 for Years 1993 to 2027

Offshore Subarea*

Offshore (Total / Peak Year**)	C-1 Base Case	C-1 High Case	C-2 Base Case	C-2 High Case	C-3 Base Case	C-3 High Case	C-4 Base Case	C-4 High Case	Total Central Gulf Base Case	Total Central Gulf High Case
Wells Drilled										
Exploration and Delineation Wells	25 / 4	40 / 7	60 / 11	95 / 16	120 / 21	185 / 31	135 / 24	220 / 37	340 / 60	540 / 90
Development Wells***	20 / 2	40 / 2	45 / 4	90 / 5	85 / 7	180 / 10	100 / 8	210 / 12	250 / 20	520 / 30
Oil Wells	10 / 1	20 / 1	25 / 2	45 / 3	45 / 3	95 / 5	50 / 4	110 / 6	130 / 10	270 / 15
Gas Wells	10 / 1	20 / 1	20 / 2	45 / 3	40 / 3	85 / 5	50 / 4	100 / 6	120 / 10	250 / 15
Platform Complex Installations										
Number Installed	6 / 1	6 / 1	5 / 1	9 / 1	10 / 1	18 / 2	9 / 1	17 / 2	30 / 3	50 / 5
Space Use Loss (ha)	1800 / 90	1800 / 90	0 / 0	0 / 0	600 / 30	900 / 45	0 / 0	0 / 0	2400 / 120	2700 / 135
Structure Removals Using Explosives	12 / NA	12 / NA	2 / NA	3 / NA	5 / NA	7 / NA	1 / NA	2 / NA	20 / 5	24 / 8
Method of Oil Transportation										
Percent Piped	****NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	98%/ 98%	98%/ 98%
Percent Barged	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	1%/ 1%	1%/ 1%
Percent Tankered	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	<1%/ <1%	<1%/ <1%
Shuttle Tanker Traffic (trips)	0 / 0	0 / 0	0 / 0	0 / 0	2 / 1	5 / 1	0 / 0	0 / 0	2 / 1	5 / 1
Barge Traffic (trips)	35 / 2	81 / 4	3 / 1	6 / 1	39 / 2	91 / 4	0 / 0	0 / 0	77 / 4	178 / 8
Pipeline Length (km)	48 / 8	48 / 8	40 / 8	72 / 8	80 / 7	144 / 16	72 / 8	136 / 16	240 / 24	400 / 40
Pipeline Displaced Sediments (1,000 m^3)	240 / 40	240 / 40	0 / 0	0 / 0	80 / 40	120 / 40	0 / 0	0 / 0	320 / 80	360 / 80
Bottom Area Disturbances (ha)										
from rig emplacements	38 / 6	60 / 11	23 / 4	36 / 6	45 / 8	69 / 12	34 / 6	55 / 9	144 / 25	229 / 38
from structure emplacements	30 / NA	30 / NA	4 / NA	8 / NA	12 / NA	18 / NA	3 / NA	5 / NA	48 / NA	60 / NA
from pipeline projects	15 / 3	15 / 3	13 / 3	23 / 3	26 / 2	46 / 5	23 / 3	44 / 5	77 / 8	128 / 13
Accidents										
Offshore Oil Spills										
>1 and < 50 bbl	****NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	21 / NA	47 / NA
>50 and <1,000 bbl	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	1 / NA	2 / NA
> 1,000 bbl	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	1 / NA	1 / NA
Blowouts	0 / 0	1 / 1	1 / 1	1 / 1	1 / 1	3 / 1	2 / 1	3 / 1	4 / 1	8 / 1
Diesel and Other Pollutant Spills	1 / 1	2 / 1	2 / 1	4 / 1	3 / 1	8 / 1	4 / 1	9 / 1	10 / 1	23 / 1
Support Activities										
Helicopter Trips (1,000 trips)	69 / NA	71 / NA	62 / NA	111 / NA	123 / NA	222 / NA	114 / NA	215 / NA	368 / NA	619 / NA
Service Vessel Trips	2,100 / NA	2,800 / NA	3,100 / NA	5,400 / NA	6,000 / NA	10,800 / NA	6,400 / NA	11,800 / NA	17,600 / NA	30,800 / NA
Offshore Operational Wastes										
Drilling Fluids (1,000 bbl)	313 / 42	555 / 63	732 / 105	1,285 / 148	1,430 / 197	2,535 / 289	1,638 / 225	2,987 / 345	4,113 / 563	7,362 / 845
Drill Cuttings (1,000 bbl)	75 / 10	131 / 16	176 / 26	305 / 37	344 / 49	600 / 72	393 / 56	708 / 86	988 / 140	1,744 / 210
Sanitary and Domestic Waste (1,000 m^3)	80 / NA	98 / NA	135 / NA	236 / NA	278 / NA	502 / NA	294 / NA	546 / NA	787 / NA	1,382 / NA
Produced Waters (1,000 bbl)	24,675 / NA	49,349 / NA	60,272 / NA	111,036 / NA	109,622 / NA	231,580 / NA	123,374 / NA	268,593 / NA	317,942 / NA	660,559 / NA
Produced Sands (1,000 bbl)	6 / NA	14 / NA	11 / NA	25 / NA	23 / NA	52 / NA	29 / NA	63 / NA	69 / NA	154 / NA
Offshore Air Emissions (1,000 metric tons)										
Nitrogen Oxides	12.98 / NA	13.16 / NA	10.82 / NA	19.74 / NA	21.63 / NA	39.48 / NA	19.47 / NA	37.28 / NA	64.90 / NA	109.66 / NA
Carbon Monoxide	1.88 / NA	1.91 / NA	1.56 / NA	2.86 / NA	3.13 / NA	5.72 / NA	2.81 / NA	5.40 / NA	9.38 / NA	15.88 / NA
Sulfur Oxides	0.17 / NA	0.18 / NA	0.14 / NA	0.27 / NA	0.28 / NA	0.54 / NA	0.25 / NA	0.51 / NA	0.85 / NA	1.49 / NA
Total Hydrocarbon Compounds	4.07 / NA	4.08 / NA	3.34 / NA	6.12 / NA	6.79 / NA	12.25 / NA	6.11 / NA	11.57 / NA	20.37 / NA	34.02 / NA
Total Suspended Particulates	0.26 / NA	0.27 / NA	0.22 / NA	0.41 / NA	0.44 / NA	0.82 / NA	0.39 / NA	0.78 / NA	1.31 / NA	2.29 / NA

* See Figure IV-1.
** Peak year figures for individual subareas may not add to the peak year figure for the total planning area because the peak years for subareas may not occur simultaneously.
*** Not all development wells classified as oil or gas produce.
**** The numbers of spills in subareas cannot be revealed because proprietary information related to projected oil reserves would be exposed.



WESTERN COASTAL AREA
W-1
Aransas, Calhoun, Cameron, Jackson, Kenedy, Kleberg, Nueces, San Patricio, Refugio, Victoria, Willacy
W-2
Brazoria, Chambers, Fort Bend, Galveston, Hardin, Harris, Jefferson, Liberty, Matagorda, Montgomery, Orange, Waller, Wharton

CENTRAL COASTAL AREA
C-1
Cameron, Calcasieu, Iberia, Lafayette, Vermilion
C-2
Ascension, East Baton Rouge, Lafourche, Livingston, St. Charles, St. James, St. Mary, St. John the Baptist, Tangipahoa, Terrebonne, West Baton Rouge

CENTRAL COASTAL AREA
C-3
Jefferson, Orleans, Plaquemines, St. Bernard, St. Tammany
C-4
Baldwin, Hancock, Harrison, Jackson, Mobile, Stone

EASTERN COASTAL AREA
E-1
Escambia, Santa Rosa, Okaloosa, Walton, Bay
E-2
Gulf, Franklin, Wakulla, Jefferson, Taylor, Dixie, Levy
E-3
Citrus, Hernando, Pasco, Pinellas, Hillsborough, Manatee, Sarasota, Charlotte, Lee, Collier
E-4
Monroe, Dade

Figure IV-1. Gulf of Mexico OCS Planning Areas and Coastal and Offshore Subareas.

Table IV-3

Offshore Scenario Information Related to Sale 143 for Years 1993 to 2027

Offshore (Total / Peak Year**)	W-1 Base Case	W-1 High Case	W-2 Base Case	W-2 High Case	W-3 Base Case	W-3 High Case	Total Western Base Case	Total Western High Case
	Offshore Subarea*							
Wells Drilled								
Exploration and Delineation Wells	5 / 1	10 / 2	25 / 4	50 / 10	180 / 30	360 / 69	210 / 35	420 / 80
Development Wells***	5 / 1	10 / 1	15 / 1	30 / 2	90 / 4	230 / 17	110 / 5	270 / 20
Oil Wells	0 / 0	0 / 0	5 / 1	10 / 1	45 / 2	110 / 8	50 / 2	120 / 9
Gas Wells	5 / 1	10 / 1	10 / 1	20 / 1	45 / 2	120 / 9	60 / 3	150 / 11
Platform Complex Installations								
Number Installed	1 / 1	1 / 1	2 / 1	5 / 1	7 / 1	24 / 5	10 / 2	30 / 6
Space Use Loss (ha)	300 / 15	300 / 15	0 / 0	0 / 0	0 / 0	0 / 0	300 / 15	300 / 15
Structure Removals Using Explosives	1 / 1	1 / 1	1 / 1	2 / 1	1 / 1	3 / 1	3 / 1	6 / 2
Method of Oil Transportation								
Percent Piped	****NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	82%/ 82%	82%/ 82%
Percent Barged	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	1%/ 1%	1%/ 1%
Percent Tankered	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	17%/ 17%	17%/ 17%
Shuttle Tanker Traffic (trips)	0 / 0	0 / 0	0 / 0	0 / 0	66 / 3	171 / 8	66 / 3	171 / 8
Barge Traffic (trips)	0 / 0	0 / 0	9 / 1	22 / 1	0 / 0	0 / 0	9 / 1	22 / 4
Pipeline Length (km)	8 / 8	8 / 8	16 / 8	40 / 8	56 / 8	192 / 8	80 / 16	240 / 48
Pipeline Displaced Sediments (1,000 m^3)	40 / 2	40 / 2	0 / 0	0 / 0	0 / 0	0 / 0	40 / 2	40 / 2
Bottom Area Disturbances (ha)								
from rig emplacements	8 / 2	15 / 3	27 / 4	55 / 11	46 / 8	92 / 18	83 / 14	153 / 29
from structure emplacements	5 / NA	5 / NA	3 / NA	6 / NA	3 / NA	9 / NA	10 / NA	19 / NA
from pipeline projects	26 / 6	26 / 6	22 / 5	30 / 6	58 / 14	101 / 20	106 / 26	157 / 30
Accidents								
Offshore Oil Spills								
>1 and < 50 bbl	****NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	8 / NA	20 / NA
>50 and <1,000 bbl	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	0 / 0	1 / NA
> 1,000 bbl	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	0 / 0	1 / NA
Blowouts	0 / 0	0 / 0	0 / 0	1 / 1	2 / 1	4 / 1	2 / 1	5 / 1
Diesel and Other Pollutant Spills	0 / 0	0 / 0	0 / 1	1 / 1	3 / 1	8 / 1	3 / 1	9 / 1
Support Activities								
Helicopter Trips (1,000 trips)	12 / NA	12 / NA	25 / NA	60 / NA	95 / NA	303 / NA	131 / NA	375 / NA
Service Vessel Trips	400 / NA	600 / NA	1,200 / NA	2,600 / NA	6,700 / NA	16,400 / NA	8,300 / NA	19,500 / NA
Offshore Operational Wastes								
Drilling Fluids (1,000 bbl)	69 / 14	139 / 21	280 / 35	559 / 85	1,892 / 241	4,121 / 607	2,241 / 283	4,819 / 706
Drill Cuttings (1,000 bbl)	16 / 3	33 / 5	68 / 9	136 / 21	462 / 61	996 / 152	546 / 72	1,164 / 177
Sanitary and Domestic Waste (1,000 m^3)	15 / NA	20 / NA	44 / NA	107 / NA	276 / NA	766 / NA	335 / NA	892 / NA
Produced Waters (1,000 bbl)	1,415 / NA	2,829 / NA	13,752 / NA	27,504 / NA	111,036 / NA	274,252 / NA	126,203 / NA	304,585 / NA
Produced Sands (1,000 bbl)	0 / NA	0 / NA	3 / NA	8 / NA	22 / NA	56 / NA	24 / NA	64 / NA
Offshore Air Emissions (1000 tons)								
Nitrogen Oxide	2.31 / NA	2.15 / NA	4.63 / NA	10.75 / NA	16.20 / NA	51.58 / NA	23.14 / NA	64.48 / NA
Carbon Monoxide	0.35 / NA	0.32 / NA	0.70 / NA	1.59 / NA	2.46 / NA	7.64 / NA	3.51 / NA	9.55 / NA
Sulfur Oxide	0.06 / NA	0.05 / NA	0.12 / NA	0.23 / NA	0.43 / NA	1.12 / NA	0.62 / NA	1.40 / NA
Total Hydrocarbon Compounds	0.71 / NA	0.72 / NA	1.43 / NA	3.57 / NA	5.01 / NA	17.16 / NA	7.16 / NA	21.45 / NA
Total Suspended Particulates	0.06 / NA	0.05 / NA	0.12 / NA	0.23 / NA	0.42 / NA	1.09 / NA	0.60 / NA	1.36 / NA

* See Figure IV-1.

** Peak year figures for individual subareas may not add to the peak year figure for the total planning area because the peak years for subareas may not occur simultaneously.

*** Not all development wells classified as oil or gas produce.

**** Information in these categories cannot be revealed by subarea because proprietary information related to projected oil reserves would be exposed.

Western Gulf of Mexico Offshore Subareas W-1, W-2, and W-3

W-1: This subarea is located within the Miocene Trend in Texas and includes most of the Texas Shelf with some deep-water areas in the Corpus Christi and Port Isabel Areas. Subarea W-1 is primarily composed of Miocene-age sediments, but older sediments (Oligocene-Frio) are encountered close to the Texas coast. Drilling can be expected to continue along regional down-to-the-basin faults. The Corsair Trend contains thick deposits of Miocene-age sands and extends northeast to southwest through Brazos, Matagorda Island, and Mustang Island. Hydrocarbon production is mostly gas, with the greatest potential on the upper and central portion of the shelf.

W-2: This subarea is located within the Pleistocene Trend in Texas and encompasses mostly shelf and upper slope areas offshore Texas and Louisiana. This area is characterized by thick sequences of sand, producing gas and condensate, especially along the shelf edge. Shallow accumulations of gas, identified as the "Pleistocene Bright Spot Trend" is located in the northern and western portions of Subarea W-2.

W-3: This subarea is identified as the Cenozoic Deepwater Trend, which is located to the south and east of Subareas W-1 and W-2. This area is characterized by Cenozoic sediments of the middle and lower slope in deep water offshore Texas and Louisiana. Miocene potential may exist in this area as the result of turbidity currents and submarine channels transporting sediment into deeper waters. Another potential play is the western extension of the Flexure Trend in the deep-water areas of East Breaks and Garden Banks. Although both oil and gas can be expected, a large portion of this area, similar to Subarea C-4 (Louisiana), is considered to have a low probability of producing economic quantities of hydrocarbons.

2. Description of Offshore Operations and Impacting Factors

Exploring for, developing, and transporting the hydrocarbon resources that are developed as a result of the proposed actions require a complex and interrelated series of operations that begin with the leasing of offshore blocks and continue through postlease seismic/surveying operations; the drilling of exploration wells; the installation of production facilities; the drilling of development wells; the movement of hydrocarbons via pipelines, barges, and shuttle tankers; the eventual dismantling of the production facilities; and all of the offshore movements of personnel and supplies that are needed to maintain these operations. These diverse activities can be associated with possible impacts to the offshore (and possibly onshore) resources of the Gulf. The following discussions describe the various kinds of offshore activities that could potentially affect the environmental and socioeconomic resources of the Gulf of Mexico and identify the resources that could be affected. Detailed analyses of the impacts of these activities on environmental and socioeconomic resources are contained in Sections IV.D.1. and 2.

Tables IV-2 and IV-3 show the magnitudes of the impact factors or agents that are projected to occur in the various offshore subareas of the CPA and WPA from the proposed actions under the Base and High Case scenarios. These quantities are expressed as the total amount generated over the life of the proposed actions, and as a peak-year figure. The peak-year number is the projected occurrence of the impact factor during the year when the oil and gas activities associated with the impact factor are at a maximum. Peak-year numbers cannot be developed for every impact factor because of the nature of the data that the numbers are derived from. An average annual figure can be developed in some cases by dividing the quantity for the total amount generated over the life of the proposed action by the expected duration of the activity associated with the impact factor (11 years for exploratory activity, 20-year production life for platforms, etc.).

a. Offshore Infrastructure Activities

(1) Surveying/Seismic Operations

Seismic operations are conducted from vessels, ranging in length from 20 to 50 m (65-175 ft), that tow an array of geophysical instruments. The instruments use an acoustic pulse generated by a string of airguns, waterguns, or explosives as an energy source to pinpoint areas with hydrocarbon potential and to identify hazard conditions such as faulting, potential slide areas, and shallow gas pockets. Seismic activities in the Gulf may affect fish resources, marine turtles, and marine mammals proximate to the operations. The degree of affect is highly dependent upon the method used to generate the sound pulse. Airguns have little effect on even the most sensitive fish eggs and no effect on fish or invertebrate larvae (Hanley, 1984; Falk and Lawrence, 1973). A task force report on geophysical operations in 1982 found no evidence to suggest that nonexplosive acoustic sources cause injury to marine mammals. They may, however, elicit changes in marine mammal and marine turtle behavior varying from an immediate response (e.g., flight and startle response) to no apparent reaction, depending on the proximity of the seismic pulse (Malme et al., 1984).

Seismic operations using explosives have historically taken place around the mouth of the Mississippi River in unconsolidated silty deposits. An environmental assessment is required for all seismic operations that intend to use explosives. Prior to 1989, approximately two applications per year for explosive seismic operations were reviewed by the MMS Gulf of Mexico OCS Region. Since 1989, no plans for explosive seismic operations have been received by the MMS Gulf of Mexico OCS Region (Brinkman, pers. comm., 1991). Because of the hazards associated with explosives and the ability to produce 3D surveys with airgun pulses, the use of airguns is preferred for Gulf offshore seismic surveys. It is assumed that no seismic activity using explosives will occur as a result of the proposed actions.

Prior to August 14, 1990, no records were kept on the amount or location of postlease seismic activities that were conducted on leases because lessees were not required to report nonexplosive activities to MMS. Therefore, no estimates of postlease annual seismic activity is available. The MMS, Gulf of Mexico OCS Region, Office of Resource Evaluation is receiving some reports of activities and is working to ensure that each and every oil and gas company is aware of the need to report all postlease seismic activities.

(2) Drilling Rigs and Platforms

(a) Exploration and Delineation Phase

Offshore exploratory activities are carried out from mobile drilling rigs. Exploration/delineation wells are drilled to determine whether or not economically recoverable resources occur on a lease and to delineate the extent of a reservoir. The exploratory well, casing, and hole are abandoned once the exploration phase is complete. Only rarely is the hole reentered for production purposes.

The five most common types of mobile rigs employed for exploratory drilling offshore are submersible drilling rigs, semisubmersible drilling rigs, jack-up drilling rigs, drillships, and drill barges. The preferred environment for each type of mobile drilling rig is highly dependent on its performance at various water depths and in adverse weather conditions. Other important considerations in the selection of a mobile rig are staff support requirements, rig mobilization problems, positioning capabilities, and station maintenance requirements (University of Texas at Austin, 1981). All these factors will play a part in a company's selection of a mobile rig for their exploratory drilling activities.

Submersible rigs were among the first types of drilling rigs used for exploratory drilling offshore. Submersible rigs can be floated from one drill site to the next after exploratory drilling is complete; however, they are not easily moved. Once in position over the drill site, their lower hull is flooded until it sinks and rests on the seafloor to support the drilling operation. Because submersible rigs are designed to rest on the seafloor, they are limited to operations at relatively shallow water depths.

Semisubmersible rigs are floating platforms used for drilling at deeper water depths. These rigs use dynamic positioning or anchoring to maintain their position over the drill site without the use of bottom-supported structures. Semisubmersible rigs are the most stable offshore drilling unit for deep and rough waters.

Jack-up rigs are the most popular bottom-supported, mobile offshore drilling structures. Once the rig is positioned over the drill site, its legs are jacked down until they rest on the seafloor. Jack-up rigs are limited to water depths of approximately 350 ft (107 m) and are difficult to tow; however, they have relatively low initial costs and can perform better than floating rigs under adverse weather conditions.

Drillships and drill barges are vessels that function as offshore drilling platforms for exploratory activity. The primary distinction between the two is that drillships are self-propelled while drill barges are not. The advantages of drillships are that they can operate in deep water and they can travel easier and faster to distant drill sites. However, they require additional staffing to operate the ship. With increasing industry interest in deep-water exploration and development in the Gulf, drillships will likely be used more in the future. This document assumes that all exploration and delineation wells in water depths greater than 1,500 ft will be drilled from drill ships. At present, industry can drill in water depths up to 2,400 m (8,000 ft), which places few limitations on exploratory drilling on the Gulf OCS. (See Section IV.A.2.a.(5) for a discussion of deep-water oil and gas operations.)

Drill barges, on the other hand, do not require a ship crew on board since they are towed to the drill site by tug boats. However, drill barges take longer to travel to the drill site location. The primary disadvantage of both drillships and drill barges is their limited capability to operate in adverse weather conditions and rough waters.

This document assumes that the average time required to drill an exploration/delineation well is 45 days, and the average well depth will be 4,100 m (13,500 ft). It is further assumed that two to four wells will be drilled per field and that the typical rig will drill nine wells/year. During drilling operations, 67 people are assumed to be working at the rig site per day. The total number of exploration and delineation wells that are projected to be drilled in the CPA and WPA for the Base and High Case scenarios is shown in Tables IV-2 and IV-3, respectively.

(b) Development Phase

Development wells are usually drilled from fixed platforms, which are equipped with production and maintenance facilities on the deck. Development wells are drilled with one (or infrequently two) drilling units placed on the platform deck. For analysis purposes, it is assumed that 8-20 wells will be drilled from each platform, with an average of about 12 wells. Five percent of the development wells are projected not to produce. The average lives of gas and oil wells are estimated to be 12 and 14 years, respectively. The average depth of a development well is assumed to be 3,050 m (10,000 ft). During the development well drilling phase, it is assumed that 58 people per rig will be employed on site. Tables IV-2 and IV-3 show the numbers of development wells projected to be drilled under the Base and High Case scenarios for the proposed actions.

(c) Production Phase

Various kinds of facilities can be installed at a production site. The choice of production facility is dependent mainly on water depth and the size of the reservoir to be produced. In water depths less than 460 m (1,500 ft), fixed platforms rigidly attached to the seafloor will be used. In shallower water depths, where production costs are relatively low, the installation of several production structures can often be economically justified to produce a reservoir. This document assumes that, in less than 152 m (500 ft), each production site will be associated with a platform complex that includes two to three structures. Based on historic platform statistics, it is assumed that 68 percent of these structures will be classified as major (defined as having at least six completions and two pieces of production equipment) and that 20 percent will be manned (defined as having sleeping quarters on the structure). Manned platforms are assumed to have 14 people working on site.

At water depths greater than 152 m (500 ft), production expenses increase to the extent that only one production facility per field can be economically justified. At these depths, all production structures will be major and will serve as a production complex. This document assumes that for water depths up to 304 m (1,000 ft) 20 percent of the production complexes will be manned and that all production complexes will be manned at water depths greater than 304 m.

At water depths approaching 456 m (1,500 ft), traditional platform designs based on the rigid attachment of platform legs to the seafloor cannot be used. This document assumes that at water depths exceeding 456 m, compliant structures, such as tension leg platforms (TLP's) will be used at sites where production will be transported via pipeline. All TLP's are considered major, manned structures. This document assumes that a floating production system (FPS) will be employed for liquid hydrocarbon development in water depths exceeding 456 m and where a production site is farther than 160 km (100 mi) from an existing pipeline system, making the costs of installing a new pipeline segment prohibitive. The hydrocarbons will be transported from the FPS directly to onshore terminals via shuttle tankers. It is assumed that two FPS's will be employed in the WPA and one in the CPA for the proposed action.

The number of platform complexes projected for the proposed actions can be found in Tables IV-2 and IV-3. The average life of a platform complex is assumed to be 20 years. These tables also provide a breakdown of platform projections by offshore subarea. An in-house MMS analysis of the breakdown of platform projections by water depth was also completed to provide more detailed information on the most likely location of platforms within each offshore subarea. Results from this analysis were used in the assessment of the potential impact of platforms on offshore environmental resources. However, details of the analysis cannot be revealed in this document due to the proprietary nature of the information.

(3) Structure Removals

Lessees are required to remove all structures and underwater obstructions from their Federal OCS leases within one year of the lease's relinquishment or termination of production. Plastic explosives sever the conductors and pilings 5 m below the seafloor and are used because of the strongly overbuilt condition of multileg offshore structures that must withstand probable hurricane conditions over an average 20-year lifespan. Explosive platform removals may adversely affect marine mammals and turtles in proximity to the removal. The concussive force of the explosives is lethal to most fish associated with the platform. Those species that have internal air chambers (swim bladders), are demersal, or are in close association with the platform being removed are certainly killed (Caillouet et al., 1986). Within the past decade, stocks of demersal reef fish (red snapper) have precipitously declined in the Gulf of Mexico. There is concern over a possible connection between the decline and explosive platform removals. To examine this issue of concern, in 1992 MMS funded an interagency study with NMFS to assess fish mortality from explosive platform removals. This study will further attempt to relate the role of red snapper mortality from platform removals to the status of reef fish stocks in the Gulf (USDOI, MMS, 1990a).

The MMS has issued strict guidelines for explosive platform removal to offshore operators in order to eliminate potential harm to endangered marine turtles and marine mammals. These guidelines include daylight detonation only, staggered charges, placement of charges 5 m below the seafloor, and pre- and postdetonation surveys of surrounding waters. It is assumed that these guidelines will be followed during the removal of all platforms installed as a result of the proposed actions.

All platforms installed as a result of the proposed action will be removed by the end of the year 2027, 35 years after the sale. Over that period, it is assumed that 80 percent will be removed by explosives only in water depths less than 455 m due to engineering differences between fixed platforms in deep-water systems. (See Section IV.A.2.(a)(5) for further information regarding deep-water activity.) The 80 percent figure is based on an analysis of platform removal records at MMS (Shaw, personal comm., 1991). Use of other nonexplosive methods, such as mechanical cutters to sever pilings of multileg structures, are too hazardous to underwater workers and are ineffective. However, a number of offshore operators and engineering firms in the Gulf are presently engaged in development of new technology and removal methods alternative to explosives.

It is assumed that during the peak year, five platforms will be removed from the CPA and one will be removed from the WPA using explosives as a result of the proposed actions (Tables IV-2 and IV-3). Annual rates for all removals (including nonexplosive) from the CPA range from zero to six in the CPA and from zero to one in the WPA. It is assumed that these structures will be removed during the last 12 years of the life of the proposed action.

(4) Workover/Abandonment Activities

Workover operations consist of work conducted on wells after the initial completion for the purpose of maintaining or restoring the productivity of a well. Tubing can be pulled and the casing at the bottom of the well pumped and washed free of sand that may have accumulated. Other examples of workover operations are acidizing the perforated interval in the casing, plugging back, squeezing cement, milling out cement, jetting the well in with coiled tubing and nitrogen, setting positive plugs to isolate hydrocarbon zones, etc. Workover operations can require the use of a jack-up rig barge. Operations, which can take from a few days to several months to complete, occur in mature oil and gas areas and, thus, are common in the Gulf of Mexico. In 1990, about 4,200 completions, workovers, and plugging/abandonment operations took place, with about 2,400 of these estimated to require rig emplacement. About 20 percent of all workover operations require a jack-up rig or other major rig. All plugging and abandonment operations conducted when the well is finished production require rig activity. Worldwide rig activities show that workover rig activities accounted for 15 percent of rig drilling operations from 1986 through 1990 (The Offshore International Newsletter, 1991).

The following are assumptions about workover activities occurring in association with the proposed actions: It is assumed that each development well will require one to three workovers, averaging 1.5 workover operations per development well. One plugging/abandonment operation will be required per completion well. Using these numbers, estimates of workover operations from the proposed actions are 375 and 780 workovers in the CPA and 165 and 405 workovers in the WPA, for the Base and High Cases, respectively. Well abandonment operations are equal to the number of development wells emplaced, i.e., 250 and 520 in the CPA and 110 and 270 in the WPA, for the Base and High Cases, respectively. Operations will average 10 days and will require support services similar to support provided during well development. Twenty percent of all workovers will require rig activity.

Workover operations can result in water quality impacts associated with the improper discharge of workover fluids used to treat the well and can result in blowouts and oil spills if drilling occurs. Nineteen percent of historic blowouts on the Gulf of Mexico OCS have been from workover operations. Secondary impacts can occur from support activities needed during workover operations. There will be some increase in helicopter traffic, service vessel trips, and employed personnel on the platform. These increases are not included in the numbers of trips provided in the tables.

(5) Deep-water Activities

This section presents information about the general status of deep-water operations and technological developments in the Gulf of Mexico. The development of the OCS program in the Gulf has seen the movement of industry activity from tracts close to shore in shallow water to ever deeper prospects, some of which are located 150 mi or more from the coast. Future activities in the Gulf are likely to emphasize more and more deep-water projects. Specific assumptions about aspects of deep-water development that are relevant to the analysis of potential impacts to Gulf resources are presented in Section IV.A.2.a.(2) for each phase of operation.

Presently, the offshore oil and gas industry is establishing the technology required for producing natural gas and oil resources from the deep-water areas of the Gulf of Mexico. For the past half-century the majority of offshore developments have been focused on the continental shelf, in water depths less than 200^{m}(600+ ft). Future developments in the northwest and north-central Gulf of Mexico will move from the continental shelf area to the continental slope and margins. Slope and margin technology has a unique set of problems associated with extreme water depths, bottom topography, and bottom conditions. As far back as 1985, industry experts indicated that the existing technology could be extended to approximately 8,000 ft without the need for major technological breakthroughs.

Recently, record-setting developments and giant field discoveries set the stage for deep-water activities in the Central Gulf of Mexico. Shell's "Bullwinkle" facility (1,350 ft of water) in Green Canyon Block 65 went into production in August 1991. Several options for producing Shell's recent "Mars" prospect in Mississippi Canyon Block 763 (3,100 ft of water) are being considered, including the use of tension leg platforms, floating and subsea production systems, and compliant towers. Production from Conoco's Joliet and Marquette (Green Canyon Block 184) fields is being processed from a central production platform on adjacent Green Canyon Block 53, located in 470 ft of water. Recently, Freeport McMoran set a new record for the world's tallest 4-pile platform when its Crystal platform was installed in Mississippi Canyon Block 365 in water depths exceeding 600 ft.

In the Western Gulf of Mexico, deep-water drilling is currently confined to two programs being carried out in Garden Banks and to a third in the relatively unexplored Keathley Canyon area. In the Garden Banks area, two wells have been spudded in water depths of 2,850 ft; whereas in Keathley Canyon, BP is currently operating in water depths exceeding 5,800 ft. Shell's billion dollar Auger field development in Garden Banks Block 426 (2,680 ft of water) will become the deepest water production facility in the world.

According to the Federal Government's Office of Technological Assessment (1985), a number of technological areas are critical in deep-water petroleum development. These areas include structural design; developing techniques for installation, maintenance, and repair of structures; drilling, well control, and completion; and technologies for support operations. To continue operating in these new environments, the use and development of new technologies is needed. Several of the newer technologies under consideration are discussed below.

Structures

With regard to exploratory drilling, the offshore industry has a fleet of drillships and semisubmersibles capable of drilling in water depths greater than 3,000 ft and, in some instances, in water depths up to 7,500 ft. Technological advances that made drillships capable of operating in deep-water areas include the development of dynamic positioning and advanced reentry systems.

Today, several concepts for extending the depth of production systems are being employed in the Gulf of Mexico and worldwide. These include the use of the guyed and buoyant towers, tension leg platforms, and subsea production systems. With the exception of the subsea completion systems, all these structures are termed "compliant structures," which move slightly with wind, waves, and current forces. Conventional structures are designed to resist these forces.

The use of these various structure types will depend on several variables--cost, density of wells within proximity to the structure, bottom conditions, proximity to existing infrastructure, and reservoir and well characteristics. A compliant tower is preferred when developing an area with a high number of wells in close radius to the structure. A tension leg, platform, or another form of buoyant system is better suited to situations in which a field can be developed with fewer wells. The greatest limiting factor is the cost of platform structures. In minimizing the size of structures to cut costs and thus, restricting the capacity of production and process facilities, the production period is lengthened.

Exxon installed the first "unconventional" structure in the Gulf of Mexico, which consisted of a guyed tower to develop its Lena Prospect (300 m) in Mississippi Canyon. This design can be used in water depths up to 600-750+ m (2,000-2,500 ft). In the late 1980's, Conoco used the first tension leg platform in the Gulf to begin production of it's Joliett field (500 ft of water). Shell is presently moving forward with it's planned installation (1993) of a 32-slot tension-leg platform on it's Auger discovery (2,680 ft of water). Regarding subsea completion technology in the Gulf, work is progressing on Exxon's Zinc-Alabaster project (1,500 ft of water) in Mississippi Canyon. This half-billion dollar project will require the largest multi-well satellite subsea template (Zinc gas field) yet seen in the Gulf of Mexico. This template will be tied back to a new 18-slot platform (Alabaster gas/oil field) and some six miles away in 468 ft of water. Texaco is evaluating subsea development options to tap gas reserves on its Shasta Prospect in Green Canyon (900-1,500 ft of water). Texaco has gained considerable experience with this technology in the North Sea.

Pipelines

According to R.J. Brown and Associates, considerable research is being expended for the installation of gas and oil transport systems in deepwater areas. As of late 1990, the deepest project was in Placid's Green Canyon Block 29, in which flowlines were installed to a template and wellhead in water depths up to 2,400 ft. Now, the industry is looking beyond the 2,400-ft mark established by the Placid project. As pipeline installations are being conducted in deeper water depths, the structural qualities of the pipe for resisting collapse are becoming more important. There is a depth restriction, which depends upon the design criteria used, and unless new approaches evolve, methods of installation will be limited in terms of pipe diameter, wall thickness, and depth. For fixed wall thickness pipes, the larger the diameter, the shallower the water depths in which it can be installed without additional measures to prevent collapse. One technique employed, yet restricted to towing techniques, requires pressurization of the pipe to prevent collapse, thus increasing the depth at which installation may occur.

The conventional laybarge has a long history of pipeline installations with sizes ranging up to 56 inches and smaller lines laid at depths in excess of 1,000 ft. A more recent innovation has been the development of a high-performance, dynamically positioned lay vessel, which employs a new "J" lay technology. This has considerable promise for smaller diameter piping in water depths up to 5,000 ft. New towing techniques are also being used for deeper water prospects. The use of these techniques began in the late 1940's when strings of pipe were made up onshore and towed both on the surface and bottom. Today it is feasible to construct pipelines onshore, in excess of 10 km (6 mi) in length, and to tow these from the coast to deep-water sites. It is also technically feasible to install and connect single or bundled pressurized lines up to 24 inches in diameter and to install at depths up to 5,000 ft by the use of such towing techniques.

Floating Production Systems

The use of tanker-based Floating Production, Storage, and Offloading systems (hereafter referred to as floating production systems, or FPS's) are thought to be an economical solution for satisfying industry's needs in the deep-water areas (up to 3,000 ft of water) of the Gulf of Mexico. Such a facility would be complete, with equipment ranging from wellheads, production risers, and well control equipment to a tanker (75,000-150,000 dead weight tons) (dwt), mooring, and tanker offloading systems. The availability of crude sales lines, environmental conditions, and travel rates for shuttle or export tankers will determine the unit's minimum storage and tanker size. Such a system has several advantages over a semisubmersible based floating production system, in that an FPS would have more deck space and deck loading capabilities, stability, and oil storage capacity of between 1 and 2 million bbl (MMbbl). To date, about 12 tanker based FPS's have operated worldwide, with none encountering major safety problems or significant oil spills.

b. Offshore Transport of Oil and Gas

Transportation of petroleum hydrocarbons to onshore terminal facilities in the Central and Western Gulf of Mexico historically has relied on an ever-expanding pipeline network. Along with the movement of oil and gas/condensate through pipelines, a small percentage of oil has traditionally been barged from shallow water areas to onshore oil terminals. Because MMS projects that leasing in deep-water blocks not located in proximity to the existing oil-pipeline network will occur as a result of the proposed actions, future shuttle tankering of oil is projected to occur in both the CPA and the WPA. Tables IV-2 and IV-3 present projected percentages of oil transported via pipeline, barge, and shuttle tanker and the numbers of trips expected in support of the proposed actions. Tables IV-4 through IV-6 provide information on the volumes of oil making landfall in the various onshore subareas and on the locations of offloading operations. The following discussions provide further information supporting the projected transportation scenario, identify the potentially affected resources, and describe the general impacts associated with each method of transport.

(1) Pipelines

Pipelines are now used as the primary means of oil/condensate movement and the sole means of gas transportation in the Gulf. Although MMS anticipates the usage of shuttle tankers to transport oil produced on the OCS in the future, pipelines are still expected to account for 98 percent and 82 percent of the liquid hydrocarbons transported in the CPA and WPA, respectively, during the life of the proposed actions (Tables IV-2 and IV-3).

Pipelines in the Gulf include trunkline and gathering line systems. Gathering lines, typically short segments of small diameter pipelines, transport production from a structure to a tie-in with an existing pipeline system. This document assumes that 8 km (5 mi) of gathering lines will be installed with each production facility associated with the proposed actions.

Table IV-4

Onshore Scenario Information Related to Sale 142 for the Years 1993-2027

Onshore (Total / Peak Year)	C-1 Base Case	C-1 High Case	C-2 Base Case	C-2 High Case	C-3 Base Case	C-3 High Case
Oil Landings						
Pipeline Transported Oil (MMbbl)	0 / 0	0 / 0	118 / 6	261 / 13	19 / 1	42 / 2
Shuttle Tanker Offloadings	0 / 0	0 / 0	0 / 0	0 / 0	2 / 1	5 / 1
Barge Offloadings	39 / 2	89 / 4	19 / 1	45 / 2	17 / 1	40 / 2
Onshore Oil Spills						
>1 and <50 bbl	***NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA
>50 and < 1,000 bbl	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA
> 1,000 bbl	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA
Support Activities						
Helicopter Coastal Crossings (1,000's)	37 / NA	62 / NA	84 / NA	142 / NA	74 / NA	125 / NA
Service Vessels						
Landings	6,200 / NA	10,900 / NA	6,300 / NA	11,000 / NA	3,900 / NA	6,900 / NA
Bilge Water Discharged (MMliter)	20 / NA	35 / NA	20 / NA	35 / NA	12 / NA	22 / NA
Onshore Disposal of Offshore Wastes						
Produced Sands (1,000 bbl)	***NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA
Produced Waters (1,000 bbl)	0 / 0	0 / 0	0 / 0	0 / 0	34,071 / NA	70,821 / NA
Drilling Fluids (1,000 bbl)	***NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA

Onshore (Total / Peak Year)	C-4 Base Case	C-4 High Case	W-2 Base Case	W-2 High Case	Total Base Case	Total High Case
Oil Landings						
Pipeline Transported Oil (MMbbl)	0 / 0	0 / 0	0 / 0	0 / 0	137 / NA	303 / NA
Shuttle Tanker Offloadings	0 / 0	0 / 0	0 / 0	0 / 0	2 / 1	5 / 1
Barge Offloadings	0 / 0	0 / 0	2 / 1	4 / 1	77 / 4	178 / 8
Onshore Oil Spills						
>1 and <50 bbl	NA / NA	NA / NA	NA / NA	NA / NA	**<10 / 1	<10 / 1
>50 and < 1,000 bbl	NA / NA	NA / NA	NA / NA	NA / NA	0 / 0	0 / 0
> 1,000 bbl	NA / NA	NA / NA	NA / NA	NA / NA	0 / 0	0 / 0
Support Activities						
Helicopter Coastal Crossings (1,000's)	6 / NA	10 / NA	4 / NA	7 / NA	206 / NA	347 / NA
Service Vessels						
Landings	500 / NA	800 / NA	700 / NA	1,100 / NA	17,600 / NA	30,800 / NA
Bilge Water Discharged (MMliter)	2 / NA	3 / NA	2 / NA	3 / NA	56 / NA	98 / NA
Onshore Disposal of Offshore Wastes						
Produced Sands (1,000 bbl)	NA / NA	NA / NA	NA / NA	NA / NA	69 / NA	154 / NA
Produced Waters (1,000 bbl)	0 / 0	0 / 0	0 / 0	0 / 0	34,071 / NA	70,821 / NA
Drilling Fluids (1,000 bbl)	NA / NA	NA / NA	NA / NA	NA / NA	744 / 102	1,333 / 153

* See Figure IV-1.
** Assumptions about number of oil spill occurrences are derived from historical trends but are not based on statistical analyses.
*** Data are not shown by subarea because of statistical uncertainties.

Table IV-5

Onshore Scenario Information Related to Sale 143 for the Years 1993 - 2027

Onshore (Total / Peak Year)	W-1 Base Case	W-1 High Case	W-2 Base Case	W-2 High Case	C-1 Base Case	C-1 High Case
	Onshore Subarea*					
Oil Landings						
Pipeline Transported Oil (MMbbl)	14 / 1	36 / 2	23 / 1	60 / 3	0 / 0	0 / 0
Shuttle Tanker Offloadings	31 / 2	80 / 5	28 / 2	73 / 4	5 / 1	13 / 1
Barge Offloadings	0 / 0	0 / 0	7 / 1	18 / 3	2 / 1	4 / 1
Onshore Oil Spills						
>1 and <50 bbl	***NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA
>50 and < 1,000 bbl	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA
> 1,000 bbl	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA
Support Activities						
Helicopter Coastal Crossings (1,000's)	23 / NA	67 / NA	28 / NA	80 / NA	22 / NA	63 / NA
Service Vessels						
Landings	2,500 / NA	5,900 / NA	3,500 / NA	8,100 / NA	1,800 / NA	4,300 / NA
Bilge Water Discharged (MMliter)	8 / NA	19 / NA	11 / NA	26 / NA	6 / NA	14 / NA
Onshore Disposal of Offshore Wastes						
Produced Sands (1,000 bbl)	***NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA
Drilling Fluids (1,000 bbl)	***NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA

Onshore (Total / Peak Year)	C-2 Base Case	C-2 High Case	C-3 Base Case	C-3 High Case	Total Base Case	Total High Case
Oil Landings						
Pipeline Transported Oil (MMbbl)	3 / <1	8 / <1	0 / 0	0 / 0	40 / 1	104 / 4
Shuttle Tanker Offloadings	0 / 0	0 / 0	2 / 1	5 / 1	66 / 3	171 / 8
Barge Offloadings	0 / 0	0 / 0	0 / 0	0 / 0	9 / 1	22 / 4
Onshore Oil Spills						
>1 and <50 bbl	NA / NA	NA / NA	NA / NA	NA / NA	<10 / 1	**<10 / 1
>50 and < 1,000 bbl	NA / NA	NA / NA	NA / NA	NA / NA	0 / 0	0 / 0
> 1,000 bbl	NA / NA	NA / NA	NA / NA	NA / NA	0 / 0	0 / 0
Support Activities						
Helicopter Coastal Crossings (1,000's)	0 / NA	0 / NA	0 / NA	0 / NA	73 / NA	210 / NA
Service Vessels						
Landings	500 / NA	1200 / NA	0 / NA	0 / NA	8,300 / NA	19,500 / NA
Bilge Water Discharged (MMliter)	2 / NA	4 / NA	0 / NA	0 / NA	26 / NA	62 / NA
Onshore Disposal of Offshore Wastes						
Produced Sands (1,000 bbl)	NA / NA	NA / NA	NA / NA	NA / NA	24 / NA	64 / NA
Drilling Fluids (1,000 bbl)	NA / NA	NA / NA	NA / NA	NA / NA	406 / 51	872 / 128

* See Figure IV-1.

** Assumptions about number of oil spill occurrences are derived from historical trends but are not based on statistical analyses.

*** Data are not shown by subarea because of statistical uncertainties.

Table IV-4

Waterway Usage by OCS-Related Navigation Associated With Sales 142 and 143 for the Years 1993-2027

Coastal Subarea	Waterway Used	Service Base/Terminal	% OCS Usage Base Case	Number of Service Vessel Landings (Sale 142) Base Case	Number of Service Vessel Landings (Sale 142) High Case	Number of Service Vessel Landings (Sale 143) Base Case	Number of Service Vessel Landings (Sale 143) High Case	Number of Barge Offloadings (Sale 142) Base Case	Number of Barge Offloadings (Sale 142) High Case	Number of Barge Offloadings (Sale 143) Base Case	Number of Barge Offloadings (Sale 143) High Case	Number of Shuttle Tanker Offloadings (Sale 142) Base Case	Number of Shuttle Tanker Offloadings (Sale 142) High Case	Number of Shuttle Tanker Offloadings (Sale 143) Base Case	Number of Shuttle Tanker Offloadings (Sale 143) High Case
C-1	Calcasieu Ship Channel		<0.1%											5	13
		Cameron		3,870	6,770	1,140	2,680								
		Lake Charles						15	36	1	3				
		Gibbstown						8	18	0	1				
	Freshwater Bayou		<0.1%												
		Intracoastal City		2,120	3,720	630	1,470								
		Kaplan		50	80	10	30								
	Mermentau Navigation Channel		<0.1%												
		Grand Chenier		140	250	40	100								
	Vermilion Bay/Bayou Teche		1.9%												
		Louisa		50	80	10	30								
		Weeks Island						15	36						
C-2	Atchafalaya River		0.9%												
		Amelia		110	200	10	20								
		Bayou Boeuf		60	100	0	10								
		Berwick		60	100	0	10								
		Freshwater City		110	200	10	20								
		Morgan City		3,590	6,290	290	690								
		Gibson						6	13						
	Bayou Lafourche/Belle Pass		1.2%												
		Fourchon		620	1,080	50	120								
		Leeville		340	590	30	60								
	Houma/Caillou/Terrebonne		2.2%												
		Dulac		790	1,380	60	150								
		Houma		560	980	50	110								
		Theriot		60	100	0	10								
		Gibson						6	13						
		Cocodrie						8	18						
C-3	Barataria Waterway/LaLoutre		<0.1%												
		Grand Isle		330	580										
	Miss. River Gulf Outlet		<0.1%												
		Hopedale		50	100										
	Miss. River Passes		<0.1%									2	5	2	5
		Venice		3,510	6,150										
	Empire Waterway		0.6%						40						
		Empire						17							
	La Loutre/St Malo/Ysclosk[e]y Miss. River/Harvey Canal		0.5%												
		Harvey		50	100										
C-4	Bayou LaBatre		<0.1%												
		Bayou LaBatre		30	50										
	Mobile Bay		<0.1%												
		Mobile		370	640										
		Theodore		30	50										
	Pascagoula/Bayou Casotte		<0.1%												
		Pascagoula		60	100										

Table IV-6. Waterway Usage by OCS-Related Navigation Associated With Sales 142 and 143 for the Years 1993-2027 (continued)

Coastal Subarea	Waterway Used	Service Base/Terminal	% OCS Usage Base Case	Number of Service Vessel Landings (Sale 142) Base Case	Number of Service Vessel Landings (Sale 142) High Case	Number of Service Vessel Landings (Sale 143) Base Case	Number of Service Vessel Landings (Sale 143) High Case	Number of Barge Offloadings (Sale 142) Base Case	Number of Barge Offloadings (Sale 142) High Case	Number of Barge Offloadings (Sale 143) Base Case	Number of Barge Offloadings (Sale 143) High Case	Number of Shuttle Tanker Offloadings (Sale 142) Base Case	Number of Shuttle Tanker Offloadings (Sale 142) High Case	Number of Shuttle Tanker Offloadings (Sale 143) Base Case	Number of Shuttle Tanker Offloadings (Sale 143) High Case
W-1	Aransas Pass		<0.1%												
		Port Aransas				70	170								
		Ingleside				810	1,900								
		Rockport				70	170								
	Brazos Santiago Pass		<0.1%												
		Port Isabel				150	350								
	Corpus Christi Ship Channel		<0.1%											31	80
		Corpus Christi				70	170								
	Matagorda Ship Channel		<0.1%												
		Port O'Connor				1,250	2,930								
	Port Mansfield Cut		<0.1%												
		Port Mansfield				70	170								
W-2	Freeport Harbor Channel		<0.1%											9	23
		Freeport		160	280	830	1,960								
	Houston/Galv Channel		<0.1%											14	36
		Surfside		20	40	120	280								
		Galveston		190	340	1.010	2,380			4	10				
		Pelican Island		80	140	420	980								
	Sabine Pass Ship Channel		<0.1%											5	13
		Sabine Pass		200	360	1,070	2,520								
		Port Arthur						2	4	3	8				
			TOTAL	17,600	30,850	8,300	19,500	77	178	9	22	2	5	66	171

Trunklines are large diameter pipelines designed to transport substantial volumes of production from offshore fields to onshore terminals or to a tie-in with an existing trunkline. Trunklines are long and are typically designed to transport production from several offshore leases. Because of the large expense of installing a trunkline, it is assumed that production from more than one lease sale is needed to economically justify its installation. It follows, therefore, that no new trunklines will be installed under either the Base or High Case scenarios associated with the proposed sales. (New trunklines are projected under the Total OCS Program scenario and are described in Section IV.B.1.b.(2)).

As of December 1990, the total length of existing pipelines (including gathering lines and trunklines) in the Gulf of Mexico was 28,595 km (17,757 mi) in the CPA and 4,654 km (2,892 mi) in the WPA (Tables IV-7 and IV-8). This existing pipeline system provides a network for the gathering lines installed as a result of the proposed action to tie into. Under the Base and High Case scenarios, respectively, 240 and 400 km (150 and 303 mi) of new offshore gathering lines will be installed in the CPA, and 80 and 240 km (50 and 150 mi) in the WPA (Tables IV-2 and IV-3). Tables IV-2 and IV-3 also show the distribution of projected new pipelines by offshore subareas. No new pipeline landfalls are projected under either the Base or High Case scenarios.

The proposed scenarios include increased levels of activity in water depths exceeding 300 m, compared to earlier periods of OCS development. With the increasing trend toward leasing and development in deep-water areas of the Gulf, pipeline installation projects are extending into water depths that will require new technological innovations. Section IV.A.2.a.(5) discusses some of the technological issues associated with deep-water activities in the Gulf.

One approach to deep-water installation projects has been to assemble long lengths (up to 10 km, or 6 mi) of pipe onshore and then to tow the assembled pipe to the production site. This approach has already been used successfully for a project in the Green Canyon Area and is being planned for a new pipeline project in the Mississippi Canyon Area. Onshore, a private beach on Matagorda Island has been used to assemble the pipe in both cases. Under the proposed action scenarios, it is assumed that some deep-water gathering line projects will use pipe towing from shore-based facilities and that the same shore base on Matagorda Island will be used to assemble the pipe segments. The MMS requires that an Environmental Assessment and a Hazards Survey be conducted along the tow route to determine whether or not any resources near the route could be affected by the towed pipeline segment. Based on information obtained from the completed tow project to Green Canyon, it is assumed that the impact area of the pipe will be limited to the diameter of the pipe and that the tow will maintain a plus or minus 30-m accuracy with respect to the proposed route.

Impacts from the installation of offshore pipelines include effects on water quality, benthic communities, archaeological sites, and fishery resources. These impacts could occur as a result of the resuspension of bottom sediments during the pipeline installation process, from mechanical damage to benthic and archaeological resources from pipelaying activity, or from exposed pipelines and valves at the seafloor snagging with fishing nets.

(2) Oil Barges

Barging oil, rather than transporting it to shore by pipeline, has been occurring to a small extent in the OCS waters since the 1950's. An operator will usually decide at the start of production whether or not to barge the oil. The decision to barge rather than to pipe is contingent on a number of factors--the location of the lease block, the amount of production expected to occur, the proximity to existing pipelines, and the rates charged by pipeline companies. Barging is often faster and cheaper than the time and expense for laying a new pipeline. Some oil companies simply prefer barging. All of the lease blocks where barging is taking place are located fairly close to shore. Barging is expected to remain an activity in waters closest to State waters. It is assumed that barging new oil resources developed as a result of the proposed actions will only occur in offshore areas where barging currently occurs. The following discussion accounts only for barging operations from offshore platforms to onshore terminals located along the Texas and Louisiana coasts. Barging is also associated with transporting the oil from the terminal to the refinery. These secondary barging operations are discussed in Section IV.A.3.b.

Historically, about 3 percent of oil produced in the Gulf of Mexico has been barged to shore. However, because the proposed action scenarios project a large percentage of leasing in deep waters, projections of oil barging occurring from the proposed actions are only slightly greater than 1 percent in the CPA and less than 1 percent in the WPA.

Tables IV-2 and IV-3 provide assumptions of the percentages of oil barged and the estimated number of barge trips from each of the offshore subareas projected for the Base Case and High Case scenarios for proposed Sales 142 and 143. In the CPA, 77 and 178 barge trips are estimated to occur due to the Base Case and High Case, respectively, with 4 and 8 trips occurring during the peak year. Most of the barging activity in the CPA will originate from Subarea C-1 and C-3. In the WPA, only 9 and 22 barge trips are expected to occur due to the Base Case and High Case, respectively, with only one trip occurring during the peak year for the Base Case. All of these trips will originate in W-2.

The capacity of barges used for the transport of OCS-produced oil can range from 5,000 to 80,000 bbl. Barges collect oil from a number of platforms before returning to shore. Barges typically stay offshore for as much as one week from the time they leave their docks.

The types of potential impacts from barging operations are similar to those from tankers, that is, primarily oil pollution and loss of property and life caused by collisions. Unlike tankers, barges in dedicated service do not clean their tanks between loadings, do not require ballasting waters, and do not accumulate large amounts of bilge waters contaminated with fuel oils. Barges, however, have more oil spills than tankers; this is probably because of the greater amount of barge traffic. An examination of U.S. Coast Guard statistics on spill incidents occurring in all navigable waters of the U.S. was compiled for the years 1984-1986 (USDOT, CG, 1989) and shows that there are about twice as many barge spills as tanker spills. During 1984-1986, an average of 508 barge spills per year spilled an average of 63,980 bbl per year. In comparison, there were only 206 tanker spills, spilling an average of 95,975 bbl per year. Although the quantity spilled from tankers appears to be more, the data is skewed by one very large spill that occurred in 1985. If only 2 years of tanker spill data are examined, an average of only 16,197 bbl are spilled per year. The larger percentage of spillage from barges is likely attributed to spills occurring at terminals. See Section IV.C.1. for projections of barge spills related to the proposed actions.

(3) Shuttle Tankers

Historically, there has been no shuttle tankering of oil in support of the OCS oil industry in the Gulf of Mexico. However, because of projected leasing in deep water and far from the existing pipeline network, assumptions on the use of shuttle tankers are considered in the impact analyses. Tankering is projected to take place outside of a 100-mi radius from the existing pipeline network. A combination of tankering and pipelining is not assumed to occur from the same production facility. The oil will be loaded at the production site, projected to be a tanker-based floating production, storage, and offloading system, and brought directly into a major terminal/port system to be offloaded. Section IV.A.3.b.(3) discusses the locations of the offloading terminals and/or major ports projected to serve oil tankering operations associated with the proposed actions.

Shuttle tankers used for OCS operations in the Gulf are expected to have capacities ranging from 20,000 dwt (133,000 bbl) to 50,000 dwt (333,000 bbl). The specifications for a typical 20,000-dwt tanker are 172 m (565 ft) in length by 27 m (89 ft) in breadth with a draft of about 10 m (34 ft).

Less than 1 percent of oil produced in the CPA as a result of Sale 142 (Base Case) is estimated to be transported via shuttle tankering (Table IV-2). Under the Base Case for proposed Sale 142, two shuttle tanker trips are expected to occur sometime during the 20-year life of the FPS's. These trips will originate in offshore Subarea C-3 and will offload at the Mississippi River Port system. Under the High Case, five trips are expected (Table IV-2).

Seventeen percent of the oil to be produced in the WPA as a result of Sale 143 (Base Case) is estimated to be transported to shore via shuttle tankering (Table IV-3). Under the Base Case of proposed Sale 143, 66 trips are expected. These trips will originate from Subarea W-3 and will offload at five major port areas in both Texas and Louisiana. Under the High Case, 171 trips are expected.

The primary environmental concern associated with shuttle-tanker operations is potential oil pollution, which can occur as a result of tanker accidents or operational discharges. Collisions, another concern, can result not only in oil spilled from the vessels involved, but also in the loss of life and property.

Besides the large spills that can occur from groundings and collisions, smaller spills can occur during offloading and onloading operations. Section IV.B.6. discusses the historical record of spills from tankering, in general. Section IV.C.1. presents assumptions and probabilities of spills from shuttle tanker activities projected to occur from the proposed actions.

Although operational discharges from tanker transportation operations have been identified as a major source of oil pollution in the past (see Section IV.B.6. for further discussion), new regulations, such as the Oil Pollution Act of 1990, are expected to reduce significantly such discharges. Shuttle tankers carrying oil produced as a result of the proposed actions are expected to discharge ballast and bilge waters into onshore receptacle facilities.

c. Offshore Transport of Personnel/Supplies

Supplies, information, and personnel must be transported, sometimes long distances, by boats and helicopters to OCS oil and gas drilling and production operations. Such activities usually begin at service/supply bases located in the coastal areas. Service bases, heliports, and vessel usage of coastal areas are discussed in detail in Section IV.A.3.

(1) Service Vessels

The types of vessels working for the oil and gas industry are extremely varied but can be divided according to their function into three basic types: supply, crew, and utility vessels. Service vessels can also be grouped into two size categories. The large category includes vessels longer than 45 m (150 ft) and are usually between 50 m and 60 m (160 ft and 200 ft) in length. The small category includes mainly crew boats that average about 32 m (110 ft) in length. Most vessels (68%) used for OCS operations are supply boats that are in the large category (Turner and Cahoon, 1987). These supply boats have a 3.5-m (12-ft) draft when loaded, and can carry 30 tons of materials. Crewboats draw 2-2.75 m (7-9 ft) of water. Dry cargo supply and crewboats make up about 89 percent of all vessel types (Turner and Cahoon, 1987). Utility boats perform various functions for rigs and are about 100 ft long with 10- to 12-ft drafts. Examples of types of boats grouped under service vessels include coring vessels, dedicated spill-response vessels, geochemical survey boats, pipe carriers, platform supply boats, and research vessels.

Commodities transferred from offshore and onshore are as varied as the types of vessels and include such items as drilling fluids, cement, drilling equipment, food, water, and miscellaneous supplies. Each trip of a service vessel averages 338 tons of materials (Turner and Cahoon, 1987).

The following assumptions about service vessel activity are made as part of the proposed action scenarios: (a) crewboats will have 6 personnel per boat; supply boats will have 20 personnel; (b) service vessels will travel to exploratory and development well drilling sites three times per week; (c) service vessels will travel to production sites much less, making one trip per five production platform complexes each week; (d) one trip represents a round trip, that is, the vessel travels from the service base to the offshore site(s), then returns to the service base; (e) once reaching navigation channels, a vessel takes, on an average, 4 hours to reach the shorebase; and (f) in the WPA, most service vessels will be traveling about 175 mi round trip taking 15 hours to complete their offshore journey; in the CPA, most service vessels are expected to travel around 260 mi (round trip) offshore, traveling 23 hours. Perhaps most importantly, it is assumed that some new service vessels will have to be built that are larger than those currently used. Larger, deeper-draft vessels may be needed to reach oil and gas operations projected to occur far from shore in deeper water.

Central Planning Area: Table IV-2 provides the number of service vessel trips projected to occur as part of the Base Case and High Case scenarios for proposed Sale 142. Under the Base Case, 17,600 service vessel trips are expected during the 35-year life of the proposed actions. Under the High Case, there will be 30,800 trips during the 35-year life of the proposed action. About 70 percent of these trips will originate from offshore Subareas C-3 and C-4.

Western Planning Area: Table IV-3 provides the number of service vessel trips projected to occur as part of the Base Case and High Case scenarios for proposed Sale 143. Under the Base Case, 8,300 service vessel trips are expected during the 35-year life of the proposed action. Under the High Case, there will be 14,500 trips during the 35-year life of the proposed action. Most of these trips will originate from offshore Subarea W-3.

The type and size of vessel and the vessel speed and route must be considered when evaluating potential impacts. Service vessel use on the OCS can cause air and water quality degradation, alteration of the natural habitat by vessel movement and anchoring operations, and collisions with marine mammals or sea turtles. Not analyzed in this document, collisions resulting in property damage, fire, and loss of life also can occur from the larger service vessels. Deck drainage, bilge pumping, and accidental loss of trash and debris can affect water quality and associated biota (Sections IV.A.2.d.(5)(f), Trash and Debris and IV.A.3.c.(3)(b), Operational Discharges). Navigation channels built to support service-vessel traffic change current and circulation patterns and allow saltwater intrusion into wetland areas. Frequent vessel traffic leads to accelerated erosion along navigation channels in the coastal area and to increased turbidity and other secondary impacts. Impacts due to navigation channels are discussed in Section IV.A.3.c.(3). This section also discusses the deepening of the channels that will be required to accommodate any new, deep-draft service vessels.

(2) Helicopters

Helicopters are the primary mode of transporting personnel between shore and offshore platforms. Helicopter noise can have adverse impacts on birds, marine mammals, and recreational beach users if flight ceilings are lower than recommended levels. The Federal Aviation Administration (FAA) recommends operational safety procedures and a flight ceiling of 1,000 ft over land, except National Wildlife Refuges and National Park Lands, where at least a 2,000-ft ceiling is recommended. The MMS sent a special letter to all Gulf of Mexico lessees in 1990 informing and reminding them of the special flight ceiling protection recommended for flights over National Wildlife Refuges and National Parks. The Offshore Operator's Committee also provided helicopter companies with updated information on the location of national parks, refuges and seashores in the coastal areas of the Gulf region (Helicopter Safety Advisory Conference, 1991).

Helicopters transporting offshore personnel typically maintain at least a 1,000-ft elevation over water, except when visibility is limited or for short trips between platforms. The analysis of environmental impacts in this document assumes that pilots adhere to the FAA recommendations of flight ceilings of 1,000 ft or higher and to establish safety procedures.

It is assumed for analysis purposes that helicopters will visit drilling rigs, structures during development drilling, each production platform complex between one and two times per day, and pipeline lay barges one time per day. Based on these assumptions, 368,000 and 619,000 helicopter trips are projected in the CPA under the Base Case and High Case scenarios, respectively; and 131,000 and 375,000 trips in the WPA are projected to occur (Tables IV-2 and IV-3). A trip is defined as a take-off and landing at an offshore facility.

Historically, helicopters have completed 13-14 flights, averaging 15 minutes per flight, in a typical day; they return to shore-based heliports after going to an average of 3-4 offshore facilities. Therefore, they make 7-8 coastline crossings per day, which computes to about two crossings per 3-4 flights (a flight is equivalent to one takeoff and landing). Flights in the future are assumed to take 30 minutes to account for the fact that activity will take place farther offshore.

d. Offshore Impacting Factors Related to the Proposed Actions

(1) Bottom Disturbances

Disruption of the seafloor by the placement of structures (including rigs, platforms, and pipelines) and anchors will occur from oil and gas operations. The magnitude of these disruptions on associated resources, particularly biological and archaeological resources, is dependent on a number of factors, including the configuration of the exploratory drilling rigs, production platforms, and pipelines that are being installed, the type of oil and gas operation, and the depth and currents of the waters. The installation of structures across parts of the OCS that include potential archaeological sites and unique and sensitive benthic biological communities, such as coral reefs and hard-bottom pinnacle and chemosynthetic communities, could result in mechanical damage from dredging and anchoring activities. Various Notices to Lessees (NTL's) exist, and stipulations are proposed to protect archaeological and sensitive biological resources from damage during these activities. The placement of offshore structures could also affect water quality and fishery resources.

(a) Fixed Structures

Bottom Area Contacted

Each platform placed on the OCS disturbs some of the bottom directly beneath the structure and around it where anchors are set to hold the vessel or structure in place. Some generalities may be made to determine the "average" bottom area contacted by installation of such structures. For purposes of analysis, this EIS assumes the following. The mud mats, which are used to support the jack-up rigs (most commonly used in water depths less than 30.5 m (100 ft)) are approximately 0.4 ha (0.9 ac) in area. A three-leg rig will thus directly impinge on an area approximately 1.1 ha (2.7 ac). In most cases, anchor impacts also are associated with these direct impacts. An additional 0.4 ha (1.0 ac) has been estimated for these impacts, bringing the total area impacted by a typical rig to 1.5 ha (3.7 ac). Semi-submersible rigs, used in water depths from about 21 m (70 ft) to about 457 m (1,500 ft), disturb roughly the same 1.5 ha of bottom. It is assumed that 2 ha (4.9 ac) of the bottom will be directly affected by the installation of production platforms; in water depths greater than 457 m, where tension-leg platforms are projected to be used, the area affected doubles to 4 ha (9.9 ac). Pipelines disturb 0.32 ha (0.8 ac) for each kilometer (0.62 mi) of pipeline installed.

The development scenario for the Base Case for proposed Sale 142 assumes 340 exploration and delineation wells and 30 platform complexes (Table IV-2). This equals the direct disturbance of approximately 192 ha (474 ac) of open ocean bottom. Two hundred forty kilometers (149 mi) of pipe gathering lines are estimated to be installed, resulting in the disturbance of another 77 ha (190 ac) of bottom.

The development scenario for the Base Case for proposed Sale 143 assumes 210 exploration and delineation wells and 10 platforms (Table IV-3). This equals the direct disturbance of approximately 93 ha (230 ac) of open ocean bottom. Eighty kilometers (50 mi) of pipelines are estimated to be installed, resulting in the disturbance of another 26 ha (64 ac) of bottom.

Volume of Sediment Displaced

The trenching (burying) of pipelines, which is required only in water depths less than 61 m (200 ft), resuspends some 5,000 m^3 (6,540 yd^3) of sediments per kilometer (0.62 mi). For proposed Sale 142, this results in about 320,000 m^3 (418,560 yd^3) of sediments being resuspended into the water column over the 35 years of activity that would result. For proposed Sale 143, about 40,000 m^3 (52,320 yd^3) would be resuspended.

The effects of sediment resuspension include increased water turbidities and mobilization of pollutants in the water column.

(b) Anchoring

Each drill ship, exploration rig, platform, and pipeline placed on the OCS disturbs, in addition to some of the bottom directly impacted by the structure, some area or areas around it where anchors are set to hold the vessel, structure, or support vessel in place. In addition, pipelaying barges use an array of eight 9,000-kg (20,000-lb) anchors to both position the barge and to move it forward along the pipeline route. These anchors are continuously moved as the pipe-laying operation proceeds. The area actually affected by anchors will depend on water depth, wind, currents, chain length, and the size of the anchor and chain. Anchor damage includes the crushing and breaking of coral heads. Also, anchoring often destroys a wide swath of sessile organisms when the anchor is dragged or when the vessel swings at the anchor, causing the anchor chain to drag the seafloor.

Service vessel anchoring is assumed to not occur in water depths greater than 152 m (500 ft) and only occasionally in shallower waters. Barges and shuttle tankers are assumed to always tie up to a production system rather than anchor. Mooring buoys may be placed near drilling rigs or platforms so that service vessels need not anchor, especially in deeper water (in all depths of water, vessels may also tie up directly to the rig or platform). These temporarily installed anchors will most likely be smaller and lighter than those described above and, thus, will be less damaging to the bottom. Moreover, installing one buoy will preclude the need for numerous individual vessel anchoring incidents.

With the proposed Live Bottom and Topographic Features Stipulations (Sections II.A.1.c. and II.B.1.c.), anchoring impacts from the offshore industry would be largely prevented.

(2) Bottom Debris

Bottom debris is herein defined as ferromagnetic and non-ferromagnetic material resting on the seabed (such as cable, tools, pipe, drums, structural parts of platforms, as well as objects made of plastic, aluminum, wood, etc.). This material is accidentally lost, or illegally tossed, by workers from fixed structures, jack-up barges, drilling ships, and during pipeline emplacement. Varying quantities of ferromagnetic bottom debris may be lost, or illegally tossed, per operation. The maximum quantity of bottom debris per operation is assumed to be several tons. A total of 840 exploration and delineation and development wells are expected to be drilled in the CPA under the Base Case. In addition, 30 platform installations are expected and 240 km of pipelines are projected for the CPA (Table IV-2). It is assumed, therefore, that up to several thousand tons of bottom debris associated with OCS activity may result from the proposed action. Underwater OCS ferromagnetic debris may result in the masking of magnetic signatures from historic period shipwrecks. Bottom debris may also result in the damage or loss of commercial fishing equipment, gear (primarily nets), and/or fisheries catch. Extensive analysis of remote-sensing surveys within developed blocks indicates that the majority of ferromagnetic bottom debris associated with OCS exploration and development activities falls within 1,500 ft of the structure/jack-up/lay barge.

Underwater OCS debris can become snagged by fishery gear resulting in trawl and vessel damage, business downtime, and loss of catch. Approximately 97 structures were removed from the Gulf of Mexico in 1990 (Shaw, personal comm., 1991). Recently, in light of projected increases in the number of annual structure removals, the Louisiana Concerned Shrimpers Association brought to the attention of MMS its concern over debris remaining on the bottom at the site after structures are removed. Subpart C of 30 CFR 250.112(i) requires that the locations of structure removal be cleared of all bottom obstructions. To examine this conflict more closely, MMS established a Regional Site Clearance Committee in 1989. The Committee's membership consists of representatives from the State of Louisiana's Department of Wildlife and Fisheries, the Louisiana Concerned Shrimpers Association, the Offshore Operators Committee, and the MMS Offices of Field Operations, Leasing and Environment, and the Regional Director. The Committee drafted and distributed through MMS an NTL (90-03) to all offshore operators that is a minimum interim requirement for site clearance (and verification) of abandoned oil and gas structures in the Gulf. After additional information is collected from operational experience under NTL 90-03, new regulations will be drafted. It is assumed that offshore operators will adhere to the NTL 90-03 guidelines and eliminate bottom debris associated with platforms removed as a result of the proposed action. It is assumed that the economic loss to Gulf fishermen from bottom debris/gear conflict as a result of the proposed action will be less than one percent of the value of any fiscal year's commercial fisheries landings for the entire life of the proposed action.

Most financial losses to Gulf fishermen from bottom debris and fishing gear conflicts are covered by claims made to the Fishermen's Contingency Fund (FCF) administered by the Financial Services Division of NMFS (Jackson, written comm., 1991). (See Section I.B.3.d.(3)(f) for a detailed discussion of the FCF.) During FY 91, 124 claims of conflict between fishermen and offshore oil and gas bottom debris were processed with 43 percent being approved for a total of $213,777 awarded to the fishermen. It is assumed that any economic loss to Gulf fishermen from bottom debris/gear conflicts as a result of the proposed action will be less than one percent of value of that same year's commercial fisheries landings for the entire life of the proposed action.

(3) Space-Use Conflicts

The presence of a production platform, with a surrounding 100-m navigational safety zone, results in the loss of approximately 6 ha (15 ac) of trawling area to commercial fishermen and causes space-use conflicts in water depths of less than 152 m (USDOI, MMS, 1991a). Exploratory drilling rigs spend approximately 45 days per well on site and are a short-lived interference to commercial fishing. Virtually all commercial trawl fishing in the Gulf is performed in water depths less than 152 m, and those platforms constructed in greater depths will not conflict with commercial fishing. Seismic surveys are not an issue of space-use conflict in the Gulf of Mexico commercial fisheries. The development scenarios in the CPA for the Base and High Cases for proposed Sale 142 assume that, on average, approximately 73 ha (180 ac) and 82 ha (202 ac), respectively, will be lost to commercial fishing per year during the 33 years that production platforms are in place (Table IV-2). The development scenarios in the WPA for the Base and High Cases for proposed Sale 143 assume that approximately 9 ha (21 ac) (Table IV-3) will be lost to commercial fishing in each Case. During the peak year (Base Case) for the CPA, 120 ha (296 ac) may be unavailable to fishing and for the WPA, 15 ha (37 ac).

(4) Aesthetic Interference

Drilling rigs and platforms can directly impact public perceptions of coastal and nearshore seascape views. Indirectly, rigs and platforms are associated with oil spills and marine trash and debris, which can also adversely affect the aesthetics of the marine environment or coastal shorefront. Platforms and drilling rigs established in the first two or three tiers of nearshore Federal oil and gas lease tracts (3-10 mi from shore) can be readily seen and recognized during good weather conditions from the southern most coastal shorelines of Louisiana, Mississippi, and Alabama. Drilling rigs and very large production platforms 10 or more miles from shore, such as those operating in the first tier of Federal oil and gas lease tracts off Texas, may be barely perceptible from shore in the fairest of weather conditions, but would be indistinguishable from objects such as ships, and are unlikely to spoil natural shorefront vistas. On a clear night, lights from the top of drilling rigs could be visible almost to where they dip below the horizon from the curvature of the earth (about 20 mi). Long-term oil and gas production in State waters off Louisiana and Texas, and recent State water production and exploratory drilling within view of the shorelines of Mississippi and Alabama have accustomed many coastal residents to the visual presence of drilling rigs and production platforms in nearshore coastal waters.

For purposes of this EIS, it is expected that 16 platform complexes will be installed in offshore Subareas C-1 and C-3 (Table IV-2). Under the High Case scenario, as many as 24 platform complexes would be installed in coastal Subareas C-1 and C-3. Based on MMS in-house analysis, it is more likely that most of the platforms installed in these subareas will be beyond 10 mi (16 km) from shore. It is assumed, however, that at least one drilling rig will operate in coastal nearshore tracts and that one production platform will be installed within the first two or three tiers of Federal lease blocks off the coast of Louisiana, Mississippi, or Alabama. All rigs and platforms located on the OCS as a result of proposed Sale 143 (offshore Texas) will be operating 10 or more miles from the coastal shoreline.

(5) Offshore Operational Wastes

The largest quantities of operational wastes generated by offshore oil and gas exploration and production activities include produced water, drilling fluids and cuttings, ballast water, and storage displacement water. Other major wastes from the offshore oil and gas industry include the following: from drilling--waste chemicals, fracturing and acidifying fluids, and well completion and workover fluids; from production--producedsand, deck drainage, and miscellaneous well fluids (cement, BOP fluid); and from other sources--sanitary and domestic wastes, gas and oil processing wastes, and miscellaneous minor discharges. In general, oily wastes such as produced waters and sands, as well as processing fluids, are collected into one drainage system and then sent into a sump tank where oil is separated, often by gravity. The water phase is then discharged overboard either at the surface or it is shunted. The oily sludge and sometimes the oily wastes themselves, such as produced sands, are brought onshore for disposal. Other disposal alternatives, such as downhole injection, encapsulation, or offshore storage, require prior approval by the Regional Director. For analytical purposes, this document assumes that USEPA's effluent limitation guideline regulations (Section I.B.3.d.(3)(e)), will be promulgated. In the development of estimates of future discharges, characteristics of the waste streams, and disposal methods, MMS assumes that the proposed effluent limitations are finalized and that USEPA's preferred option for each waste, as identified in the proposed rule (40 CFR 435), will be chosen.

Major contaminants or chemical properties of concern in oil and gas operational wastes can include high salinity, sulfides, low pH, high biological and chemical oxygen demand, various metals, crude oil compounds, organic acids, and radionuclides. Most recently, the public has expressed considerable confusion and concern regarding radionuclide contamination in oil-field wastes generated in the Gulf of Mexico. Over the past several years, measurements of elevated levels of radiation in used oil-field equipment have raised the sensitivity of the public and regulators to the fact that naturally occurring radioactive materials are generated from the mineral-extraction process.

It is now known that naturally occurring radioactive materials, collectively known by the acronym NORM, can occur in significantly higher than background levels in many oil-field wastes. As the production stream is brought to the surface, NORM may remain dissolved at diluted levels or may precipitate as scale on the insides of well tubing, pipes, and processing equipment and in the sludges that collect in the tanks, vessels, and filtration units. Offshore, NORM is found in oil and gas production equipment and in the produced sands, solids, and waters generated during production. Drilling muds and cuttings and workover fluids have also been found to be contaminated with NORM. Sections that follow provide information about levels of NORM measured in each waste type. Onshore, solid NORM may be found in gas processing plant equipment, in heater treaters and separators at separation facilities, and associated with pipeyards.

The NORM is defined as any naturally occurring material that emits low levels of radioactivity, originating from processes not associated with recovery of radioactive material. All soils and rocks contain some radioactive materials (unstable elements), and any activity that concentrates them to levels well above their natural abundance--such as mineral extraction and refining--may potentially create a health hazard. The radionuclides of concern in NORM are Radium-226, Radium-228, and other isotopes in the radioactive decay chains of uranium and thorium. Radium is a long-lived nuclide with a 1600-year half-life and when ingested, concentrates in the bones. Radium emits alpha, beta, and gamma radiation. Alpha particles are the most energetic radiation but are easily blocked and cannot penetrate the skin. However, if ingested, alpha radiation can cause bone cancer, or if airborne and breathed, it can cause lung cancer. Radium also emits gamma rays, which are very penetrating and considered hazardous at high concentrations.

Because NORM materials have relatively low activity levels compared to nuclear industry man-made isotopes and because of their natural presence, they have been largely ignored until now by regulators. The NORM were not covered by the Atomic Energy Act of 1954 and, thus, are not regulated by the Nuclear Regulatory Authority nor USEPA as radioactive wastes. At present, there are no Federal regulations for handling and disposing of NORM-contaminated materials. The Louisiana Department of Environmental Quality (DEQ) is the only State agency to have adopted NORM regulations (Chapter 14, "Regulation and Licensing of Naturally Occurring Radioactive Materials (NORM), LAC 33:XV). On September 20, 1989, the DEQ developed regulations that provide strict disposal requirements for all NORM materials emitting radiation greater than 50 microroentgens (micro-REMS) per hour and that establish guidelines for conducting NORM confirmatory surveys of suspected contaminated land. The State of Texas has, at present, draft proposed regulations (Draft 2 Texas Regulations for Control of Radiation, Part 46, "Licensing of NORM").

Part of the lack of regulation stems from the fact that, at present, little can be concluded definitely concerning the effects of this wastes and associated disposal practices on both human health or marine life. While scientists know that radiation causes cancer, there is deep disagreement over just how much radiation it takes to affect human health. Even less is understood about the fate of NORM from the overboard disposal of oil-field wastes, about how much marine uptake occurs, and what this uptake means to the health of the marine ecosystem. Selection for the oil industry of criteria for contaminant levels and exposure rates based on radiation limits set for other industries is premature until more is known about the fate and effects of oil-field NORM.

Despite the lack of conclusive data on the effects of NORM, the Minerals Management Service initiated a policy to control the overboard disposal of OCS-generated NORM solid wastes under the authority of the OCS Lands Act. By MMS regulatory authority to approve the disposal of oil-field waste (30 CFR 250.40), the agency has taken a major step and has developed interim guidelines to industry for the overboard disposal and handling of NORM-contaminated production and workover solids. Also, USEPA is now considering establishing discharge limits on the radionuclide content of produced water as part of the effluent limitation guideline regulations.

An interim policy Letter to Lessees (LTL) was issued on November 20, 1990, requiring all disposal to be approved by the MMS Regional Office (Appendix E). The granting of approval for the overboard disposal of solids was basically put on hold after this LTL was issued. Industry applications received by MMS showed that the majority of the accumulations were solids having radiation human exposure limits equal to or very near background measurements. Since MMS was not approving overboard offshore disposal, the operators have been either storing the materials offshore or transporting the material onshore for disposal at approved sites. Specific problems related to onshore disposal of NORM-contaminated production solids is discussed in Section IV.A.3.c.(4)(b). Given the radiation exposure levels being reported and the problems associated with the onshore disposal of these wastes, MMS has decided that overboard disposal of most solids represents the best disposal alternative at this time. A second LTL, issued December 11, 1991, establishes more detailed interim guidelines for the reporting and disposal of produced well solids and for collecting data to be used to promulgate formal policy. (Appendix E contains both LTL's). In general, the second LTL allows MMS to approve all overboard disposal of production solids with a radiation dose rate equivalent of no greater than 25 microroentgens per hour above background. Material with higher measurements will be considered on a case-by-case basis. This level is based on proposed worker and public health exposure limits in the aforementioned proposed Texas and Louisiana regulations. No concentration limits for radium per unit discharge, i.e., picoCuries/gram, will be determined until more is understood about the physical and chemical properties of oil-field NORM, although industry is asked to analyze the samples for total radium concentrations.

There is a tremendous effort underway by MMS, the Department of Energy, USEPA, State agencies, and industry to gather data on NORM contamination levels; on the fate of discharges and the environmental consequences of current disposal practices of NORM-contaminated oil-field wastes; and on disposal alternatives and treatment methods. Industry is leading the way in studies that are determining expected levels and the fate and effects of offshore, disposal of these wastes. The American Petroleum Institute (API), the Offshore Operators Committee's (OOC) Environmental Science Task Force, and individual oil companies are gathering much needed data. The MMS is working cooperatively with these agencies and industry to study, as quickly as possible, all information that is being generated. Few conclusions can be made at this time.

Human health effects have received the most attention. Brookhaven National Laboratories (1991), as part of an API study, concluded that areas near coastal produced-water discharges did not exhibit NORM contamination above USEPA's reportable quantity for worker risk. Brookhaven did postulate that such discharges could pose a small risk to human health through ingestion of contaminated fish and oysters. The USEPA, in its draft risk assessment, suggests that diffuse NORM presents little hazard to most people, with the exception of workers who inhale radium dust during improper disposal activities. In 1993, MMS will begin a study that will evaluate data on human exposure from various disposal alternatives.

To understand ecosystem impacts, the fate of offshore discharges is being assessed through a number of studies. Industry has recently completed a study of the dispersion of produced well solids discharged directly from a production platform. The study focused on the ability of current technology to clean or wash produced solids and to measure the environmental fate in the surrounding area. One hundred and forty-four barrels of produced sand, containing from 19-68 picocuries per gram of radium-226, was discharged. Sediments around the discharge site showed radioactivity levels indistinguishable from background radioactivity (Randolph et al., in press). Offshore sand discharge was also modeled using OOC's dispersion plume model. The results showed a 5 pCi/g maximum elevation of surrounding bottom sediments. The study also examined water and sediment NORM contamination at 12 OCS discharge sites where solids were discharged in the past year (Randolph et al., in press).

Although data is available that shows biological uptake of NORM by oysters and fish in inland coastal waters (Rabalais et al., 1990; St. Pé, 1990; Mulino and Rayle, 1992) near produced-water outfalls (now terminated), no studies have yet been completed examining fish and oysters near platforms for NORM contamination. Avanti Corporation is examining the effect of NORM discharged on caged organisms at six OCS platforms in a study funded by USEPA. The draft NPDES general permit for the Western Gulf of Mexico (Section I.B.3.d.(3)(e)) is proposing the monitoring of water and fish tissue for radium levels near produced-water offshore outfalls. A Department of Energy study, which is underway, will monitor the recovery of impacted wetland and open bay, produced-water discharge sites in coastal Louisiana and Texas.

In conclusion, it is believed that it is premature to assume that there will be or are significant effects occurring from the offshore disposal of NORM-contaminated liquids and solids. At present, MMS assumes that the ongoing efforts to study information regarding the fate and effects of NORM-contaminated wastes will result in the proper management of all future disposal of NORM wastes, preventing any significant environmental damage.

(a) Drilling Muds and Cuttings

The major source of contamination from drilling operations is the drilling fluids, or "muds," and the cuttings from the drill bit. Drilling fluids are suspensions of solids and dissolved materials in a base of water or oil that are used in rotary drilling for oil and gas exploration and development to remove cuttings from beneath the bit, to control well pressure, to cool and lubricate the drill string, and to seal the well.

Drilling fluids/muds are composed of bulk constituents and special-purpose additives. Although water-based systems are the most common muds used, oil-based fluids are used for a variety of applications, such as high temperature wells, deep holes, and wells where sticking and hole stabilization is a problem. In addition, water-based drilling fluids may have diesel oil or mineral oil added to them. Hydrocarbons (diesel or mineral oil) were added for lubricity in 12 percent of the wells surveyed in 1984 by API (USEPA, 1991). Drilling fluids also may contain entrained formation hydrocarbons. The principle contaminants of concern in drilling muds include oil content, biochemical oxygen demand, chemical oxygen demand, total organic carbon, and priority pollutants (excluding pesticides). Stephenson (1991) has recently analyzed a limited data set of muds from 14 offshore wells for radium-226 and -228 content (naturally occurring radioactive material, or NORM). The analysis showed that NORM concentrations in the mud averaged four picoCuries and were at or below the average NORM concentrations in surface sediments in uncontaminated areas. The primary concern in the drill cuttings waste stream is the discharge of oil and other mud constituents that adhere to or are mixed with waste cuttings.

The circulated mud brings to the surface silts, cuttings, water, oil and gas, which must be separated out. The mud is often recycled, especially on a multiple-well platform. However, drilling fluids must be eventually disposed of for a number of reasons, as must drill cuttings from the drilled formation. Although drilling discharges can be barged ashore or to other sites at sea for disposal, cost and operational considerations favor on-site disposal by either overboard discharge or shunting through a pipe to some depth. The cuttings, silt, and sand are discharged overboard if they do not contain free oil. The heavier particles sink to the bottom while the mud and fines are swept downcurrent away from the platform. Based on observations of discharges, the plumes are spread out at some depth, depending on density characteristics, and are rapidly dispersed by the turbulent diffusion characteristics of the ocean. Horizontal turbulent diffusion results in dilution of the plumes by a factor of 10,000 or more within an hour of release and an even greater dilution of suspended components because of settling (Brandsma and Sauer, 1983). At most depths typical of the continental shelf, the majority of discharged fluids and cuttings are initially deposited on the seabed within 1,000 m of the discharge point. This material may persist as initially deposited or may undergo bioturbation and rapid or prolonged dispersion, depending on the energy of the bottom-boundary layer. Effects on benthos have been observed in the field under low to moderate energy regimes within 1,000 m of the discharge point.

As discussed above, MMS assumes that the USEPA proposed effluent limitations will be finalized. These effluent limitations for drilling fluids and cuttings are (1) prohibit any discharge within 4 mi from shoreline, (2) limit the acute toxicity to a minimum 96-hour LC_{50} of 30,000 ppm as measured in the diluted suspended particulate phase, (3) prohibit the discharge of diesel oil, (4) prohibit the discharge of free oil, and (5) limit of the discharge of cadmium and mercury in whole drilling mud at the point of discharge to 1 mg/kg.

For analysis purposes (Section IV.D.), it is assumed that there will be 7,134 bbl of drilling fluids and 1,853 bbl of cuttings produced per exploratory well, and 6,749 bbl of drilling fluids and 1,430 bbl of cuttings produced per development well (USEPA, 1991). The different volumes are based on the expected different average depth for the two types of wells. It is assumed that oil-based muds will be used when drilling operations exceed 10,000 ft in depth. Given this and the proposed effluent limitation of no discharge closer than 4 mi from shoreline, it is assumed that 18.1 percent of drilling muds will be brought onshore for disposal (USEPA, 1991).

Assumptions regarding the fate of discharged muds and cuttings include the following: horizontal turbulent diffusion results in the dilution of these discharges by a factor of 10,000 within one hour of discharge and the plume diminishes to background levels in the water column within 1,000 m of the discharge point.

(b) Produced Waters

Produced water (also known as production water or produced brine) is the total water discharged from the oil and gas extraction process. It is comprised of the formation waters, injection water (if used for secondary oil recovery and broken through into the oil formation), and various chemicals added during the oil and water separation process. During production of oil and gas, formation water (also called fossil or connate water) located in the permeable sedimentary rock strata may be brought up to the surface. This water comprises the bulk of produced water. The amount of produced water generated per volume of oil varies greatly, but it is the largest, single volume waste stream in the entire exploration and production process. Most older wells, as oil and gas production declines, produce increasing amounts of water. In some oil-fields, water emerges with the oil in the early stages of development; whereas in other wells, appreciable water never comes up with the oil. Produced water can constitute from 2 to 98 percent of the waste stream of a producing field.

Produced waters are usually high in total dissolved solids (salinity), total organic carbon, and low in dissolved oxygen. Other basic components include heavy metals, elemental sulfur and sulfide, organic acids, treating chemicals, and emulsified and particulate crude oil constituents. Salinity can vary from a few parts per thousand (ppt) to 300 ppt (the salinity of saltwater is 35 ppt). Metals that may be present in produced waters in higher concentrations than seawater include aluminum, barium, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver, vanadium, and zinc. Because these waters are closely intermingled with petroleum, they contain variable concentrations of dissolved and dispersed petroleum hydrocarbons. Oil and grease content recently measured in produced-water discharges from 30 platforms in the Gulf of Mexico averaged (flow weighted) 89.8 ppm (USEPA, 1991). In addition, high concentrations of other soluble organic compounds (characteristically greater than 200 ppm) are found, particularly phenols and organic acids (Boesch, 1988). Treating chemicals are added deliberately by the offshore operator to treat or prevent operational problems that may occur in the production process (Stephenson, 1991). Treating chemicals can generally be classified into three categories: production treating chemicals, gas processing chemicals, and stimulation and workover chemicals. These chemicals are discussed in more depth in Section IV.A.2.d.(5)(c).

Concentrations of NORM greater than background levels are found to exist in oil-field produced waters. The NORM measured in produced-water samples from Gulf oil platforms (both State and OCS production) exhibit radium activities as high as 2,801 picoCuries per liter (pCi/l) (Snavely, 1989; Rabalais et al., 1991; Stephenson and Supernaw, 1990; Louisiana Dept. of Environmental Quality, 1990). Snavely found that 78 percent of the wells sampled in a number of studies he reviewed exceeded 50 pCi/l. Most recently, the Offshore Operators Committee analyzed 42 platforms on the Gulf of Mexico OCS to determine radionuclide content. The mean concentration of soluble Ra-226 was 262 pCi/l with a range of 4.1-584 pCi/l (Stephenson and Supernaw, 1990). On February 20, 1990, the Louisiana Dept. of Environmental Quality issued an Emergency Rule requiring a single analysis for Ra-226 and Ra-228 in each State-regulated, produced-water outfall; 153 samples were taken and the radium measured. The mean concentration was 160 pCi/l for Ra-226 and 181 pCi/l for Ra-228, with a high of 930 pCi/l for Ra-226. The USEPA reports that average open-ocean surface waters contain about 0.05 pCi/l, whereas coastal waters do not generally contain levels higher than 1 pCi/l.

Produced water may be reinjected into the formation or treated to decrease its oil content and then discharged into surface waters. An examination of production facilities discharging produced waters showed that only about 20 percent of existing structures discharged produced waters directly into surrounding waters; the other facilities thereby transporting their produced waters to these sites (1989 in-house analysis). Although much of the water produced from OCS oil and gas operations is discharged offshore, some of the water is piped ashore and then treated and disposed of at coastal separation facilities. (Section IV.A.3.c.(4)(a) discusses onshore disposal of produced waters.) About 11 percent of produced waters generated offshore are expected to be shipped into Louisiana State waters for disposal.

Projections of the amount of produced water generated from operations associated with the proposed actions are derived from an analysis described in the supporting reports for the proposed USEPA (1991) effluent limitations. For a typical well, about 450 bbl of produced water per oil well per day and about 68 bbl of water per gas well per day can be expected. Given this, total estimates of produced waters generated over the 20-year platform life are 317,942,000 bbl in the CPA and 126,203,000 bbl in the WPA (Tables IV-2 and IV-3). Subtracting the 11 percent of produced waters expected to be brought onshore for disposal, the amount of produced waters projected to be discharged into CPA offshore waters is about 283 MMbbl.

A number of studies have investigated the fate and effects of OCS discharges around production platforms in open waters (USDOI, MMS, 1990b). These studies and their conclusions are discussed in Section IV.B.1.b.(4)(e).

(c) Other Development/Production Fluids

Other discharges associated with OCS activities include well treatment, completion, and workover fluids; deck drainage; and minor discharges.

Well treatment, completion, and workover fluids are proposed for regulation under the U.S. Environmental Protection Agency's NPDES permit. Well treatment fluids are any fluids used to restore or improve productivity of the formation. Well completion fluids are used to prepare the well for actual oil extraction. Workover fluids are used to restore an abandoned well to production or to repair a well. Composition of these fluids varies, but they usually are low solids, weighted brines with specialty additives, or acidic solutions. Principle contaminants can include low pH, oil and grease, metals, a variety of organic compounds, and NORM. Because these fluids are sometimes used to dissolve NORM-contaminated scale buildups, their waste streams have been found to have radioactive isotope concentrations as high as 25,000 pCi/l.

These fluids may remain in the formation, become spent (if acidic), resurface with the produced fluid as a discrete slug, or mingle with drilling fluids or produced water and become part of these waste streams. If they appear as a discrete slug upon resurfacing, they can be disposed of, stored, reused, or treated and discharged. One Gulf operator reported well treatment fluids usage at a rate of 1,283 bbl per discharge, with one discharge per workover activity (USEPA, 1991). However, it was not possible to develop estimates of volumes that may be discharged from production associated with the proposed actions.

The USEPA is considering three effluent limitation options for these fluids: (1) no discharge of free oil; (2) zero discharge of any concentrated slug of fluids along with a 100-bbl buffer on either side of the slug; or (3) no discharge. When the fluids are mingled with produced waters, they would have to meet the same requirements as proposed for produced water discharges.

Deck drainage results from rain runoff, miscellaneous leakage and spills, and washdown of the platforms or drilling rigs. Deck drainage is usually contaminated with oil and grease and a number of hazardous chemicals and trace metals in low concentrations. Measurements of influent oil and grease content range from 1-16,908 ppm; and oil and grease in the discharged drainage range from 1-673 ppm, showing that oil and grease can greatly exceed the discharge limits of produced waters (USEPA, 1991). The source of the oil in the deck drainage is any residual oil from previous spills and leakage of oils and other production chemicals used by the facility. Oil may also be present due to the washdown solvents. Platforms have pans and sumps that collect such drainage. The drainage is gravity separated into wastes materials and effluent. The effluent can be treated separated or combined with produced water, and discharged overboard. The waste materials are treated, used in the drilling mud system, or transported to shore for disposal. The USEPA proposed effluent limitations for deck drainage are (1) no free oil and (2) same limitations selected for produced waters.

The quantities of deck drainage can vary greatly. An analyis of 950 Gulf of Mexico platforms during 1982-1983 measured deck drainage quantities ranging from 1 to 4,304 bbl/day with a average of 50 bbl/day (USEPA, 1991). No estimates of quantities of deck drainage discharges are provided for the proposed actions.

The term "minor discharges" is defined by USEPA (1991) to include all other point source discharges other than produced water, drilling fluids, deck drainage, well treatment and workover fluids, and sanitary and domestic wastes. These wastes are assumed to be minor, and no regulatory control exists or is proposed (USEPA, 1991). These sources are categorized into 15 "minor wastes" that include desalinization unit discharge, blowout preventer (BOP) fluid, laboratory waste, ballast/bilge water, noncontact cooling water, seafloor contamination, uncontaminated seawater used for a variety of operations, boiler blowdown, excess cement slurry, diatomaceous earth filter media, painting wastes, uncontaminated freshwater, accidentally discharged bulk transfer materials, waterflooding discharges, and test fluids. More information on these waste streams can be found in USEPA's (1991) *Development Document for Effluent Limitation Guidelines and Standards for the Offshore Subcategory of the Oil and Gas Extraction Point Source Category.*

(d) Production Sands/Solids/Equipment

Solid wastes discussed here include production sands, salvaged and discarded tubular pipes, pipe scale, and tank bottom sludge. Other solid wastes such as oil-field equipment (used filters, drums, etc.), cement bags, crates, plastics, and a variety of domestic wastes are discussed in Section IV.A.2.d.(5)(f), under *Trash and Debris.*

Produced sand and other solids, such as scale, corrosion by-products, and parrafin, associated with oil and gas production are gravimetrically separated out of the production stream and accumulate in production tubing, flowlines, and various oil and gas process vessels. These solids are removed periodically to improve production. Low volumes of these fine sands may be drained into drums on deck or are carried through the oily water treatment system and appear as suspended solids in the produced-water effluent or settle out in treatment vessels. Due to the oil-wetting of clay particles and the presence of paraffin, grease, and other hydrocarbon-containing materials that are in various quantities in tank bottoms, tank bottoms are often referred to as sludges. If sand volumes are larger, the solids are removed in cyclone separators, producing a solid phase waste. Produced sands are, in reality, a mixture of many different kinds of solids. The primary component is sand (SiO_2), with varying amounts of mineral scale, corrosion products, and other formation fines. The principle contaminants of concern in the sludge or sand mixtures are oil and NORM. The majority of tank bottoms have measurable radioactivity levels at or slightly above background levels. However, instances of tank bottoms having radioactive isotope concentrations as high as 2,000 picoCuries per gram (pCi/g) have been documented. The Offshore Operators Committee recently surveyed radium in produced sand from 30 OCS locations in the Gulf and found Ra-226 levels averaging 47 pCi/g (Offshore Operators Committee, 1991).

The natural Ra-226 activity in Louisiana surface waters is below 1.0 pCi/l; for Louisiana soils, levels range from less than 1.0 to 7.0 pCi/g. Ra-226 levels for openocean waters and marine sediments average 2 pCi/l and 1-17 pCi/g, respectively.

Industry has estimated that, historically, about 20-25 percent of production solids have been cleaned of oil and grease contaminants and discharged overboard. The other 75-80 percent of production solids were brought onshore for disposal. However, because of the recently recognized NORM contamination in these compounds, previous disposal practices have been abandoned and a number of disposal methods are being considered. Disposal methods are discussed above in Sections IV.A.2.d.(5) (offshore disposal) and IV.A.3.c.(4) (onshore disposal).

Realizing the uncertainty of the regulatory climate regarding produced sands, this EIS assumes, for analytical purposes, that no produced sands will be discharged offshore and that all will be brought onshore. Estimates of total produced sand expected from a platform are from 25 to 250 bbl per day according to the USEPA (1991), or 5 percent of the oil produced (USEPA, 1976). Total volumes of produced sands generated from oil and gas production associated with the proposed actions are projected to be 69,000 and 154,000 bbl in the CPA, Base Case and High Case, respectively; and 24,000 and 64,000 bbl in the WPA, Base Case and High Case, respectively.

Not all scale is removed from equipment and disposed of with produced sands. Scale is a hard, rock-like flow restrictive substance that may form and adhere to downhole tubulars and in association with above-ground processing and transparent equipment and piping. As wells and facilities reach the end of their economic life, plugging and abandonment procedures are performed on the wells, and the production facilities are removed. Pipes removed from the wells and the process equipment may have accumulations of scales within. These scales may contain Ra-226 and Ra-228 in concentrations averaging 0.1-2,800 pCi/g. Some of these levels have been measured as high as 100,000 pCi/g. Presently, such accumulations prohibit the sale of this equipment either as scrap metal or for reuse in ways other than which they were originally intended. Therefore, these tubular goods must be cleaned to remove the contaminants before the transfer of ownership. Once removed, the contaminated wastes are returned to the operators for appropriate disposal. Because of the cost involved in contaminant removal, many operators have elected to stockpile the tubulars and process vessels at operator-owned facilities or nonhazardous oil-field waste (NOW) sites until a cost-effective method of radioactive scale removal is found.

(e) Treated Sanitary and Domestic Wastes

Domestic wastes are wastewaters originating from sinks, showers, laundries, and galleys, as well as wastewater from safety shower and eye-wash stations and fish-cleaning stations. Domestic wastes also may include solid materials (paper, boxes, etc.) that are combustible. These solid materials, defined as trash and debris, are not regulated under the NPDES process and are discussed in Section IV.A.2.d.(5)(f). Sanitary wastes are composed of human body wastes from toilets and urinals. Some platforms combine sanitary and domestic wastewaters for treatment; others maintain sanitary wastes separately for treatment by an approved marine sanitation device.

The volume and concentration of sanitary wastes will vary widely with time, occupancy, platform characteristics, and operation situation. In offshore operations, toilets are usually flushed with brackish water or seawater. Concentrations of fecal coliform bacteria serve as an indicator of the potential pathogenicity of water resulting from the disposal of human wastes. Specific levels of suspended solids and chlorine residual in an effluent are indicative of corresponding levels of fecal coliform. If the suspended-solid levels in an effluent are less than 150 mg/l and the chlorine residual is maintained at 1 mg/l, then fecal coliform levels should be less than 200 per 100 ml. Properly operating biological treatment systems on offshore platforms have effluents containing less than 150 mg/l of suspended solids; therefore, chlorine residual is a reasonable control parameter. Domestic wastes contain no fecal coliform so must only be ground up by a comminutor so that the discharge will not result in any floating solids.

In general, a typical manned platform will discharge 0.075 m^3 per person per day of treated sanitary wastes and 0.110 m^3 per person per day of domestic wastes (USEPA, 1991). Total volumes of discharges from all exploration, development, and production operations can be found in Tables IV-2 and IV-3. Not included in these figures are discharges from service vessels, which is estimated at 0.227 m^3 per person per day (NERBC, 1976). It is expected that such discharges are rapidly diluted and dispersed.

(f) Other Trash and Debris

Oil and gas operations on the OCS lead to the generation of waste materials made of paper, plastic, wood, glass, and metal. These wastes are collected and prepared for transportation and disposal onshore. Sometimes oil and gas trash is lost overboard from rigs and platforms or during transport back to shore. Through ingestion or entanglement, trash in the marine environment can adversely impact marine fish and wildlife resources and has been known to adversely affect navigation and fishing operations. Even when properly disposed of in approved landfills, this trash is contributing to the scarcity of available landfill space in adjoining State coastal areas.

Human trash loads exceeding one ton or more per mile continue to be reported from coastal cleanups along Texas and Louisiana beaches, adversely affecting the recreational ambience of the beach environment. Beach users and other commercial and recreational users of the Gulf of Mexico are known to contribute to beach trash and debris. Some items, however, clearly associated with offshore oil and gas operations, can be recognized among the beach litter along the Louisiana and Texas coasts. Items such as 55-gallon drums, 5-gallon containers, paint cans, hard hats, pipe thread protectors, shrink wrap, stripping lumber, wooden pallets and wire spools, empty mud chemical sacks, plastic and glass containers, large pieces of styrofoam, and cardboard boxes are common items recognized on coastal beaches. Possible sources include drilling rigs, production platforms, workboats, crewboats, supply or service vessels, oil barges, shuttle tankers, pipe-laying barges, and geological, geophysical, or environmental research vessels associated with the proposed actions. Because deliberate offshore disposal of solid waste is prohibited from offshore oil and gas operations, it is assumed that only the accidental loss of trash and debris from all phases of OCS operations associated with the Base Case and High Case scenarios from proposed Sales 142 and 143 will contribute some solid wastes to the Gulf of Mexico. Most of the trash generated by offshore oil and gas operations will be returned to shore for disposal in approved landfill sites. A small amount of the trash generated offshore will be incinerated offshore, but the practice is decreasing because of safety considerations and more stringent environmental regulations.

(6) Air Emissions

Offshore air emissions related to the proposed actions result from platform operations; drilling of development, exploration, and delineation wells; helicopters, service vessels, shuttle tankers, and barging of crude oil. These emissions occur mainly from combustion or burning of fuels and natural gas and from venting or evaporation of hydrocarbons. The combustion of fuels occurs primarily on diesel-powered generators, pumps, or motors and from lighter fuel motors. Venting or evaporation of hydrocarbons occurs during loading, storage, and transporting of crude oil. Other air emissions can also result from catastrophic events such as oil spills and blowouts.

The OCS offshore infrastructure contributing to air emissions includes platforms and well drilling rigs. Primary air pollutants associated with OCS activities are nitrogen oxides (NO_x), carbon monoxide (CO), sulphur oxides (SO_x), volatile organic compound (VOC), and suspended particulate (TSP). Ozone, a secondary air pollutant, is not emitted by sources; it is the result of photochemical reactions in the atmosphere. Emission of primary pollutants from OCS platforms and drilling operations are estimated using the emissions factors shown below. These emission factors were developed from a 1985 MMS inventory of offshore OCS structures. Emission factors are expressed in tons per year per platform (which implicitly assumes that an average OCS platform can be defined) and in tons per well over 45 days. The most emitted pollutant are nitrogen oxides derived mainly from the diesel-powered motors.

Average Annual Emissions from OCS Infrastructures in the Gulf of Mexico

	NO_x	CO	SO_x	VOC	PM_{10}
Platforms (t/p/y)	85.75	11.17	0.15	32.50	0.21
Expl. Well (t/45-d)[1]	9.67	2.58	1.13	0.97	0.28
Expl. Well (t/45-d)[2]	7.16	1.91	0.84	0.72	0.21

Source: USDOI, MMS, Gulf of Mexico OCS Region estimates, 1989.

[1] Assumes a 13,500-ft hole, 597,120 horsepower hour (hphr) diesel reciprocating engines, and 45-day drilling period.

[2] Assumes a 10,000-ft hole, 597,120 horsepower hour (hphr) diesel reciprocating engines, and 45-day drilling period.

Emission factors of primary pollutants for accidental releases of oil or blowouts are presented below. These catastrophic events generally produce high-level emissions over a very short time in a localized area. Events such as oil spills or blowouts, with or without fire, are nonroutine in nature and are unpredictable. The release of air pollutants from oil spills is high during the first hour and decreases rapidly thereafter. It is assumed that emission of air pollutants from oil spills cease completely after three days. A blowout resulting in a gas discharge without fire releases only petroleum hydrocarbons and hydrogen sulfides, if present. If the blowout occurs with fire, combustion by-products, including all primary pollutants would be released. Blowouts are estimated to occur at a rate of about 7 per 1,000 wells drilled. Under the Base and High Case scenarios, 4 and 8 blowouts (Table IV-2) are assumed to occur in the CPA, respectively. In the WPA, the number of blowouts assumed to occur in the Base and High Cases are 2 and 5, respectively (Table IV-3). These blowouts will not be associated with oil spillage greater than 50 bbl. Section IV.A.2.d.(8) discusses the risk of oil spills occurring with blowouts.

Emissions Associated with OCS Accidents
(tons/hour)

Accident Type	THC*	NO_x	SO_x	CO	PM_{10}
140-bbl spill					
First hour	4.0	—	—	—	—
Second hour	2.0	—	—	—	—
10,000-bbl spill					
First hour	285.0	—	—	—	—
Second hour	145.0	—	—	—	—
Blowout-No fire**	1.0	—	—	—	—
Blowout-With fire**	0.34	0.02	0.21	0.34	0.07

*THC's are used as VOC emissions.
**Assumes a blowout of 1,000 Mcf/d (gas) and 1,000 BPD (oil).

Source: USDOI, MMS, 1983.

Emissions of air pollutants during loading, storage, and transporting of crude oil and gas are calculated using the methodology and emissions factors presented in USEPA publication AP-42 of 1985 with supplements A, B, and C. Helicopter emissions are also calculated using the methodology of USEPA publication AP-42, since helicopters land and take off from platforms and are by law part of the platform emissions. For purposes of calculation, each platform is assumed to be visited 1.5 times per day by helicopters. The total number of helicopter trips are shown in Tables IV-2 and IV-3. Helicopter type is a factor that needs to be considered when calculating their emissions.

The total amount of air pollutants emitted as a result of the proposed actions, Base and the High Case scenarios, are presented in Tables IV-2 and IV-3.

(7) Noise

Noise emissions resulting from OCS oil and gas development are associated with the operation of offshore platforms, drilling rigs, seismic surveys, and helicopter and service-vessel traffic. Noise emissions associated with these activities are variable and may be loud or soft, transient or constant. Noise emitted from activities associated with the proposed actions may affect resources proximate to the activities. Helicopters and service vessels are the primary mode of transporting personnel and equipment between shore and offshore platforms.

Noise from these transient sources may affect birds, marine mammals and turtles, and recreational beach users. Noise from offshore seismic surveys is transient but may startle marine mammals and turtles proximate to the generated pulse. Noise from offshore development and production will be of a longer term and may affect marine mammals and turtles.

Machinery noise sources found on drilling and production platforms are generally similar to those used for shore-based operations. Special noise attenuated devices are sometimes used on offshore platforms to protect workers in their living quarters. Compressors and diesel engines are typically the loudest equipment on platforms, emitting about 90 decibels (dB) at a distance of 15 m (50 ft). By comparison, a diesel truck under full load also emits about 90 dB at 15 m. Other sounds, such as the banging of pipes or platform noises, may also degrade the underwater acoustic environment. Gales (1982) points out that in light seas the subsea surface noise propagated by a platform could be detected up to 100 mi away. In a quiet sea with light wind conditions, normal offshore platform operations would be inaudible beyond about 2 mi (assuming an ambient background noise level of 40 dB and attenuation due to sound wave spreading only). In rough seas and weather conditions, the offshore facility would be inaudible beyond about 1/8 of a mile (assuming a 70-dB background).

The Acoustic Society of America (1980) has estimated maximum sources levels at 230-250 dB relative to micropascal at 1 m for various types of activities associated with seismic exploration. These are classified as the highest sound pressure levels associated with offshore oil and gas explorations; the pulses are of short duration (generally less than 1 second) and are generated intermittently for relatively short survey periods (on the order of a few months in any given area) (Gales, 1982). Seismic surveys also may be interrupted for a period of several hours or days. Received-noise levels will be less than produced levels, and the rate of decay will depend on bottom absorption ability, the type of spreading (cylindrical or spherical), and other physical factors. Even with the maximum pressure levels estimated for seismic arrays a re/micropascal), the sound pressure level is expected to be under 200 dB at distances beyond 100 yd (Gales, 1982). It is assumed that noise generated from seismic surveys as a result of the proposed action will occur only from airgun-generated pulses.

Helicopter and service vessel traffic produce noise of a transient nature. The noise level produced in the air or on the water varies greatly with the type, size, speed, etc. of the moving object. To ensure the protection of endangered and threatened species, environmentally sensitive coastal areas, and the aesthetic value of recreational beaches, the Helicopter Safety Advisory Conference (HSAC) published an information booklet, which was distributed to helicopter operators, pilots, and users in the Gulf of Mexico (Helicopter Safety Advisory Conference, 1991). The HSAC booklet states that "all aircraft (fixed-wing or rotor) maintain a minimum of 2,000 feet above the surface of all National Parks, Monuments, Seashores, Lakeshores, Recreation Areas, Scenic Riverways, National Wildlife Refuges, Big Game Refuges, Game and Wildlife Ranges and Wilderness Primitive Areas." In addition, the Federal Aviation Administrative (FAA) Advisory Circular 91-36c encourages pilots making flights near sensitive areas or near locations of endangered or threatened marine animals to fly at altitudes higher than the minimum permitted by regulation and on flight paths that will eliminate interaction or reduce noise in such areas. The HSAC booklet provides all necessary maps of applicable areas in the Gulf. It is assumed that helicopter traffic as a result of the proposed action will adhere to the recommended flight ceilings and special prohibitions.

Service vessel traffic slows as it approaches coastal areas and inland waterways, thereby significantly decreasing noise emission in sensitive coastal areas and near recreational beaches (USDOT, CG, 1991). It is assumed that service-vessel traffic as a result of the proposed action will adhere to Coast Guard regulations, will use existing ports areas, and will slow as they approach the coastline. Offshore, it is assumed that service-vessel traffic has the potential to elicit a short-term startle reaction from marine mammals and turtles. However, most species of cetaceans, such as bottlenose and spotted dolphins, deliberately seek out and travel with vessels in the Gulf.

(8) Blowouts

Improperly controlled well pressures can result in the sudden, uncontrolled escape of petroleum hydrocarbons. Such an incident is referred to as a blowout. The loss of control can be momentary or could last for hundreds of days. The longest time recorded for a blowout in the Gulf of Mexico OCS was 156 days. Blowouts have caused the greatest number of fires, explosions, deaths, injuries, and property damage or loss on offshore rigs or platforms; can result in significant air and water pollution incidents; and have resulted in costly delays in drilling and production programs (Danenberger, 1980; Fleury, 1983).

Blowouts can occur during any phase of oil development: exploratory drilling, development drilling, production, and workover operations. Since 1971, MMS has maintained a data base on blowouts. This database includes information on the causes and extent of damage from the blowout event. During the time period 1971-1989, there were 116 blowouts (USDOI, MMS, 1991b). Thirty-four percent occurred during exploratory drilling, 28 percent during development drilling, 10 percent during well completions, 9 percent during production, and 19 percent during workover operations. Sixty-three percent of the oil spilled from these operations was during production.

To estimate the number of blowouts that could occur from the proposed actions, the number of wells drilled was correlated with the number of blowout events during the time period of 1975-1989. It is estimated that about 7 blowouts will occur per 1,000 well starts. Tables IV-2 and IV-3 provide the total numbers projected over the life of the proposed action.

Because there have been several large spills in the Gulf of Mexico and elsewhere areas associated with blowout events (the Santa Barbara Blowout and the Mexican Ixtoc blowout), the biggest concern associated with blowout events is often the potential for oil spills. An analysis of MMS blowout and oil-spill data shows that between 1958 and 1986 only about 23 percent of reported blowouts resulted in some oil spilled and about 8 percent resulted in spills of 50 bbl or greater. Only 4 percent resulted in spills over 1,000 bbl (USDOI, MMS, 1988b). Potential spills from blowouts are accounted for in our platform spill estimates provided in Section IV.C. It is assumed that there will be no oil spills greater than 50 bbl resulting from the projected blowouts.

Blowouts can also disturb both archaeological and biological resources due to sediment resuspension and explosive impacts. Deep-water benthic communities, topographic features, and live-bottom areas can be affected by blowouts, as well as offshore water quality and air quality.

(9) Offshore Spills

The OCS hydrocarbon development creates concerns about crude oil, diesel, and condensate spills. A spill event can occur on OCS waters and, because of oceanographic and meteorological processes, it can be transported to nearshore or coastal areas. Besides spills, there are chronic leaks from facilities, transportation, and or processing facilities. These leaks are, in general, less than or equal to 1 bbl. Materials that can be spilled during the activities include crude oil, condensate, diesel, and other pollutants. These spill events occur in a random fashion in time and space. Any attempt to describe these random processes must, therefore, use statistical procedures and techniques. Section IV.C. presents a discussion of the statistical techniques, rates, probabilities, and assumptions about spills in offshore areas. Also, the section presents details of historic occurrence of spills, processes, and characteristics of the spills disscussed in this document. The projected number of oil spill occurrences of different size categories under the Base and High Case scenarios in the CPA and WPA is shown in Tables IV-2 and IV-3.

3. Description of Onshore/Coastal Operations and Impacting Factors

Numerous onshore facilities and activities are needed to support offshore oil and gas operations. Service facilities (service bases and heliports) are used as transfer and loading sites for the movement of supplies and personnel to offshore work locations. Construction facilities (platform fabrication yards and pipeyards) assemble and prepare the structures that are used to develop and transport hydrocarbons. Processing and storage facilities (terminals, separation facilities, gas treatment plants, and refineries) provide temporary storage sites for hydrocarbons, remove various impurities from the hydrocarbon stream, and separate and distill various hydrocarbon fractions from the raw product.

Impacts from onshore infrastructure can result from the construction of new facilities, the operation of existing facilities, and transportation activities to and from the infrastructure sites. This document assumes that no new facilities will be constructed as a result of the Base or High Case scenarios. The specific reasons why this assumption is made for each infrastructure type are discussed in the sections that follow. These sections also briefly describe the kinds of impacts that could occur as a result of the ongoing operation of these facilities.

Numerous other activities occur onshore and within coastal waters in association with OCS oil and gas operations. These activities include the movement of oil via pipeline, barge, and shuttle tanker; the offloading of oil at terminals; service vessel and barge traffic through coastal waters; helicopter flight patterns over the coast; onshore oil spills; and the onshore disposal of offshore wastes. The projected magnitudes of these activities and quantities are shown by coastal subareas (Figure IV-1) in Tables IV-4, IV-5, and IV-6.

a. Onshore Infrastructure

(1) Service and Construction Facilities

(a) Service Bases

The total number of service vessel trips expected to result from the proposed actions under the Base and High Case scenarios is shown in Tables IV-2 and IV-3. Service base locations in the Central and Western Gulf, and the waterways that provide access to these bases, are indicated in Table IV-6. Table IV-6 also shows the projected number of service vessel trips to these bases as a result of the Base and High Case scenarios. The distribution of vessel trips to the various service bases was derived from an analysis of the historical records of service base usage by OCS-related traffic. Activities associated with the Base and High Case scenarios are assumed to account for 3 and 7 percent, respectively, of the utilization of the service bases listed in Table IV-6 during the 35-year life of the proposed actions.

No new service base construction is projected under the Base and High Case scenarios. This assumption is based on the widespread distribution of existing service base facilities throughout Texas and Louisiana and on the ability of the existing service base capacity to support levels of OCS activities in previous years that exceed the levels projected during the life of the proposed action. While the proposed actions are associated with increased oil and gas activities in deep-water areas of the Gulf, which may utilize larger service vessels than have been traditionally used for OCS operations, this document assumes that existing facilities can be used either as they currently exist or with modifications to the navigation channels that provide access to the service bases. (Navigation channels are discussed in Section IV.A.3.b.(3) below.)

It is assumed that each service base can support 6 mobile rigs or 20 platforms. Each service base is assumed to occupy 12 ha of land. Service bases are located adjacent to navigation channels that provide easy access to offshore waters of the Gulf.

Offshore oil and gas exploration, development, and production require onshore support from bases serving as the transfer point for materials and personnel. A supply base is used for transferring heavy equipment and supplies (machinery, drilling muds, cement, drilling water, etc.) to boats. It provides facilities for boat dockage, fuel storage, loading/unloading, warehousing, open storage, and parking. Personnel and light equipment disembark from a crew base. Crew bases can be located at the same site as a supply base or at a separate facility. A crew base located at a separate pier includes a pier, parking, and security arrangements at a minimum. Crew and supply bases operate 7 days a week throughout the year (Centaur Associates, Inc., 1985). A service base is assumed to occupy 16 ha (40 ac) of land.

Environmental impacts associated with normal service-base use include runoff and spillage of fuels and chemicals from the facility, discharges from supply and crew boats, channel-bank erosion from vessel traffic, and disturbance of bottom sediments and communities if dredging is required to maintain channel navigability. There will be no impacts from new construction activity because no new service-facility construction is projected in support of the leases that may result from the proposed actions.

(b) Heliports

A total of 325 heliports, or designated areas where helicopters can land, have been built and are used throughout the coastal areas of the CPA and WPA to accommodate the transportation needs of oil and gas operators moving people and, occassionally, equipment between shore and offshore work locations. As of 1990, there were 33 operating helicopter hubs, or major base locations, in the coastal areas of Louisiana, Texas, and Alabama. Most hubs (21) are located across coastal Louisiana. Eleven others are located in the Texas coastal area and 1 in coastal Alabama. Helicopter hubs in the CPA and WPA accommodate up to 46 helicopter pads. Under the Base and High Case scenarios, it is assumed that 3 and 8 percent, respectively, of existing heliport capacity is attributed to OCS operations.

(c) Pipeyards

The number of existing pipeline coating yards in the Central and Western Gulf is 9 and 8, respectively (Table IV-14). No new pipeline coating yards are projected to be constructed under the Base or High Case scenarios. The basis for this assumption is that current capacity can accommodate up to 1,440 km (900 mi) of pipeline installations per year, based on the lengths of offshore pipelines that have been installed in recent years. Projected new pipeline lengths under the Base and High Case scenarios will not result in this capacity being exceeded. Furthermore, during the past two years, four pipeline coating yards have closed in the Gulf area, indicating current overcapacity at pipe coating yards. Industry also does not foresee new expansion in these facilities (Jones, personal comm., 1991).

Because of the low cost of transporting coated pipe compared to the cost of the pipe, existing pipeyard locations can economically service pipeline projects in any area of the Gulf. There is not economic grounds, therefore, to construct new pipeyards in coastal areas with locational advantage to new pipeline projects offshore but currently having no existing facilities, such as in offshore Subarea C-4 or the southern part of W-3 (Figure IV-1). Under the Base and High Case scenarios, respectivley, two percent and three percent of the utilized capacity of pipeyards in the Gulf will be associated with OCS operations.

These facilities store and coat pipe that will be used for offshore pipelines. The external surfaces of pipes are coated with metallic, inorganic, and organic materials. These materials protect the pipe from external corrosion and abrasion and add weight to counteract buoyancy with a concrete coating. Although some pipes are coated on a lay barge as the pipe is being installed offshore, most coating occurs at an onshore facility.

Pipeyards are assumed to occupy 12 ha (30 ac) of land and can store up to 200 km (124 mi) of pipe. Most of the space needs of a yard (up to 95%) are for storing untreated and treated pipe. During some stages of the coating process, treated pipe may have to cure in storage for 3 weeks or more before it can be moved. The yards must be located along a navigable waterway that has an access channel with at least a 4.5-m (15-ft) draft. The major environmental impacts from pipeyard operations include water and air discharges from the coating process. Waste waters from a pipeyard can contain antifouling chemicals and a variety of contaminated process waters. Air emissions containing carbon monoxide, sulfur and nitrogen oxides, and particulate can occur as a result of routine processing operations, from leaks at seals and valves on storage tanks, and from vehicle emissions.

(d) Fabrication Yards

The number of platform fabrication yards located in the various coastal subareas in the CPA and WPA are 14 and 11, respectively (Table IV-14). No new platform fabrication yard construction is projected for the Base and High Case scenarios for the proposed actions. The bases for this assumption are the overcapacity of platform fabrication facilities in the Gulf, as witnessed by the closure of eight yards and the temporary idling of three more in the past few years, the increasing consideration being given by industry to the use of floating production facilities in deep-water areas, and a trend toward purchasing tension-leg platform hulls from overseas.

Platforms used in the development of offshore oil and gas fields are fabricated and assembled at platform fabrication yards and then towed to their offshore sites for installation. These platforms consist of an above and below water component, called the deck and the jacket, respectively. These components may be constructed at the same or at different yards. Because of the large size of these structures, access to a large navigation channel is of prime importance in the location of these facilities. As indicated in Table IV-14, the largest number of platform yards occur in coastal Subarea C-2, which includes the Atchafalaya River, a large, wide navigable river.

The primary activity at these yards is the shaping, cutting, and welding of the steel components of the offshore structure. Because of the size of the structure being constructed and the need for storage space for large amounts of steel, a platform fabrication yard typically occupies a large amount of coastal land. In this document, each fabrication yard is assumed to occupy 50 ha (124 ac). Three and five percent of the utilized capacity of fabrication yards in the Gulf are assumed to be associated with the Base and High Case scenarios, respectively.

The main environmental impacts from the routine operation of these facilities include the discharge of waste waters and storm runoff that may contain heavy metals and particulate and the discharge of air emissions that include sand and metal dust from sandblasting operations, hydrocarbons and organic compounds from paint evaporation, and carbon monoxide and sulfur and nitrogen oxides from equipment and vehicle operations. In addition, solid wastes containing metal scraps and debris will have to be disposed of.

(2) Processing and Storage Facilities

(a) Oil Refineries

The number of existing refineries in the Central and Western Gulf are 17 and 20, respectively (Table IV). No new refinery construction is projected as a result of the Base and High Case scenarios (Table IV-9). Sufficient refinery capacity exists in the area to accommodate OCS production from the proposed actions. Furthermore, because of the large capital expenses of establishing a new refinery, it is likely that, if needed, additional refinery capacity in the Gulf will be provided by increasing the capacity of existing refineries rather than constructing new facilities. These assumptions are consistent with the national trend in refinery operations during the past decade, which has shown a decrease in the number of refineries since 1981 from 324 to 202 (U.S. Dept. of Energy, 1991a). The Department of Energy (1991b) predicts little expansion of crude oil distillation capacity nationwide through the year 2010, based on increasing foreign competition in the refined oil products market and the regulatory difficulties of building new refineries near existing facilities because of new air quality legislation. Under the Base and High Case scenarios, 1 and 2 percent, respectively, of the utilized capacity of refineries are assumed to be associated with OCS activities.

A refinery separates the naturally occurring components of crude oil into marketable products such as diesel fuel, lubricating oil, and gasoline. The refining process includes a number of interdependent operations that receive crude oil; it separates the oil into components and then blends the components into petroleum-derived products. Large tracts of land are needed for a refinery to allow sufficient space for expansion and a buffer zone. In the Gulf area, each refinery complex occupies on average 405 ha of land. Factors that are considered in locating a refinery site are the availability of large quantities of water and the accessibility of nearby deep-water facilities for large crude-oil carriers.

In the Gulf of Mexico area, either oil is delivered directly to refineries from the OCS via pipeline or barge, or it is first delivered to an oil terminal via pipeline or barge and then piped, barged, or trucked to a refinery. Barge traffic makes extensive use of the Intracoastal Waterway and other inland waterways for transporting oil from terminals to refineries.

Impacts from routine refinery operations include visual and aesthetic degradation; air emissions including particulate matter, nitrogen and sulfur oxides, carbon monoxide, and volatile hydrocarbons; and waste-water discharges including hydrocarbons, alkaline substances, particulate, and metal fragments. In addition, the unloading of barges and trucks at a refinery introduces the chance of an accidental oil spill.

(b) Gas Processing Plants

The number of existing gas processing plants in the Central and Western Gulf that process OCS hydrocarbons are 26 and 2, respectively (Table IV-8). These gas processing plants are assumed to be exclusively devoted to processing OCS production. The high concentration of processing plants in the western part of the Central Gulf (coastal Subareas C-1 and C-2) is related to the occurrence of gas-prone tracts in nearby offshore areas.

It is assumed that the existing capacity of gas processing plants will be adequate to handle all new gas production under the Base and High Case scenarios. Presently, only 64 percent of the gas processing capacity of OCS-related facilities is being used. The decision to construct a new gas processing facility at a new pipeline landfall location would be based on numerous factors, such as the proximity to an existing facility, the quantity of gas available for processing, the composition of the gas (particularly with respect to the amount of valuable liquid components and impurities such as CO_2 and H_2S), and the current and projected market conditions for gas and gas products. No new pipeline landfalls, however, are projected to occur under either the Base or High Case scenarios.

Gas processing plants remove impurities from raw gas to preset standards of the purchasing utility before the gas is commercially distributed. Initial processing of the gas can take place at the production platform to remove oil and/or water prior to reaching the processing plant. Some processing plants are constructed to also recover certain saleable natural gas liquids such as butane, propane, ethane, and natural gasoline from condensate if these components are present in quantities that make extraction economically feasible. Liquids are removed from the gas stream by a process that cools the gas through refrigeration or through a lean-oil-absorption process. A gas plant can be located either at the shore or farther inland. A site near the coast is preferred because the greater distance that offshore gas travels through a pipe the more cooling will occur. Cooling can lead to the formation of hydrates in the line; this can obstruct the gas flow. Gas is delivered to and transmitted from processing plants via pipeline.

Land requirements for a gas processing plant are usually not large. Estimates are that a 1-MMcfd facility requires 20-30 ha (50-75 ac). Typically, in the Gulf, gas processing plants constructed to process OCS gas have been larger than plants constructed for onshore production. The average design capacity for existing OCS plants is 570 MMcfd compared to 151 mmcfd for facilities processing onshore production. There are no standard sizes or designs for a gas plant, however, because the plant is specifically designed for the particular gas stream it processes. The life span of a plant is usually 10-20 years, depending on the longevity of the gas reserves being processed.

The primary environmental effects of a gas processing plant include gaseous, liquid, and solid-waste discharges. Primary air emissions include sulfur and nitrogen oxides, hydrogen sulfide, carbon monoxide, volatile hydrocarbons, and particulate. Waste-water discharges can include dissolved hydrocarbons; sulfuric acid; and chromium, zinc, phosphate, and sulfite compounds. Solid wastes are composed of sludges, scales, spent desiccants, filtration media, and oil absorbents.

(c) Separation Facilities

No new facilities are projected for the Base or High Case scenarios of the two proposed sales. The existing facility capacities and locations are considered sufficient to support any usage projected from processing oil and gas produced as a result of the proposed actions. It is projected that any water-separation operations required as part of proposed Sales 142 and 143 activities will use about 3 percent of the capacity of the existing facilities under the Base Case, and 6 percent under the High Case scenario. Table IV-14 lists the subarea locations of the existing 63 separation facilities handling OCS oil along the Gulf Coast. Fifty of these existing facilities are located within Subareas C-1, C-2, and C-3 of the Louisiana coastal zone. About 6 ha (15 ac) are required for each 100,000 bbl of oil and associated gas processed.

Separation facilities, frequently called partial-processing facilities, are often located with terminals and/or gas processing facilities. Separation occurs to remove impurities from the crude oil or gas received at the terminal. Crude oil and gas coming directly from an offshore well must be separated and the water removed prior to being processed for final disposition. The liquid components of the well stream are partially processed to remove free and emulsified water, dissolved solids, and suspended solids from the crude oil. Once the crude oil is partially processed, it is delivered to a refinery for conversion into a range of petroleum products. The separation process may begin on the offshore platform and continue with further separation and treatment at onshore processing facilities; however, the process may take place totally offshore. Natural gas is often, but not necessarily, removed on the platform and handled at separate facilities.

Impacts from separation facilities are limited to the usage of the existing facilities. They include air emissions; the discharge of cooling and boiler waters, and domestic wastewaters; storm runoff; and noise. Hydrocarbons, hydrogen sulfide, sulfur oxides, and nitrogen oxides are the primary types of air emissions. Sources include evaporation from surge and storage tanks, combustion products from process machinery and vehicles, and leakage at valves and seals. Major water-quality contaminants discharged include suspended solids, oil and grease, heavy metals, phenols, halogens, and chromium. Noise levels can be as high as 96 dB from flare stacks and treating vessels.

(d) Terminals

Terminals are defined as the receiving station for liquid hydrocarbons transported from offshore platforms to shore. Most terminals are the landfall site of a pipeline, where a metering station is located and where storage facilities are expected to be found. Terminals can occur in association with a gas processing plant if liquid hydrocarbons are being extracted from the gas stream. Most of the 94 terminals receive hydrocarbons by pipeline. Only a few receive oil by barge. Oil projected to be shuttle tankered may be received by one of these 94 terminals if there are docking facilities present (many already receive imported crude oil tankers) or it may go directly to the terminal facilities connected to nearby refineries. Some of these terminals receive gas rather than oil. Gas processing plants and separation facilities are often associated with pipeline terminals. Once received, metered, partially processed, and stored at terminals, OCS crude oil is then shipped to refineries via pipeline, barge, or truck.

The size of a terminal and tank farm depends on the production rate of the fields supplying the terminal and the throughput rate of the pipeline(s) serving the terminal, as well as the size of the tankers projected to use the facilities and the number of days it may be necessary to store the oil before throughput. Most of the land required for a terminal and related tank farms is for the storage tanks. For example, a 1-MMbbl tank farm capacity requires 7 ha (17 ac) of land and a 35-MMbbl tank farm requires 23.5 ha (58 ac) of land (NERBC, 1976).

Because no trunklines are projected to transport oil or gas produced solely as a result of proposed Sales 142 and 143 and because barging operations are projected to remain static, no new terminals will be needed. Rather, about 12 percent of the capacities of the existing terminals are projected to be used to store and manage oil and gas coming ashore produced from Sale 142 and 143 leases under the Base Case, and 12 percent under the High Case. Table IV-14 locates by subarea the existing 94 terminals operating along the Gulf coastline--80 of these are in Louisiana and 14 are in Texas.

Because no new marine terminals are projected to be built as a result of the proposed actions, there will be no impacts from the construction of new marine terminals. Impacts from existing marine terminals result from routine air and water operational emissions and runoff from the altered terrain. The magnitude of air emissions, as well as all other environmental impacts from the operation of a terminal and the associated tank farm, will depend on the volume of delivery, types of storage tanks used, and operating equipment and procedures.

Sources of air discharges at a terminal include evaporation from storage tanks, evaporation from the transfer of crude oil and fuel, combustion products from process machinery and marine vessels, and accidental small spills and leakage, as well as exhaust emissions from boaters, sumps, and compressors (NERBC, 1976). Marine terminals generate domestic wastewater from employee housing, bilge and ballast waters from vessel traffic, cooling and boiler waters from the generation of electricity, and storm runoff.

b. Landings and Coastal Transport Operations

(1) Pipelines

Currently, 150 pipeline landfalls are located along the Louisiana coast and 19 along the Texas coast as a result of previous OCS development. No new pipeline landfalls or onshore pipeline projects are anticipated as a result of the Base and High Case scenarios. The basis for this assumption is covered in Section IV.A.2.b.(1). Briefly, it is assumed that the expense of installing an offshore trunkline and associated landfall requires development from more than one lease sale to be economically justified. It is assumed that production from the proposed actions will utilize the extensive existing pipeline network to route new hydrocarbon production through. Furthermore, the projected increased utilization of floating production systems and shuttle tankers in deeper waters will reduce the need for new pipeline landfalls.

Tables IV-4 and IV-5 show the projected amounts of liquid hydrocarbons that are assumed to be transported into the various coastal subareas of the Gulf as a result of the proposed actions. Most of the pipeline transported oil associated with proposed Sale 142 (86%) will be transported into and through coastal Subarea C-2. For proposed Sale 143, the pipeline transported oil is assumed to be more evenly distributed throughout the Texas coastal area, with a small amount arriving via pipeline in coastal Subarea C-2.

Pipeline landfalls are considered an impact-producing factor for several reasons. Installing and burying the pipeline in shallow nearshore waters can temporarily disturb bottom communities and seagrass beds and can increase coastal turbidity levels. Also, coastal scientists have postulated that the dredging of channels across coastal landforms, such as barrier beaches and wetlands, could alter coastal processes or create zones of weakness resulting in accelerated erosion or landscape changes in the vicinity of the landfall. Onshore, the dredging of pipeline canals results in the direct conversion of wetland habitat to open-water and spoil-bank habitats. The canals also can alter wetlands hydrology, resulting in wetlands impacts associated with saltwater intrusion and wetland water table alterations.

(2) Oil Barges

Landings

The number of projected barge trips from offshore platforms to onshore terminals for offloading is given for each coastal subarea in Tables IV-4 and IV-5. These trips are referred to as offloadings in the tables. Subarea C-1 will receive the majority of barged oil. Table IV-6 breaks down these barge trips by utilized waterways and the specific terminals where the offloading is projected to occur. Six terminals in Lake Charles, Gibbstown, Weeks Island, Gibson, Cocodrie, and Empire, Louisiana are presently receiving OCS barged oil and are expected to continue to receive oil from platforms located in both the WPA and the CPA. Three terminals, all located in Subarea W-2 in Texas (at Texas City, Galveston, and Port Arthur) will receive WPA barged oil. In the WPA, the Houston Ship Channel, Sabine Pass Ship Channel, and the Calcasieu Ship Channel will be utilized by the barge traffic carrying WPA oil.

Coastal Barging

The projected number of barge trips carrying OCS oil (Tables IV-2 through IV-6) represents barging from the production facility to terminals along the Louisiana and Texas coasts. It does not include barge traffic involving OCS oil between terminals or from terminals to refineries. Oil piped to shoreline terminals is often subsequently transported by barge up rivers, along the Gulf Intracoastal Waterway, and along the coast.

Impacts associated with coastal and inland barging activities are related to navigation channel usage, discharges from tugs pushing the barges, and possible spills. Once a barge carrying OCS-produced oil reaches coastal waters, the barge is often linked together with other barges; sometimes as many as three or four barges are pushed by one tugboat. Such activities increase channel-bank erosion. Crude oil spills from both the barging of OCS oil from platforms to the first offloading terminal and from the terminal along the coast are projected (Section IV.C.1.).

(3) Shuttle Tankers

Landings

The number of projected shuttle tanker trips from offshore platforms to onshore terminals for offloading, called oil landings, is given for each coastal subarea in Tables IV-4 and IV-5. Table IV-6 shows the number of shuttle tanker trips expected to occur along navigational channels going to major port areas. For the Base Case scenario of Sale 143, there are 66 shuttle tanker trips projected. This traffic will carry oil from floating production systems located in the WPA to onshore port areas. In Texas, there are projected to be 33 trips to the Corpus Christi area, 9 trips to Freeport, 14 trips to the Houston area, and 5 trips to Port Arthur. In Louisiana, 5 trips to Lake Charles and 2 trips to Mississippi River ports are projected. The two shuttle tanker trips projected to occur while carrying oil from CPA floating production systems associated with proposed Sale 142 will offload along the Mississippi River.

No oil is projected to be reloaded back on shuttle tankers and moved coastwise to other terminals.

Any environmental impacts from shuttle tanker activities in the coastal area is related to the risk of oil spills (Section IV.C.). The greatest risk of spill occurrence is at a terminal during offloading and onloading operations.

(4) Navigation Channels

The OCS oil and gas industry uses the extensive waterway system located within the Gulf Coast States to provide access between onshore support operations and offshore platforms and rigs. Vessels moving along coastal navigation channels include crewboats, supply boats, barges, derrick vessels, geophysical-survey boats, and floating production platforms, etc. Navigation channels serve as routes for service vessels traveling back and forth from service and supply bases. Also, the channels may be traversed by barges carrying oil from the OCS or between terminals, may be used for transporting platforms and pipelines, and may provide access to oil-spill cleanup equipment stored at coastal ports. In this document, it is assumed for analytical purposes that OCS-related facilities are located, on an average, 25 km inland from the coast along a navigation channel.

Table IV-6 provides projections of the average usage of all major navigational channels along the Gulf Coast in support of OCS activities as a result of the proposed actions. Six of these channels are used by the OCS oil and gas industry more than 0.1 percent of the time: Bayou Lafourche, Empire Waterway, Bayou La Loutre/St. Malo/Ycloskey, Vermilion Bay/GIWW 159-160, the Houma/LeCorpe/Caillou waterway, Bayou Terrebonne (Bayou Terrebonne usage is aggregated with the Houma/LeCorpe/Caillou waterway in Table IV-6), and the Atchafalaya River/GIWW 79-95. All of these waterways are located in Louisiana. It is assumed that OCS usage of these channels under the Base and High Case scenarios will account for 0.2 and 0.4 percent, respectively, of the total vessel usage of these channels. The maximum percentage usage of a channel for OCS activities as a result of the proposed actions is 2.2 percent for the Houma/Caillou/Terrebonne waterway.

c. Onshore/Coastal Impacting Factors Related to the Proposed Actions

(1) Disturbances from Use of Existing Infrastructure

The infrastructure and facilties described above generate emissions and wastes that can affect the coastal environment. Other activities associated with onshore infrastructure that could affect the coastal environment include the movement of oil via pipeline, barge, and shuttle tanker; the offloading of oil at terminals; and the use of navigation channels by OCS-related traffic.

(a) Nonpoint Source Discharges

The operation of onshore facilities used in support of the proposed actions is expected to result in some routine nonpoint source pollution. The facility's presence, along with access routes, alters the natural hydrology and geography of the area over time. The volume and rate of stormwater runoff will remain greater than before construction; saltwater intrusion may occur; and, with existing vegetation modified, greater erosion around the facility may take place.

Increases of nonpoint source pollution due to runoff at support facilities may contribute particulate matter, heavy metals, petroleum products, chemicals, and radionuclides (particularly from pipeyards) to local streams, estuaries, and bays, causing temporary elevations in pollutant and turbidity levels. Two major pollutants are contained in this runoff--suspended solids (organic and inorganic) from exposed soil at the site and contaminants such as heavy metals.

(b) Operational Discharges

The supporting existing infrastructure contributes routine and accidental point source discharges to the surrounding bodies of water. Specific contaminants in operational discharges are discussed under each facility description. At service bases and marine terminals, hydrocarbons and other pollutants are discharged in the bilge and ballast waters of support vessels docking at these facilities. The bases and support vessels also contribute contaminants through their use of antifouling marine paints, through accidental oil-spillage events, and through the release of heavy metals and contaminated sludge. Pipecoating yards, platform-construction facilities, and repair and maintenance yards contaminate surrounding waters by releasing thermal effluents, radioactive substances, antifouling paint chemicals, heavy metals, and a variety of process waters, as well as solid waste such as packaging materials, metal scraps, and other debris. Gas processing plants and refineries discharge a number of types of wastewaters, including cooling and boiler waters, sanitary and domestic wastewaters, and process waters. These waters may be contaminated with dissolved hydrocarbons, sulfuric acid, chromium, zinc, phosphates, alkaline substances, and suspended solids.

Cooling water represents a significant proportion (70-100%) of the wastewater effluent from an oil refinery or gas processing plant. Chemicals added to the cooling water stream to reduce corrosion and fouling within the tower and the condenser system (including chromium and chlorine) may be extremely toxic to aquatic organisms. Domestic wastewater from support facilities will be collected and delivered to a municipal treatment plant or will receive secondary treatment in an onsite package treatment plant. Secondary treatment includes chlorination prior to discharge to the receiving waters. Receiving waters, also containing high organic carbon concentrations, will produce organic chlorine compounds (e.g., chloroform and chloramines), which are highly toxic to certain aquatic organisms.

Although it does not constitute the greatest volume of water used in refining operations, process water may be the most contaminated. The processing pollutants are added during crude-oil desalting, steam distillation, steam stripping, etc. Process water discharged from plants is of considerable volume and is highly toxic due to its anaerobic and highly reduced character and the presence of numerous heavy metals (primarily three toxic metals--mercury, cadmium, and cyanide), sulfides, and ammonia, which are produced together with the oil and gas.

The NORM deposits may also accumulate in gas-plant equipment, separation facilities, and pipeyards. In gas-plant equipment, NORM deposits may accumulate from radon-222 (radon) gas progeny. The gas is dissolved in the organic petroleum fractions in the gas plant and partitioned mainly into the propane and ethane fractions by its solubility (Rogers & Associates Engineering Corporation, 1990). Components having the highest levels of NORM include reflux pumps, propane pumps and tanks, and other pumps and product lines. In separation facilities where the separation of water occurs onshore, water handling equipment can become contaminated with NORM. Heater treaters, water knockouts, liquid product tanks, separators, tubing and piping, water transfer pumps, and other produced-water handling equipment accumulate radium isotopes in the form of scale.

The environmental impacts of operational discharges, particularly wastewater effluents, from OCS-related onshore facilities can be both lethal and sublethal. Contaminants could alter localized water quality, decrease photosynthesis of surrounding wetland vegetation, and affect fish resources. Onshore point source discharges will be subject to treatment by municipal and industrial facilities in compliance with Federal and State discharge permit requirements.

(c) Air Emissions

Onshore air emissions related to OCS activities result from the combustion of fuels, the evaporation and processing of crude oil, and the sweetening of natural gas. Combustion emissions are derived from helicopter and service vessel traffic to OCS facilities. These air emissions from helicopters depend on the number of trips and type of helicopters or vessels. Emissions from evaporation result from the transport and offloading of crude oil at terminals and from the fugitive emissions from refining facilities. Offloading air emissions refer to vapor formed over the crude oil in the storage tank and during the offloading. These emissions depend on the ambient temperature, mode of loading into the tanks, physical and chemical characteristics of the liquid, length of transit, and emission control techniques employed. Fugitive emissions occur from leaks in valves, flanges, pump seals, cooling towers, and oil-water separators.

Refining of crude oil is a multiple-step process. Emissions during refining occur in eight of these processes: vacuum distillation, catalytic cracking, thermal cracking, utility boilers, heaters, compressors, blowdown systems, and sulfur recovery. Emissions from gas processing occur only if wastes from the sweetening process are flared. The USEPA publication AP-42 (USEPA, 1985), in conjunction with estimates of OCS oil and gas to be processed in these plants, will be employed to estimate the air emissions from these operations. It is important to remember that most of the refining and gas processing facilities have control emission techniques installed, which will reduce the amount of pollutant emitted. The amounts of air emissions from these activities is shown in Tables IV-2 and IV-3.

(2) Disturbances from New Infrastructure Emplacement

New infrastructure emplacements could involve the construction of any of the onshore infrastructure facilities described above in Section IV.A.3.a. The construction of these facilities could result in the conversion of wetlands habitat to dry land as a result of filling operations to prepare the construction site. Construction of facilities on barrier beaches could alter coastal sedimentation and erosion patterns if the site was protected from erosion by armoring of the site.

New pipeline landfalls can result in direct and indirect impacts to coastal wetlands. These impacts have been discussed in Section IV.A.5.(3)(a) of the Final EIS for Sales 139 and 141 and are hearby incorporated by reference. The direct impacts of new pipeline installation projects in wetlands have been reduced in recent years by virtue of new pipeline projects being backfilled after the pipeline is installed. Backfilling, by partially filling in the canal cut and levelling spoil banks, reduces the amount of wetland area converted to nonwetland habitat and reduces indirect impacts by reducing saltwater intrusion and removing the drainage interference effects of spoil banks. Turner and Cahoon (1987) have shown a reduction from 2.49 ha/km of average direct impacts in the past to projected impacts of 0.68 ha/km in the Chenier Plain and 1.05 ha/km in the Deltaic Plain with backfilling.

(3) Vessel Usage of Navigation Channels

(a) Channel Bank Erosion

Once dredged, navigation channels can continue to cause impacts to adjacent wetlands by widening of the channel. Johnson and Gosselink (1982) have shown that channels with high navigation usage in coastal Louisiana widen about 1.5 m/yr more rapidly than channels with little usage. The OCS traffic under the Base

Case scenario is assumed to account for only 0.2 percent of the vessel traffic in coastal channels and a proportionate contribution to the overall channel widening problem along the coast.

(b) Vessel Operational Discharges

While spills capture the attention of the general public, operational discharges occurring from vessel transportation of oil account for the majority of oil discharges. The National Academy of Sciences' report (NRC, 1985) estimated that total losses of oil from transportation activities ranged from 7.4 to 19.2 MMbbl per year, with a best estimate of 10.7 MMbbl per year. About one-half of this amount is attributed to ballast water operational discharges from oil tankers (about 5 MMbbl annually); the remainder is attributed to bilge water and fuel oil released from all vessel movement in the ocean (about 2 MMbbl annually), terminal operations (about 150,000 bbl annually), dry-docking (about 222,000 bbl annually), and accidental spills (about 3 MMbbl annually). New regulations, promulgated under the international protocols provided by MARPOL 73/78 (33 CFR 157), have significantly limited operational discharges (ballast waters) from oil tankers and now require onshore receptacles. 33 CFR 157.10B specifically provides even greater restrictions on oil tankers carrying OCS produced oil. Because of this, it is assumed that all ballast and bilge waters from the projected OCS tanker operations will be discharged into onshore receiving stations.

Support vessels servicing the OCS industry offshore are expected to discharge oily bilge waters into the water. Volumes of bilge waters discharged from service vessels are expected to result in very low levels of open-water contamination. Given the small inputs anticipated, the widespread nature of the receiving waters, and the assimilative capacity of water, it is expected that there will only be some localized, short-term changes in open-water, chemical characteristics. However, there is a potential for impact when the discharges occur in confined waterways.

Bilge-water discharges can be calculated from the following equation (NERBC, 1976):

$$Q = 0.004T$$

Where Q = average bilge water generation rate (gals/min) and T = deadweight tonnage (dwt) of vessel.

Turner and Cahoon (1987, Vol. III) estimated that 68 percent of the workboats fall into the large category, about 55 m (180 ft) in length. Assuming that an average trip within the coastal zone for service vessels is four hours and knowing that a 180-ft supply boat weighs 900-1,000 dwt (Caruso, personal comm., 1989), a boat with these characteristics would discharge 3,600 liters of bilge waters into navigation channels in the coastal zone. Smaller boats (32% of the fleet) would discharge 2,200 liters per trip into coastal waters. Tables IV-4 and IV-5 provides volumes of bilge waters discharged from service vessels in coastal waters as a result of the Base Case and High Case for proposed Sales 142 and 143.

(c) Maintenance/New Dredging

Dredging must be done periodically to maintain navigation channels at their design depth. Data on the frequency of maintenance dredging in channels used by OCS traffic (Table IV-6) are in the process of being compiled from U.S. Dept. of the Army Corps of Engineers records and are not available for this Draft EIS. This document assumes that the navigation channels listed in Table IV-6 will be maintenance dredged every other year during the life of the proposed actions. This document assumes that 0.2 percent of the vessel traffic in these channels can be allocated to OCS activities under the Base Case scenario, and 0.4 percent under the High Case scenario.

In addition to dredging done to maintain channel depths, dredging to deepen existing channels could occur. The movement of OCS activities into deeper water areas of the Gulf has created the need for larger and deeper draft service vessels. Under current conditions, only Galveston, Texas, and Berwick (near Morgan City), Louisiana are considered to have deep enough access channels (5.5-6.7 m) to accommodate the largest vessels that industry anticipates using in the future. Venice and Cameron, Louisiana are considered marginal under current conditions. The New Orleans District of the U.S. Army Corps of Engineers has been studying the feasibility of deepening the access channel to Port Fourchon to provide access for deep-draft service vessels (U.S. Dept. of the Army, COE, 1991). Based on the distribution of expected deep-water resources in the Gulf, it is assumed that two channels will be deepened to 6.7 m (22 ft): one at Pass Fourchon and one in onshore Subarea W-1 in the Corpus Christi, Texas, area.

Maintenance dredging and channel deepening could affect water quality, wetlands, barrier beaches, archaeological resources, and coastal birds and endangered species. The impacts of maintenance dredging and channel deepening will be allocated to the proposed actions according to the 0.2 and 0.4 percent figures given above for the Base and High Case usage of channels.

(4) Onshore/Coastal Disposal of Offshore Oil and Gas Industry Operational Wastes

If OCS drilling and production wastes cannot meet the U.S. Environmental Protection Agency's NPDES effluent limitations or if these limitations require zero offshore discharge, offshore operational wastes must be transported to shore for onshore disposal. If USEPA finalizes its proposed effluent limitations, these limitations would greatly increase the amount of both drilling and production wastes brought onshore.

In general, offshore wastes not discharged are either piped ashore or loaded on supply boats or barges and transported onshore to industry shorebases. Once onshore they are loaded on trucks or barges to reach a commercial waste disposal facility. Onshore disposal alternatives include landspreading, landspreading with dilution, burial with unrestricted site use, disposal at a licensed commercial oil-field waste site (NOW site), burial in plugged and abandoned wells, well injection, hydraulic fracturing, or injection into salt domes.

Regulation of onshore waste disposal is considered beyond the jurisdiction of MMS and rests more with the States. The MMS operating regulations (30 CFR 250.33(b)(9)) do address oil and gas wastes requiring oil and gas operators to identify quantities of wastes generated and disposal approaches in the Exploration Plan documentation. Likewise, documentation submitted in support of Development and Exploration Plans (30 CFR 250.34 (b)(8)(c) (iii)) requires disclosure of waste handling and disposal procedures. Furthermore, Section II.B.8.2 of NTL 86-09, "Environmental Report Information Regulations," specifically directs industry to disclose waste handling and disposal procedures. At this time, industry in the Gulf of Mexico only generally addresses their onshore waste disposal plan by stating that State-approved landfill and disposal sites will be used. The MMS conducts a postlease environmental analysis on such exploration and production plans, and these plans are reviewed by the States for consistency determination.

Waste disposal is one of the most difficult problems expected to face the United States public in future years. There is considerable concern in the Gulf region about OCS waste onshore disposal practices, primarily because of known past impacts to land use and water quality from these practices.

In 1987, USEPA researched onshore oil and gas waste disposal and found considerable environmental damage around disposal sites in the Gulf area from improper regulations and management practices (USEPA, 1987; Hall, 1990; Subra, 1990). A USEPA report to Congress summarized these damages: "The principal types of damage sometimes caused by these wastes include contamination of drinking-water aquifers and foods above levels considered safe for consumption, chemical contamination of livestock, reduction of property values, damage to native vegetation, destruction of wetlands, and endangerment of wildlife and impairment of wildlife habitat" (USEPA, 1987). Subra (1990) documented the damage caused by commercial facilities located in Vermilion Parish, Louisiana, and reported that three of these facilities are now on the Superfund list. The USEPA is working with the states to improve or implement regulations to control the management of oil and gas wastes (Tonetti, 1990). It is assumed that there will continue to be some future environmental damage near some disposal facilities that will be used by the OCS industry.

Besides environmental impact from site contamination, onshore waste disposal can affect land use. In particular, the State of Louisiana has expressed considerable concern regarding insufficient waste facility capacity to handle future wastes. Furthermore, the State of Louisiana has recently received several requests for landfills to be located in wetland areas. These landfills could receive both commercial (inclusive of OCS wastes) and residential wastes (Demond, personal comm., 1991).

In general, most oil-field operational wastes, such as produced sands and drilling muds, are disposed of in the Gulf area at designated oil-field waste commercial facilities, usually called NOW sites. Oil-field waste disposal is regulated by the State of Louisiana, who requires that most operational wastes be disposed of at NOW facilities permitted by the State of Louisiana. In order to improve our understanding of solid-waste disposal, MMS completed an analysis to evaluate the capacity of such solid-waste disposal facilities located along the Gulf Coast to handle future onshore waste disposal. Section IV.B.1.c.(3)(c) is an analysis of the capacity of NOW sites to handle future generated oil-field wastes. (The disposal in onshore landfills of common trash and debris generated from the OCS oil industry is discussed separately below). The MMS analysis shows that there is ample capacity to dispose of all future wastes projected to require onshore disposal and generated by the total OCS program. Given this, it is assumed that there is sufficient capacity to dispose of future waste projected to require onshore disposal and generated by the proposed actions (a subset of the total wastes projections).

One exception to this analysis is the onshore disposal of NORM-contaminated wastes. One of the most pressing regulatory concerns involves finding ways to safely dispose of the rapidly accumulating volume of stored NORM-contaminated waste generated during the oil and gas extraction process. Section IV.A.2.d.(5) discusses the issue of NORM contamination in general and provides known levels of NORM in each waste type.

The offshore operational wastes of particular concern are production solids and equipment because the MMS assumes that all production solids and used equipment will be brought onshore for disposal. Prior to 1989, production solids disposed of onshore (industry estimates about 20-25% of production solids was discharged overboard) were disposed of at commercial oil-field wastes sites. Used equipment was discarded or recycled at pipeyards. In 1989, the State of Louisiana, Department of Environmental Quality adopted NORM regulations that established strict disposal requirements for all NORM materials emitting radiation greater than 50 microREMS per hour. The State of Texas is in the process of developing similar regulations. Operators of NOW sites have interpreted these regulations to apply to receipt of oil-field operational solid wastes and are not, in general, accepting any solid material with radioactivity greater than 50 microREMS per hour.

Rejection by NOW site operators has left very few disposal options available for NORM-contaminated materials for the Gulf of Mexico area oil industry. (In this discussion, NORM-contaminated wastes are defined as wastes that do not meet the requirements for overboard discharge outlined in the December 11, 1991, LTL discussed in Section IV.A.2.d.(5) and that are rejected by NOW operators.) At present, the majority of operators are storing NORM-contaminated material in approved waste disposal drums and stockpiling the material at shorebases until suitable disposal methods are found to avoid future liabilities. There is only one waste disposal site in this country that will accept diffuse radium waste; this site is located in Utah. Transporting NORM-contaminated materials across State lines is difficult because of regulatory concerns.

The MMS has devoted an extensive amount of time and energy examining a number of disposal options proposed by industry and, by developing the LTL, is now approving some offshore disposal of production solids. Overboard disposal of production solids with low levels of radiation should help mitigate the increasing onshore storage problem. It is noted that the preferred option in USEPA's proposed effluent limitation guideline regulations, which will supersede the MMS requirements, is zero offshore discharge of produced sands, and this is the assumed disposal option analyzed in this document.

Proposed disposal options being considered by MMS at this time include encapsulation of contaminated tubular goods and solids downhole in wells that are to be "plugged and abandoned" and the downhole disposal of NORM-contaminated materials into a depleted reservoir. The second option particularly applies to the reinjection of materials currently stored in drums onshore. These materials would be mixed with mud prior to transport offshore for reinjection. At present, the State of Louisiana has denied consistency for the onshore component of this activity.

Both industry and the State of Louisiana are gathering data on the number and location of drums containing NORM oil-field wastes and contaminated pipe stockpiles, but no statistics are currently available. Solids being stored at shorebases in drums should not be impacting land use or resulting in contamination of the surrounding environment if the material is properly stored. This is not the case with existing pipeyards projected to be used for future OCS operations. Louisiana has recorded over 600 sites (estimates are up to

2,000 sites) contaminated by previously, improperly disposed of NORM wastes (Zaloudek, personal comm., 1992). Although many of these sites are well operators, sites include many of the pipeyards used by the OCS oil industry. There will be restricted future land-use options for the land now used by such pipeyards.

There is also a growing concern among the public that there are an increasing number of incidents of improper disposal of these wastes triggered by the storage problem. For example, incidents of scrap metal being improperly sent to mills lacking radiation monitoring or of solids taken to municipal landfills or dumped in rivers (Raloff, 1991) have been recorded.

In conclusion, future onshore disposal of OCS-generated wastes contaminated with NORM are not expected to significantly impact land use or environmental resources. Any documented contamination of existing sites occurred due to historical practices. It is assumed that the OCS industry will properly dispose and store its wastes, whatever the final solution. The MMS reporting requirements listed in the NORM Letter to Lessees should ensure such practices. In general, concerns related to final safe disposal and transport of NORM-contaminated wastes is being addressed on a national level, but answers are not expected to be forthcoming in the very near future.

The following discussions provide further information on specific types of OCS offshore operational wastes disposed of onshore.

(a) Produced Waters

Some of the water produced from oil and gas operations associated with the proposed actions is projected to be piped ashore into Louisiana and then disposed. It is estimated that about 11 percent of produced waters generated as a result of Sale 142 will be brought to Louisiana for disposal in Subarea C-3 (Table IV-4; 34,071,000 bbl). However, disposal methods to be used are expected to be different from past practices because of recent regulatory changes.

Regulatory changes expected or already implemented are based partly on the results of a number of recent studies documenting high localized effects of produced-water discharges in poorly flushed coastal waters and partly on the public's increased awareness of the environmental consequences of produced waters discharged into coastal waters. Both the State of Louisiana and USEPA have new stricter regulations for nearshore or coastal discharges of produced waters. The State of Louisiana promulgated regulations banning the discharge of produced waters in most inland, coastal waters, unless the discharge is in compliance with State effluent limitations. The new regulations became effective in April 1991 with a 4-year compliance schedule for industry (6-year compliance if an operator can show economic hardship). The USEPA's proposed effluent limitations have a preferred option restricting oil and grease content in produced waters to lower quantities in waters within 4 mi from shore (USEPA, 1991), rather than beyond 4 mi. It is also expected that USEPA will also develop stricter requirements for produced-water discharges as part of their NPDES for coastal oil and gas production oil and gas operations. The proposed NPDES has not yet been published.

Given this regulatory climate, MMS has projected a significant decrease in the volumes of produced waters currently shipped onshore. However, MMS still assumes that some water will be brought onshore and disposed of by State-approved methods. The MMS's projection of 11 percent onshore disposal is based on the following: (1) it can be more cost effective to collect production from many wells or several fields for separation at a centralized facility; (2) it is more costly to construct and operate separation facilities on offshore platforms, especially in deep waters; (3) industry has argued that they cannot meet the USEPA 4-mi stricter limitations and might opt to dispose of their produced waters generated within 4 mi of shore at onshore Louisiana facilities; and (4) a knowledge of the future operating plans for the 15 largest, existing coastal OCS produced-water separation facilities identified in the Rabalais et al. (1991) study. Presently, these facilities either receive production streams from several pipeline systems serving a number of fields and operators or they are field specific. For instance, the Fourchon terminal currently receives produced waters from 20 blocks. All of these facilities have consulted with the State of Louisiana and are adopting their discharge practices accordingly. Two are shutting down. Two of these sites, the Grand Isle and Sabine Pass separation facilities, will inject future produced waters into wells. The remaining facilities have or are relocating their discharge outfalls to locations that are not prohibited by the State of Louisiana. They will discharge into State open waters, the Mississippi River or its passes, or OCS waters.

Only the four facilities that receive produced waters from a number of fields and whose management indicated that they are upgrading and expanding with the possibility of receiving produced waters from deep-water tracts will be considered in the Base and High Case assessments. These facilities, located at Grand Isle, Pass Fourchon, near the Mississippi River, and in Sabine Pass, will receive produced waters from future leases associated with Sales 142 and 143, and Sale 142 and 143 produced-water coastal disposal will occur by reinjection or discharge into the Mississippi River.

The projected volume of OCS produced water disposed of onshore was also calculated based on a number of assumptions. First, no produced waters associated with gas production will be transported to State waters. Second, projected oil platforms located near pipeline systems supporting the four major separation facilities have a 50 percent chance of tying into these systems in the future. Third, the separation facilities will continue to operate 35 years into the future, disposing of produced waters by the methods recently approved by the State of Louisiana.

In summary, no surface-water discharge of OCS-generated produced waters into inland coastal waters and open bays is projected. Because none of these facilities will be discharging produced waters into State waters (with the exception of the Mississippi River), no impacts to coastal environmental resources are expected from onshore disposal of produced waters generated as a result of production from proposed Sales 142 and 143.

(b) Production and Drilling Solids

It is projected that 18 percent of drilling muds and cuttings generated from drilling operations associated with the proposed actions will be shipped onshore for disposal. This projection is based on the following assumptions: (1) oil-based drilling muds will be used when drilling wells beyond 10,000 ft in depth; (2) exploration and delineation wells will be drilled to an average of 13,500 ft; (3) all oil-based muds will be shipped onshore; and (4) the proposed effluent limitations preferred options will be finalized, i.e., all muds generated within 4 mi from shore will be shipped onshore. Total quantities of drilling muds and cuttings disposed of onshore are provided in Tables IV-4 and IV-5. It is projected that 100 percent of production solids (sands and vessel sludges) will be disposed of onshore. This is based on the fact that USEPA's proposed effluent limitation for produced sands is zero offshore discharge. Section IV.A.2.d.(5)(d) discusses produced solids in more detail.

No projections of quantities of oil-field pipe brought onshore are made. After production ceases, oil-field pipe has routinely been pulled from the formation and brought to pipeyards to be stacked and reamed out for later reuse. Recently passed Louisiana regulations establish guidelines to protect workers at pipeyards. Previously, workers employed in the area of cutting and reaming oil-field pipe and equipment may have been exposed to health risks associated with inhalation and/or digestion of dust particles containing elevated levels of alpha-emitting radionuclides. It is assumed that future pipe may remain in place and will only be recycled if all NORM worker safety regulations are met.

(c) Other Solid Wastes

Besides drilling and production wastes, the State of Louisiana has expressed concern for the transport to shore of other types of solid wastes, such as mud bags, drums, crates, and a variety of domestic wastes that are often disposed of at municipal landfills.

No estimate of the volume of trash and debris generated on the OCS is currently available. Such trash and debris, when brought onshore for proper disposal at State-approved landfills, may add to the growing problem of existing landfill capacity and potential for future expansion. Solid-waste disposal impacts are a cumulative issue related to all future OCS Program activities (Section IV.B.3.c.(4)).

The MMS has been very active in promoting industry reduction. Our agency issued NTL 86-11, *Guidelines for Reducing or Eliminating Trash*, recommending operators and their contractors and subcontractors develop and implement proper trash handling education and training programs. The NTL also recommended reduction and compaction for all waste materials sent to onshore disposal sites. In May 1990, MMS contacted all lessees and operators and strongly encouraged use of large containers/bulkstorage offshore. Recent evidence available from industry indicates a widespread cooperation with our recommendation.

(5) Offshore Coastal Spills

The impact from oil spills associated with the OCS oil leasing program to the environmental resources identified in this document is one of the greatest concerns identified by the public. Although beyond the regulatory authority of MMS, spills can occur from onshore activities supporting the production of OCS oil and gas. Impacts from those spills are analyzed in Section IV.D. These spills are most likely to occur at coastal or onshore storage and processing facilities, particularly at the terminal transfer points and from coastal pipelines and barges moving OCS oil to processing facilities. Because MMS does not maintain records of these spills, the U.S. Coast Guard database on spills was used. This database does not distinguish the source of the spill incident, so projected onshore spill occurrences occurring from proposed action activities are estimates of the likely subset of the larger database. Assumptions of a spill occurring from the Base and High Case scenarios for proposed Sales 142 and 143 are provided in Section IV.C.1.

B. CUMULATIVE SCENARIO

The CEQ regulations require a cumulative impact analysis to be completed as part of an EIS on a particular proposed action. This analysis analyzes "cumulative" actions, defined as other past, present, and reasonably foreseeable future actions, both Federal and nonfederal (40 CFR 1508.7), that when added with actions resulting from the proposed actions result in an incremental impact to the resources of concern. The time period that these future impacts are examined is limited to the time of the proposed actions (1993-2027), and the resources analyzed are those identified as potentially being impacted from the proposed actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. This cumulative scenario provides characteristics and assumptions about potentially impact-causing events that could result from activities related to the following: future OCS program operations in addition to those resulting from the proposed actions; State oil and gas activities; other major offshore activities such as military operations, sulfur production, and marine transportation; and other major coastal activities such as river modification projects, municipal impacts, and natural subsidence of wetlands.

The Gulf of Mexico OCS Region has formulated the following hypothetical scenarios to provide a framework for assessing the additive effects of such future actions with the impacts of the proposed OCS oil and gas lease sales in the CPA and WPA (proposed Sales 142 and 143, respectively).

1. Exploration, Development, and Production Scenario and Assumptions for the OCS Leasing Program

Tables IV-7 through IV-15 present estimates of the major activities and impact factors related to future OCS Program operations in the Gulf of Mexico. The OCS Program activities are defined as all oil and gas activities occurring in the Gulf of Mexico during the life of the proposals as a result of past, proposed, and future sales on the OCS. Activity that takes place beyond the 35-year timeframe due to future sales is not included in this analysis. Section IV.A.1. provides more information on the criteria considered in the formulation of the resource estimates that have been developed.

a. Resource Estimates and Timetables

Central Planning Area: Estimates of total resource production related to the proposed action plus prior and future sales in the planning area (total OCS Program) over the period 1993-2027 are 5.46 BBO and 50.29

Western Planning Area: Estimates of total resource production related to the proposed action plus prior and future sales in the planning area (total OCS Program) over the period 1993-2027 are 1.21 BBO and 22.50 tcf of gas (Table IV-1). It is projected that during this period approximately 70 percent of the total oil and gas resources and reserves available in the WPA at the time of the proposed action will be produced.

Eastern Planning Area: Estimates of total resource production related to prior and future sales in the planning area (total OCS Program) over the period 1993-2027 are 0.19 BBO and 1.05 tcf of gas. It is projected that during this period approximately 20 percent of the total oil and 60 percent of the total gas resources and reserves available in the EPA in 1993 are produced.

b. Description of Offshore Operations and Impacting Factors

Existing offshore infrastructure related to the oil and gas industry is highly concentrated in the CPA and WPA. To date, only OCS exploration activities have taken place in the Eastern Gulf of Mexico. Tables IV-7, IV-8, and IV-9 provide estimates of existing offshore structures, actual 1990 installations, and projected installations for the CPA, WPA, and EPA.

Tables IV-7 through IV-11 show the magnitudes of projected offshore infrastructure and the impact factors or agents that are projected to occur in the various offshore subareas of the CPA and WPA from the future OCS Program activities during the 35-year life of the proposed actions. In addition, these tables provide a breakdown of these impact-producing factors by offshore subarea. Note that even though some offshore subareas do not have development activity indicated, they would have potential for development under a more favorable economic climate. Because of this fact, one can reasonably assume that exploration could take place in these subareas.

(1) Offshore Infrastructure and Activities

(a) Surveying/Seismic Operations

In addition to postlease seismic surveys that result only from the proposed actions, prelease seismic surveys from on-going OCS activity may be conducted on a speculative basis. (For further discussion of seismic operations, see Section IV.A.2.a.) Prelease operations are conducted by major seismic companies to survey unleased areas or to resurvey leased areas using new technology. Prelease speculative surveys and resurveys are conducted to locate and/or examine areas of hydrocarbon potential. The resulting information is offered for sale to the Gulf of Mexico oil and gas industry and is made available on a confidential basis to MMS, Office of Resource Evaluation. All prelease surveys, resurveys, or speculative surveys done on postlease areas are reviewed and permitted by MMS, Office of Resource Evaluation. In 1990, 155 (226,334 km) prelease/speculative seismic surveys were permitted in the CPA and 63 (78,367 km) were permitted in the WPA (Brinkman, personal comm., 1991). From January 1 through September, 1991, 78 (168,947 km) of these surveys were permitted in the CPA and 32 (37,470 km) were permitted in the WPA (Brinkman, personal comm., 1991). It is assumed that all seismic operations will be nonexplosive and that there will be a maximum of 150 prelease seismic surveys per year in the CPA and 50 per year in the WPA as a result of all future OCS activity. However, the rates assumed are based on 1990 data; one year's data collection. It is expected that prelease surveys will decline at an unknown rate for the next 35 years, in parallel with declining oil and gas development.

(b) Drilling Rigs and Platforms

Section IV.A.2.a.(2) provides general information regarding assumptions and descriptions about the three phases of activity required to produce oil and gas resources: exploration and delineation, development, and production. To discover and develop resources in the CPA will require the drilling of 5,890 exploration and delineation wells, the emplacement of 340 new platform complexes, the use of 3,422 existing platforms, and the drilling of 5,130 oil and gas development wells (Table IV-7); to discover and develop resources in the WPA

Table IV-7

Offshore Scenario Information Associated With OCS Program Activities in the Central Planning Area for the Years 1993-2027

Offshore (Total / Peak Year**)	Total to Date	1990 Annual	C-1 OCS Program Activities (Offshore Subarea*)	C-2 OCS Program Activities	C-3 OCS Program Activities	C-4 OCS Program Activities	Total CPA OCS Program Activities
Wells Drilled:							
Exploration and Delineation Wells	7,430 /	308	750 / 51	1,695 / 115	1,970 / 134	1,475 / 100	5,890 / 400
Development Wells***	17,163 /	420	785 / 36	1,565 / 72	1,790 / 82	990 / 45	5,130 / 235
Oil Wells	9,397 /	188	470 / 21	925 / 42	1,165 / 53	530 / 24	3,090 / 140
Gas Wells	7,766 /	232	315 / 15	640 / 30	625 / 29	460 / 21	2,040 / 95
Platform Complex Installations							
Number Installed	3,422 /	57	52 / 3	98 / 6	117 / 8	73 / 5	340 / 22
Space Use Loss (ha during 35 yrs)	NA /	NA	164,700 /8,520	85,068 /4,158	51,270 /2,448	0 / 0	301,038 /15,126
Structure Removals Using Explosives	NA /	NA	936 / 48	538 / 27	435 / 21	2 / 1	1,887 / 94
Method of Oil Transportation							
Percent Piped	NA /	NA	NA / NA	NA / NA	NA / NA	NA / NA	97%/ 97%
Percent Barged	NA /	NA	NA / NA	NA / NA	NA / NA	NA / NA	3%/ 3%
Percent Tankered	NA /	NA	NA / NA	NA / NA	NA / NA	NA / NA	<1%/ <1%
Shuttle Tanker Traffic (trips)	0 /	0	0 / 0	0 / 0	41 / 2	4 / 1	45 / 2
Barge Traffic (trips)	NA /	NA	3,109 / 136	228 / 10	3,488 / 153	0 / 0	6,828 / 299
Pipeline Length (km)	28,595 /	1,215	530 / 31	1,395 / 84	2,125 / 128	1,005 / 62	5,055 / 300
Pipeline Displaced Sediments (1,000 m^3)	NA /	NA	2,200 / 127	2,523 / 154	2,409 / 161	0 / 0	8,384 / 538
Bottom Area Disturbances (ha)							
from rig emplacements	NA /	NA	1,125 / 77	1,919 / 130	1,849 / 126	310 / 21	6,165 / 419
from structure emplacements	NA /	NA	104 / 6	148 / 9	145 / 9	20 / 1	472 / 29
from pipeline projects	NA /	NA	170 / 10	446 / 27	680 / 41	322 / 20	1,618 / 96
Accidents							
Offshore Oil Spills							
>1 and <50 bbl	NA /	NA	****NA / NA	NA / NA	NA / NA	NA / NA	830 / NA
>50 and <1,000 bbl	NA /	NA	NA / NA	NA / NA	NA / NA	NA / NA	33 / NA
>1,000 bbl	18 /	NA	NA / NA	NA / NA	NA / NA	NA / NA	7 / NA
Blowouts	NA /	NA	24 / 1	36 / 2	40 / 2	30 / 2	130 / 7
Diesel and Other Pollutant Spills	NA /	NA	93 / 4	119 / 5	143 / 6	44 / 2	399 / 17
Support Activities							
Helicopter Trips (1,000's)	NA /	NA	13,288 / 687	9,772 / 480	9,754 / 469	1,255 / 60	34,069 / 1,652
Service Vessel Trips (1,000's)	NA /	NA	224 / 12	203 / 11	212 / 11	63 / 4	701 / 36
Offshore Operational Wastes							
Drilling Fluids (1,000 bbl)	NA /	NA	10,648 / 607	22,654 /1,306	26,135 /1,509	17,204 / 1,017	76,642 / 4,440
Drill Cuttings (1,000 bbl)	NA /	NA	2,512 / 146	5,379 / 316	6,210 / 366	4,149 / 250	18,250 / 1,077
Sanitary Wastes (1,000 m^3)	NA /	NA	28,481 /1,480	31,494 /1,557	34,059 /1,650	8,386 / 399	102,343 / 5,054
Produced Waters (MMbbl)	NA /	NA	2,304 / NA	3,673 / NA	4,448 / NA	1,833 / NA	12,258 / NA
Produced Sands (1,000 bbl)	NA /	NA	637 / 28	815 / 36	977 / 43	302 / 13	2,731 / 120
Offshore Air Emissions (1,000 tons)							
Nitrogen Oxides	NA /	NA	888.43 / NA	589.37 / NA	533.52 / NA	45.38 / NA	2,056.70 / NA
Carbon Monoxide	NA /	NA	54.52 / NA	36.17 / NA	32.74 / NA	2.78 / NA	126.21 / NA
Sulfur Oxides	NA /	NA	9.87 / NA	6.55 / NA	5.93 / NA	0.50 / NA	22.85 / NA
Total Hydrocarbon Compounds	NA /	NA	52.20 / NA	34.63 / NA	31.35 / NA	2.67 / NA	120.84 / NA
Total Suspended Particulates	NA /	NA	5.82 / NA	3.86 / NA	3.50 / NA	0.30 / NA	134.75 / NA

* As shown in Figure IV-1.
** Not all development wells classified as oil or gas produce.
*** The peak year numbers for the individual subareas may not sum to the peak year number for the total planning area because all peak years may not occur simultaneously.
**** Data cannot be revealed by subarea because proprietary information could be exposed.

Table IV-8

Offshore Scenario Information Associated With OCS Program Activities in the Western Planning Area for the Years 1993-2027

Offshore (Total / Peak Year**)	Total to Date / 1990 Annual	W-1 OCS Program Activities	W-2 OCS Program Activities	W-3 OCS Program Activities	Total WPA OCS Program Activities
		Offshore Subarea*			
Wells Drilled					
Exploration and Delineation Wells	1,924 / 187	340 / 25	1,550 / 113	3,390 / 247	5,280 / 385
Development Wells***	1,949 / 62	145 / 7	655 / 32	1,250 / 61	2,050 / 100
Oil Wells	285 / 2	20 / 0	290 / 13	560 / 26	870 / 40
Gas Wells	1,664 / 60	125 / 6	365 / 19	690 / 35	1,180 / 60
Platform Complex Installations					
Number Installed	380 / 6	15 / 1	40 / 3	85 / 7	140 / 11
Space Use Loss (ha during 35 years)	NA / NA	21,252 /1,056	12,738 / 546	0 / 0	33,990 / 1,602
Structure Removals Using Explosives	NA / NA	116 / 6	109 / 5	6 / 1	231 / 12
Method of Oil Transportation					
Percent Piped	NA / NA	****NA / NA	NA / NA	NA / NA	88%/ 88%
Percent Barged	NA / NA	NA / NA	NA / NA	NA / NA	1%/ 1%
Percent Tankered	NA / NA	NA / NA	NA / NA	NA / NA	11%/ 11%
Shuttle Tanker Traffic (trips)	0 / 0	0 / 0	0 / 0	960 / 33	960 / 33
Barge Traffic (trips)	NA / NA	531 / 18	228 / 8	0 / 0	759 / 26
Pipeline Length (km)	4,654 / 195	790 / 71	860 / 73	1,860 / 162	3,510 / 305
Pipeline Displaced Sediments (1,000 m^3)	NA / NA	701 / 40	614 / 42	0 / 0	1,290 / 90
Bottom Area Disturbances (ha)					
from rig emplacements	NA / NA	510 / 38	2,103 / 153	908 / 66	4,176 / 304
from platform emplacements	NA / NA	30 / 2	72 / 5	29 / 3	142 / 12
from pipeline projects	NA / NA	253 / 23	275 / 23	595 / 52	1,123 / 98
Accidents:					
Offshore Oil Spills					
>1 and <50 bbl	NA / NA	****NA / NA	NA / NA	NA / NA	183 / NA
>50 and <1,000 bbl	NA / NA	NA / NA	NA / NA	NA / NA	7 / NA
>1,000 bbl	NA / NA	NA / NA	NA / NA	NA / NA	2 / NA
Blowouts	NA / NA	11 / 1	23 / 2	40 / 3	74 / 6
Diesel and Other Pollutant Spills	NA / NA	5 / 1	37 / 1	46 / 2	88 / 4
Support Activities					
Helicopter Trips (1,000's)	NA / NA	1,737 / 86	1,962 / 84	1,035 / 51	4,734 / 174
Service Vessel Trips (1,000's)	NA / NA	35 / 2	71 / 4	93 / 6	211 / 12
Offshore Discharges					
Drilling Fluids (1,000 bbl)	NA / NA	3,404 / 226	15,478 /1,022	28,605 /1,978	51,503 / 3,421
Drill Cuttings (1,000 bbl)	NA / NA	837 / 56	3,809 / 255	7,218 / 503	12,715 / 856
Sanitary Wastes (1,000 m^3)	NA / NA	4,568 / 232	5,428 / 259	3,829 / 233	19,714 / 870
Produced Waters (MMbbl)	NA / NA	108 / NA	842 / NA	1,548 / NA	2,458 / NA
Produced Sands (1,000 bbl)	NA / NA	34 / 1	251 / 9	317 / 11	602 / 20
Offshore Air Emissions (1,000 tons)					
Nitrogen Oxide	NA / NA	146.43 / NA	142.77 / NA	65.89 / NA	355.10 / NA
Carbon Monoxide	NA / NA	24.35 / NA	23.74 / NA	10.96 / NA	59.04 / NA
Sulfur Oxide	NA / NA	5.09 / NA	4.96 / NA	2.29 / NA	12.33 / NA
Total Hydrocarbon Compounds	NA / NA	39.25 / NA	17.66 / NA	17.66 / NA	95.19 / NA
Total Suspended Particulates	NA / NA	5.56 / NA	5.42 / NA	2.50 / NA	13.48 / NA

* As shown in Figure IV-1.
** Not all development wells classified as oil or gas produce.
*** The peak year numbers for the individual subareas may not sum to the peak year number for the total planning area because all peak years may not occur simultaneously.
**** Data cannot be revealed by subarea because proprietary information could be exposed.

Table IV-9

Offshore Scenario Information Associated With OCS Program Activities in the Eastern Planning Area for the Years 1993 -2027

Offshore (Total / Peak Year**)	Total to Date / 1990 Annual	Offshore Subarea* E-1 OCS Program Activities	E-2 OCS Program Activities	E-3 OCS Program Activities	E-4 OCS Program Activities	E-5 OCS Program Activities	Total EPA OCS Program Activities
Wells Drilled							
Exploration and Delineation Wells	44 / 0	270 / 18	25 / 2	0 / 0	0 / 0	245 / 16	540 / 35
Development Wells***	0 / 0	90 / 7	10 / 1	0 / 0	0 / 0	150 / 12	250 / 20
Oil Wells	0 / 0	15 / 1	10 / 1	0 / 0	0 / 0	130 / 10	155 / 12
Gas Wells	0 / 0	75 / 6	0 / 0	0 / 0	0 / 0	20 / 3	95 / 8
Platform Complex Installations							
Number Installed	0 / 0	14 / 1	4 / 1	0 / 0	0 / 0	12 / 1	30 / 3
Method of Oil Transportation							
Percent Piped	****NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA
Percent Barged	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA
Percent Tankered	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA
Pipeline Length (km)	0 / 0	920 / 90	80 / 9	0 / 0	0 / 0	175 / 21	1,175 / 115

* As shown in Figure IV-1.

** The peak year numbers for the individual subareas may not sum to the peak year number for the total planning area because all peak years may not occur simultaneously.

*** Not all development wells classified as oil or gas produce.

**** Data cannot be revealed by subarea because proprietary information could be exposed.

will require the drilling of 5,280 exploration and delineation wells, the emplacement of 140 new platform complexes, the use of 380 existing platforms, and the drilling of 2,050 oil and gas development wells (Table IV-8); and, to discover and develop resources in the EPA will require the drilling of 540 exploration and delineation wells, the emplacement of 30 platform complexes, and the drilling of 250 oil and gas development wells (Table IV-9).

(c) Structure Removals

In addition to postlease structure removals that result only from the proposed action and due to the fact that lessees are required to remove all structures and underwater obstructions from their Federal OCS leases within one year of the lease's relinquishment or termination of production, structure removals occur from ongoing OCS activity. (For further discussion of structure removals, see Section IV.A.2.(a).(3).)

The MMS has issued strict guidelines to offshore operators for explosive platform removal in order to eliminate potential harm to endangered marine turtles and marine mammals. These guidelines include daylight detonation only, staggered charges, placement of charges 5 m below the seafloor, and pre- and postdetonation surveys of surrounding waters. It is assumed that these guidelines will be followed during the removal of all OCS platforms. It is assumed that 80 percent will be removed by explosives in water depths less than 455 m. In water depths greater than 455 m engineering differs due to the requirements of deep-water technologies. Each year it is estimated that 4.1 percent of the remaining OCS structures will be removed as a result of all OCS activity. The rate of removal will average 75 structures per year in the CPA (annual range of 40-131) and 10 in the WPA (annual average of 9-14). In the CPA, there will be 1,897 structures removed explosively (94 in the peak year); in the WPA, in there will be 231 structures removed explosively (12 in the peak year).

(d) Workover/Abandonment Activities

Workover operations consist of work conducted on wells after the initial completion for the purpose of maintaining or restoring the productivity of a well. Tubing can be pulled and the casing at the bottom of the well pumped and washed free of sand that may have accumulated. Other examples of workover operations are acidizing of the perforated interval in the casing, plugging back, squeezing cement, milling out cement, jetting the well in with coiled tubing and nitrogen, setting positive plugs to isolate hydrocarbon zones, etc. Workover operations can require the use of a jack-up barge. Operations, which can take from a few days to several months to complete, occur in mature oil and gas areas and, thus, are common in the Gulf of Mexico. In 1990, about 4,200 completions, workovers, and plugging/abandonment operations occurred, with about 2,400 of these requiring rig emplacement. In general, about 20 percent of all workover operations include rig emplacement. All plugging/abandonment operations performed when the well has finished production require rig activity. Worldwide rig activities show that workover rig activities accounted for 15 percent of rig drilling operations from 1986 through 1990 (The Offshore International Newsletter, 1991).

Given such levels of activity, it is expected that workover activity will remain an important component of future OCS Program operations. However, as total offshore activity decreases so will workovers. The following are assumptions about workover activities used to develop estimates of future activities: Given that most wells require from one to three workovers during their lifetime, it is assumed that new development wells will require 1.5 workover operations during their lifetime plus one plugging/abandonment operation. Realizing that there is no knowledge of the status of workover operations on existing wells, it is assumed that each existing well will require one-half the number of workovers than expected for new wells, i.e., 0.75 workovers per existing well plus one plugging and abandonment operation. Using these assumptions, estimates of workover operations for all future OCS Program operations are 12,653 workover operations in the CPA, plus 11,740 plugging/abandonment operations and 4,958 workovers in the WPA, plus 3,254 plugging/abandonment operations. No peak-year activity is available. Operations will average 10 days and will require support services similar to support provided during the development of the well. Twenty percent of workover operations are assumed to require rig emplacements.

(2) Offshore Transport of Oil and Gas

Transportation of petroleum hydrocarbons to onshore terminal facilities in the Central and Western Gulf of Mexico historically has relied on an ever-expanding pipeline network. Along with the movement of oil and gas/condensate through pipelines, a small percentage of oil has traditionally been barged from shallow water areas to onshore oil terminals. Because MMS projects that leasing in deep-water blocks not located in proximity to the existing oil-pipeline network will occur as a result of the proposed actions and because of the lack of a onshore infrastructure in Florida, future shuttle tanker transport of oil is projected to occur in all three planning areas. Section IV.A.2.b. describes general information, assumptions, and potential impacts concerning the three modes of oil and gas transport occurring in association with OCS oil and gas leasing: pipelines, barging, and shuttle tanker operations. Tables IV-7 through IV-9 present projected percentages of oil transported via each mode expected for all future OCS Program activities (1993-2027). Nearly all economically recovered natural gas is assumed to be piped to shore. Tables IV-10 and IV-11 provide information about projected kilometers of new trunklines. Tables IV-12 through IV-14 provide information on the volumes of oil making landfall in the various onshore subareas from offshore barging, tanker transport, or piping operations, and on the locations of offloading operations, including transport from the Eastern Gulf. Table IV-15 provides information on the waterway usage by the number of barge and shuttle tanker trips and the terminals where the offloading is expected to occur. Section IV.B.1.c. discusses the locations of the offloading terminals and/or major ports projected to serve oil tanker and barge operations associated with future OCS Program activities.

Historically, about 3 percent of the oil produced in the Gulf of Mexico has been barged to shore. It is expected that the general level of barging activity will remain the same in the future and that this activity will remain in water depths less than 3,000 ft. Projected percentages of oil to be barged during future OCS Program activities are 3 percent in the CPA and a little more than 1 percent in the WPA. In the CPA, over 6800 barge trips are estimated to occur from future Central Planning Area OCS Program activities (Table IV-7). Most of the barging activity in the CPA will originate from Subareas C-1 and C-3. In the WPA, only 759 barge trips are expected to occur from OCS Program activities occurring during the 35-year life of the proposed action. Most of these trips will originate in Subarea W-1, with the remaining occurring from Subarea W-2 (Table IV-8).

Although shuttle tanker transport of OCS Gulf of Mexico oil has not occurred to date, it is expected that shuttle tanker transport of OCS oil will occur from future leases located in deep waters outside of the existing pipeline network in support of the OCS Program. Less than one percent of oil produced in the CPA as a result of OCS Program operations, occurring during the 35-year life of the proposed actions, is estimated to be transported via 45 shuttle tanker trips (Table IV-7). These trips will originate primarily in offshore Subarea C-3 and will offload at the Mississippi River ports (Tables IV-7 and IV-15). Under the High Case, five trips are expected (Table IV-2).

Eleven percent of the oil to be produced in the WPA as a result of OCS Program activities (1993-2027) is estimated to be transported to shore by shuttle tankers (Table IV-8). Sixty-six trips are expected, all originating in Subarea W-3 and offloading at five major port areas in both Texas and Louisiana (Tables IV-13 and IV-15).

Because no pipeline system exists in the Eastern Gulf and because of the lack of an onshore infrastructure base to store and refine oil produced in the EPA from OCS Program operations, almost 94 percent of the oil projected to be produced in the EPA will be transported by shuttle tankers to CPA onshore support facilities (Table IV-9). Five hundred and thirty trips of 50,000-dwt shuttle tankers are expected to transport oil produced in the EPA to terminals along the Mississippi River, in Pascagoula, Mississippi, and in Mobile, Alabama. Table IV-15 shows the number of trips to each of these three offloading areas and the coastal waterways traversed.

Most of the oil and gas resources discovered in the Gulf of Mexico will be piped ashore, relying on the extensive and continually expanding existing pipeline network. As of October 1990, approximately 33,249 km of OCS pipelines had been constructed in the Central and Western Gulf of Mexico, whereas no pipeline construction had occurred in the Eastern Gulf. The installation of new pipelines on the OCS will be needed to bring undeveloped resources ashore and to connect new production platforms to existing pipeline systems. Under the OCS Program scenario, 97 percent of the liquid hydrocarbons in the CPA and 88 percent in the WPA are projected to be transported by pipeline. To date, all natural gas developed on the OCS has been transported to shore via pipeline. Under the proposed action, it is assumed that nearly all economically recoverable natural gas will continue to be piped to shore, but that a small percentage (less than 1%) developed in deep-water tracts that are not located near an existing pipeline network will be handled differently. Options include flaring (which is currently prohibited by MMS) or converted to other products--such as methane, liquified gas, or water--prior to transportation by tanker. The MMS is currently working with OCS operators to develop methods to transport natural gas resources in areas where transportation by pipeline is not economically feasible.

In the Central Gulf, there were an estimated 28,595 km of pipelines (trunk and gathering lines) as of 1990. Another 2,304 km of new trunklines (1,080 km--oil, 1,224 km--gas) and 2,751 km of new gathering lines will be constructed to support current and future oil and gas activities in the CPA (Table IV-10). Sixty-eight percent of all new trunklines will be constructed in water depths greater than 300 m. Peak-year pipeline construction projections are projected to be 300 km. Seventy-one percent of all new pipeline construction in the CPA will occur in offshore Subareas C-2 (1,305 km) and C-4 (1,980 km). Three new pipelines are projected to make landfall along the Mississippi and Alabama coasts in Jackson County, Mississippi (1--oil), and Mobile County, Alabama (2--gas). Of these, the new oil pipeline in Jackson County and a new gas pipeline in Mobile County will be constructed to support OCS activities adjacent to the northwest Florida panhandle coastal area, as well as activities in the CPA east of the Mississippi River.

Table IV-10

Projected New Central Gulf OCS
Oil and Gas Trunklines (km) by Water Depth

Offshore	0-1,000'		1,000'-3,000'		3,000' +		Total	
Subareas	Oil	Gas	Oil	Gas	Oil	Gas	Oil	Gas
C-1	120	0	0	0	0	0	120	0
C-2	160	64	144	96	40	96	344	256
C-3	200	216	136	48	160	416	496	680
C-4	0	0	0	0	120	288	120	288
Totals	480	280	280	144	320	800	1,080	1,224

In the Western Gulf, there were an estimated 4,654 km of pipelines as of 1990. Another 2,368 km of new trunklines (992 km--oil; 1,376 km--gas) and 1,142 km of new gathering lines will be constructed to support current and future oil and gas activities offshore Louisiana and Texas. Table IV-11 estimates the total length of new trunklines projected for the WPA. Sixty-seven percent of the projected new trunklines will be constructed in water depths greater than 300 m. Peak-year pipeline construction projections equal 305 km. Fifty percent of all new pipeline construction will occur in offshore Subarea W-3 (1,176 km). Three new oil pipelines are projected to make landfall along the Texas coast in Matagorda County (Matagorda Peninsula), Calhoun County (Matagorda Island), and Nueces County (Mustang Island).

Table IV-11

Projected New Western Gulf OCS
Oil and Gas Trunklines (km) by Water Depth

Offshore	0-1,000'		1,000'-3,000'		3,000' +		Total	
Subareas	Oil	Gas	Oil	Gas	Oil	Gas	Oil	Gas
W-1	280	224	0	128	0	32	280	384
W-2	120	128	88	192	0	0	208	320
W-3	0	0	120	64	384	608	504	672
Totals	400	352	208	384	384	640	992	1,376

In the Eastern Gulf, approximately 690 km of new trunklines (290 km--oil, 400 km--gas) and 450 km of new gathering lines will be constructed to support current and future oil and gas activities offshore Florida. No pipelines are projected to make landfall along the Florida coast; however, two new pipelines (one oil and one gas) will be constructed to support current and future activities off Florida's northwest coast, as well as activities in the CPA east of the Mississippi River. It is anticipated that these pipelines will make landfall in Jackson County, Mississippi, and Mobile County, Alabama.

With the increasing trend toward leasing and development in deep-water areas of the Gulf, pipeline installation projects are extending into water depths that will require new technological innovations. This document assumes that technological advances during the life of the proposed actions will allow pipeline installations in water depths exceeding 1,525 m (5,000 ft). Deep-water pipeline installation challenges include the design of flow systems that can withstand the high external hydrostatic pressures at the seafloor, the adaption of existing lay-vessel and mooring technology to deep-water conditions, and tie-in problems at deep-water production structures.

One approach to deep-water installation projects has been to assemble long lengths (up to 10 km or 6 mi) of pipe onshore and to tow the assembled pipe to the production site. This approach has already been used successfully for a project in the Green Canyon Area, and is being planned for a new pipeline project in the Mississippi Canyon Area. Section IV.A.2.b.1. contains a discussion of pipe towing and the assumptions this document uses to evaluate the impacts of this pipeline installation method on the potentially affected resources of the Gulf. Under the OCS Program, it is assumed that some deep water trunk line and gathering line projects will use pipe towing from shore-based facilities.

(3) Offshore Transport of Personnel/Supplies

It is expected that personnel and supplies will continue to be transported to offshore drilling and production sites by both service vessels and helicopters. Tables IV-7 and IV-8 provide the number of trips occurring offshore from each of these modes of transport for each subarea in the Central and Western Gulf of Mexico. Section IV.A.2.c. discusses offshore support operations in general, describing the activities and their expected impacts. Service bases, heliports, and vessel usage of coastal areas are discussed in Section IV.B.1.c.

There are 701,000 service vessel trips projected to occur in the CPA (Table IV-7) and 211,000 trips in the WPA (Table IV-8) from future OCS Program operations occurring during the 35-year life of the proposed actions, with 36,000 and 12,000 trips occurring during the peak year, respectively. Because of the increase in OCS activity in deep waters far from shore support, service vessels are expected to be larger and deeper draft than existing vessels. Future changes in service bases and coastal transport occurring in association with the use of deeper draft vessels are discussed in Sections IV.B.1.c.(1) and 3.(b).

A large amount of helicopter traffic is projected to occur to support all future oil and gas operations occurring during the 35-year life of the proposed actions. Over 34 million helicopter trips in the CPA and almost 5 million trips in the WPA are expected to occur (Tables IV-7 and IV-8).

There are approximately 600 aircraft servicing the oil and gas industry's transportation needs in the Gulf. Since 1985 the number of aircraft in the fleet has declined by about 150 helicopters. Three or four oil and gas operators own and operate helicopters; however, most helicopters used in the oil and gas fields of the Gulf of Mexico are leased from 11 commercial helicopter operators. Historically, helicopter operations accounted for approximately 2 million flights annually (takeoffs and landings), representing over 0.5 million flight hours transporting 3.5 million passengers a year. Based on the MMS projections of total trips during 1993 to 2027, helicopter trips will decline to average about 1 million flights annually, half as much as the above figure for 1989.

As of 1991, about 400 shore-based helicopters fly every day, with another 75 helicopters based offshore. At any one time, 15-20 percent of the fleet of 600 aircraft is in maintenance and not operational. The average length of helicopter trips/flights involved in OCS operations in the CPA and WPA is 15 minutes. Historically, helicopters are in the air 3.5 hours per day and make about 13 or 14 trips.

In support of all future OCS operations, it is assumed that, although the number of trips are expected to decrease as the fleet flies farther offshore, the total flying time will remain at historical levels. Therefore, for analytical purposes, future flying times per helicopter are estimated to be between 3 and 4 hours daily, but each flight will take longer, averaging between 30 and 40 minutes. Furthermore, the number of trips daily per drilling, pipelaying, or production operations are expected to be the same as projected under the Base Case scenario (Section IV.A.2.c(2)).

Between Mobile, Alabama, and Brownsville, Texas, there are 33 helicopter hubs and 325 heliports (1-46 helipads per heliport) actively supporting offshore oil and gas operations. Offshore, approximately 2,000 platforms, 200 drilling rigs, and 8 barges involved in oil and gas operations have heliport facilities. In 1989 the accident rate was one accident per 200,000 takeoffs and landings. (Current and historical information derived from Helicopter Safety Advisory Conference, 1991; Osborne, personal comm., 1991).

(4) Offshore Impacting Factors Related to Future OCS Operations

(a) Bottom Disturbance

A detailed description of the disruption of the seafloor by the placement of structures (including rigs, platforms, and pipelines) and anchors from oil and gas operations is given in Section IV.A.2.d.(1) above and is not repeated here. As noted therein, such disruption may impact sensitive biological and archaeological resources if no mitigation measures are imposed. Various NTL's exist and stipulations are proposed to protect archaeological and sensitive biological resources from damage during these activities. As noted, jack-up rigs and semisubmersible rigs, used in water depths less than 457 m (1,500 ft), disturb a total of approximately 1.5 ha (3.7 ac). It is assumed that 2 ha (4.9 ac) of the bottom will be directly affected by the installation of production platforms; in deeper waters, the area affected doubles to 4 ha (9.9 ac). (These rig and platform numbers include disturbance by anchors used during installation.) Pipelines disturb about 0.32 ha (0.8 ac) for each kilometer (0.62 mi) of pipeline installed.

The development scenario for the OCS Program for proposed Sale 142 assumes 5,890 exploration and delineation wells and 340 platform complexes (Table IV-7). This equals the direct disturbance of approximately 6,637 ha (16,400 ac) of open-ocean bottom. It is estimated that 5,055 km (3,140 mi) of pipelines will be installed, resulting in the disturbance of another 1,618 ha (3,998 ac) of bottom. The trenching (burying) of pipelines (only in water depths less than 61 m (200 ft)) resuspends some 5,000 m^3 (6,540 yd^3) of sediments per kilometer (0.62 mi); under this scenario, 8,384,000 m^3 (10,966,272 yd^3) of sediments would be resuspended into the water column over the 35 years of activity.

The development scenario for the OCS Program for proposed Sale 143 assumes 5,280 exploration and delineation wells and 140 platform complexes (Table IV-8). This equals the direct disturbance of approximately 4,318 ha (10,670 ac) of open-ocean bottom. It is estimated that 3,510 km (2,180 mi) of pipelines will be installed, resulting in the disturbance of another 1,123 ha (2,775 ac) of bottom, and 1,290,000 m^3 (1,687,320 yd^3) of sediments would be resuspended into the water column over the 35 years of activity. The placement of offshore structures includes effects on water quality, benthic communities, archaeological resources, and fishery resources. The effects of sediment resuspension include increased water turbidities and mobilization of pollutants in the water column.

Service vessel anchoring is assumed not to occur in water depths greater than 152 m (500 ft) and only occasionally in shallower waters. Mooring buoys may be placed near drilling rigs or platforms so that service vessels need not anchor, especially in deeper water (in all water depths, vessels may also tie up directly to the rig or platform). These temporarily installed anchors will most likely be smaller and lighter than those described above and, thus, will be less damaging to the bottom. Moreover, installing one buoy will preclude the need for numerous individual vessel anchoring incidents.

Anchoring may disturb sensitive offshore benthic communities and historic and prehistoric archaeological resources. Anchoring occurring as a result of pipeline and platform emplacements and rig activities is accounted for in the area disturbance estimates. During pipeline-laying operations, an array of eight 9,000-kg (20,000-lb) anchors is continuously repositioned. With the proposed Live Bottom and Topographic Features Stipulations (Sections II.A.1.c. and II.B.1.c.), anchoring impacts from the offshore industry would be largely prevented.

(b) Bottom Debris

Bottom debris is herein defined as ferromagnetic and nonferromagnetic material resting on the seabed (such as cable, tools, pipe, drums, structural parts of platforms, as well as objects made of plastic, aluminum, wood, etc.) that are accidentally lost, or illegally tossed, by workers from fixed structures, jack-up barges, drilling ships, and during pipeline emplacement. It is reasonable to assume that varying quantities of ferromagnetic bottom debris may be lost, or tossed, per operation. For the purpose of the present analysis, the maximum quantity of bottom debris per operation is assumed to be several tons. It is estimated that several tens of thousands of tons of bottom debris (both ferromagnetic and nonferromagnetic) have been deposited on the seafloor as a result of prior OCS oil and gas activity. Oil and gas activity on the Gulf of Mexico OCS as a result of future OCS activities for the next 35 years will likely add several thousands of tons to the amount of bottom debris on the seafloor. This bottom debris will be mitigated to some extent by seafloor clearance associated with structure removals and regular inspection and burial of pipelines (Alpert, 1990). Extensive analysis of remote-sensing surveys within developed blocks indicates that the majority of ferromagnetic bottom debris associated with OCS exploration and development activities falls within 455 m (1,500 ft) of the structure/jack-up/lay barge.

Underwater OCS ferromagnetic debris may result in the masking of magnetic signatures from historic period shipwrecks. Bottom debris may also result in the damage or loss of commercial fishing equipment, gear (primarily nets), and/or fisheries catch.

Most financial losses to Gulf fishermen from bottom debris and fishing gear conflicts are covered by claims made to the Fishermen's Contingency Fund (FCF) (See Section I.B.3.d.(3)(f) for a detailed discussion of the FCF). The average claim-processing time has been reduced from as much as seven months to less than 50 days after NMFS receives the completed claim. During FY 88, 113 claims of conflict between fishing and offshore oil and gas development were processed with 87 percent being approved for a total of $550,936 to the fishermen; FY 89, 172 claims with 86 percent approved for $783,372; FY 90, 193 claims with 83 percent approved for $504,396. Although Gulf fishermen are experiencing some economic loss from gear conflicts, the economic loss for a fiscal year has historically been less than 1 percent of the value of that same fiscal year's commercial fisheries landings (Jackson, written comm., 1991; Davenport, written comm., 1991).

(c) Space-Use Conflicts

In addition to space-use conflicts from platform installations that result only from the proposed action, fishermen are unable to trawl in areas occupied by existing structures (for further discussion of space-use conflicts, see Section IV.A.2.d.(3)). Commercial fish trawling in the Gulf of Mexico is performed in water depths less than 152 m. The presence of a production platform, with a surrounding 100-m navigational safety zone, results in the loss of approximately 6 ha (15 ac) of trawling area to commercial fishermen and causes space-use conflicts (USDOI, MMS, 1991a). It is estimated that during the peak year approximately 15,126 ha (37,361 ac) will be unavailable to commercial fishing in the CPA and 1,602 ha (3957 ac) unavailable to commercial fishing in the WPA. This assumption is based on all structures in place in less than 455 m of water in the first year after proposed Sales 142 and 143, respectively. Platforms in water depths greater than 455 m are engineered differently due to special requirements of deep-water technology.

Commercial fishing may also conflict with offshore oil and gas development when trawls and bottom-set longlines are fished on top of pipelines and pipeline valves. These hangs can result in loss of catch, in damage to fishing gear, and potentially in the rupturing of the pipeline. A recent issue of concern to both Federal and State agencies stems from several accidents involving commercial fishing vessels striking exposed gas pipelines in Louisiana State waters. In two incidents, loss of life (18 persons) occurred. The Department of Transportation (DOT) is examining these events. In an attempt to improve navigational safety and to reduce the hazard noted above, Congress enacted a new law requiring maintenance of the 1 m (3.3 ft) minimum burial depth. In addition, the act requires operators to report annually to the Secretary of DOT on each pipeline's age, location, and condition. Present OCS regulations require operators to bury all pipelines greater than 22 cm (8.625 in) in diameter and installed in water depths less than 60 m (200 ft) to a depth of 1 m (3.3 ft). It is assumed that all pipelines and pipeline valves will be constructed, buried, and maintained according to the new regulations.

(d) Aesthetic Interference

Oil and gas drilling rigs and production platforms within 10 mi of shore can be seen from shore on a clear day. A preponderance (more than 80%) of the nearshore Federal lease tracts within 10 mi of the coast of Louisiana, Mississippi, and Alabama are under lease and many are actively producing oil and gas. As many as 100 production platforms are located on Federal lease tracts within 10 mi of the Louisiana coastal shorefront. Seaward of the barrier islands off Mississippi and Alabama there are 7 existing platforms producing oil and gas on Federal lease tracts within 10 mi of shore. It is estimated that 169 new production platforms will be installed in Subareas C-1 and C-3 (Table IV-3) by the year 2027 resulting from the OCS leasing program. Probably 5 percent or less, or 6 of these structures, will be installed within 10 mi of shore or within sight of the coastal shorefronts of Louisiana, Mississippi's outer islands, or Alabama's barrier islands.

(e) Offshore Operational Wastes

The largest quantities of operational wastes from offshore oil and gas exploration and production activities include produced water, drilling fluids and cuttings, ballast water, and storage displacement water. Other major wastes include the following: from drilling--waste chemicals, fracturing and acidifying fluids, and well completion and workover fluids; from production--producedsand, deck drainage, and miscellaneous well fluids (cement, BOP fluid); and from other sources--sanitary and domestic wastes, gas and oil processing wastes, and miscellaneous minor discharges. Section IV.A.2.d.(5) describes what is known about the generation, composition, present disposal practices, and fate of offshore discharges for each major operational waste. This section also provides the basic assumptions for the proposed actions regarding quantities generated per activity, such as drilling fluid volumes per well drilled, and projected disposal methods. It is assumed that these assumptions are applicable to all future OCS Program operations. This section describes major contaminants found in each waste type. In particular, the section describes what is known about NORM generated as a result of oil and gas extraction processes. Current efforts to study disposal options of NORM-contaminated wastes are also outlined.

Tables IV-7 and IV-8 provide scenario projections as part of the OCS Program scenario for each major operational waste. These projections provide volumes of waste generated from future OCS drilling and production operations. Projected disposal quantities (overboard disposal quantities and onshore disposal volumes) are based on the assumption that the USEPA's proposed effluent regulations described in Section I.B.3.d.(3)(e) will be promulgated. In the development of all estimates of future discharges and disposal methods, MMS assumes that these proposed effluent limitations are finalized and that USEPA's preferred option for each waste, as identified in the proposed rule (40 CFR 435), will be chosen.

The major sources of contamination from drilling operations are the drilling fluids, or "muds," and cuttings from the drill bit. The quantities of drilling fluids estimated to be generated from all OCS well drilling activities occurring in the 35-year life of the proposed actions are 76,642,000 bbl in the CPA and 51,503,000 bbl in the WPA. Of these amounts, 62,770,000 bbl will be discharged into surrounding offshore waters in the CPA and 42,181,000 bbl will be discharged directly in the WPA. The remaining quantities generated (18%) are assumed to require onshore disposal because of effluent guideline requirements. Estimates of quantities of drill cuttings generated from all future OCS drilling operations in the CPA are 18,250,000 bbl, with 1,077,000 bbl generated during the peak-year drilling activity. Estimates of drill cuttings generated in the WPA are 12,715,000 bbl, with 856,000 bbl discharged during peak-year drilling operations.

Produced water (also known as production water or produced brine) is the total water discharged from the oil and gas extraction process. It is comprised of the formation waters, injection water (if used for secondary oil recovery and broken through into the oil formation), and various chemicals added during the oil and water separation process. Produced water can constitute from 2 to 98 percent of the waste stream of a producing field.

Offshore produced water may be reinjected into the formation or treated to decrease its oil content and then discharged into offshore surface waters. Offshore treatment facilities receive produced waters from a number of wells and are often centralized within a field or a number of fields. For example, in 1983, only 20 percent of existing offshore structures discharged produced waters; the other facilities thereby transporting their produced waters to these structures.

Although much of the water produced from OCS oil and gas operations is discharged offshore, some of the water is piped ashore and then treated and disposed of at coastal separation facilities. (Section IV.B.1.c.(3)(c) discusses onshore disposal of produced waters.) About 20 percent of the produced water volume estimated to be generated offshore in the CPA under the OCS Program scenario is expected to be shipped into Louisiana State waters for disposal.

Projections of the amount of produced water generated from operations associated with total OCS Program production during the 35-year life of the proposed actions is provided in Tables IV-7 and IV-8, CPA and WPA respectively. Subtracting the produced water volume expected to be brought onshore in Louisiana for disposal from the total volume generated in the CPA, the amount of produced waters projected to be discharged into CPA and WPA offshore waters is about 9,820 MMbbl and 2,450 MMbbl, respectively.

Solid wastes associated with OCS activities include production sands, salvaged and discarded tubular pipes, pipe scale, and tank-bottom sludge.

Total volumes of produced sands generated from all future OCS Program oil and gas production during the 35-year life of the proposed actions are projected to be 2,730,000 bbl in the CPA and 602,000 bbl in the WPA. Section IV.B.1.c.(3)(c) discusses onshore disposal of this waste. It is expected that 100 percent of produced sands will be shipped onshore for disposal.

Other solid wastes, such as oil-field equipment (used filters, drums, etc.), cement bags, crates, plastics, and a variety of domestic wastes, are collectively characterized as trash and debris. Trash and debris generated offshore from OCS oil and gas activities (metal drums and plastic containers, chemical mud bags, plastic shrink wrap, cardboard boxes, glass, and cans) can adversely affect marine fish and wildlife resources, fishing operations, and beaches if accidently lost or illegally disposed of into the offshore marine environment. Even when properly disposed of in approved landfills onshore, future OCS Program-generated trash can affect the useful life of diminishing coastal landfills and may affect wetlands loss, land use, and coastal water quality.

Volunteer cleanups of coastal beaches have been removing an estimated ton or more of human-generated trash per mile of beach in Texas and Louisiana. Although all Gulf user groups, as well as beach users themselves, are known contributors to the problem, it has been estimated that 10-12 percent of the trash removed from along the Texas and Louisiana shorefront comes from oil and gas operations in the Gulf of Mexico (USEPA, 1990; Herbert, personal comm., 1991). Offshore disposal of trash and debris from oil and gas operations in the Gulf is strictly prohibited by Federal and international regulations; therefore, no assumptions will be made on quantities of trash and debris likely to be lost from future oil and gas operations entering the marine environment. Although assumptions of amounts lost are not made, it is fully recognized that accidents, careless operations, and illegal dumping of solid waste from oil and gas operations will continue to exacerbate solid wastes, adversely impacting the Gulf and its associated coastal areas. Although the oil and gas industry is making strides in reducing trash loads generated offshore through widespread use of bulk storage and reusable containers, and the implementation of comprehensive recycling programs by some operators, large quantities of operational and galley waste are still returned to shore for disposal in approved landfills.

Liquid domestic wastes are waste waters originating from sinks, showers, laundries, and galleys, as well as waste water from safety shower and eye-wash stations and fish-cleaning stations. Sanitary wastes are composed of human body wastes from toilets and urinals. The volume and concentration of sanitary wastes will vary widely with time, occupancy, platform characteristics, and operation situation. In general, a typical manned platform will discharge 0.075 m^3 per person each day of treated sanitary wastes and 0.110 m^3 per person each day of domestic wastes (USEPA, 1991). Total volumes of domestic and treated sanitary discharges from all exploration, development, and production operations projected to occur in association with the future OCS Program can be found in Tables IV-7 and IV-8. Discharges from service vessels, which are estimated at 0.227 m^3 per person per day, are not included in these figures (NERBC, 1976). All liquid domestic and treated sanitary wastes are discharged overboard. It is expected that such discharges are rapidly diluted and dispersed.

Effects of Offshore Discharges

A number of studies have investigated the fate and effects of OCS discharges around production platforms in open waters (USDOI, MMS, 1990b). Major studies have included the Offshore Ecology Investigation in Louisiana Waters conducted by Gulf Universities Research Consortium (Ward et al., 1979); the Central Gulf Platform Study of the continental shelf off Louisiana conducted by Southwest Research Institute (Bedinger, 1981); the Buccaneer Field Study conducted off Galveston, Texas, by the National Marine Fisheries Service (Middleditch, 1981); and, most recently, the Produced Water Study conducted by Batelle for the American Petroleum Institute (Neff et al., 1989). Although focusing on estuarine waters, Rabalais et al. (1991) did examine a platform in nearshore waters off Louisiana. This information is included here, when applicable. The three studies conducted prior to 1989 have all been heavily reviewed and critiqued (USDOI, MMS, 1990b). Interpretation of the study results must factor in these criticisms and the fact that water depths in all five studies are less than the average depth of the platform locations projected from the Base Case. The Buccaneer Field (Middleditch, 1981) is in 21 m; the Eugene Island Block 105 and the Lake Pelto sites studied by Neff et al. (1989) are in water depths of 8.5 m and 3 m, respectively; and the Eugene Island Block 18 platform (Rabalais et al., 1991) is in 3 m of water.

Despite the flaws noted in these existing studies, they still can provide some insight into the fate and effects of OCS offshore operational discharges. The following summarizes the conclusions of the five studies: (1) Areas around many of the production platforms studied showed elevated concentrations of components that could have been from the platform operations. None of the studies found detectible trace metal or petroleum hydrocarbon contamination of waters and sediments beyond 200 m from the platform. (2) Decreases in faunal diversity or in the number of benthic infauna were documented around some platforms out to 300 m but, for most of the studies, not beyond small areas near the platforms. (3) The broad areas that were studied in the Central Gulf were often characterized as contaminated with pollutants from man's activities. Some implicated the Mississippi River as the probable source (Bedinger, 1981); others attributed it to the oil and gas industry. Neff et al. (1989) found barium present in sediments in his study area at concentrations substantially higher than expected of clean sediments. Neff projected that the excess barium may have been from areawide platform discharges of barium-laden drilling muds and produced waters. In two reports (Brooks, 1979; Brooks et al., 1977), Brooks concluded that produced waters are an important source of light petroleum hydrocarbon contamination in Texas-Louisiana shelf waters, particularly large amounts of low-boiling aromatics such as benzene and toluene.

Given the above, the following generalizations about expected production platform impacts due the future OCS Program activities are made: (1) Moderate petroleum contamination of superficial sediments will occur around production platforms. This contamination is likely to be at least out to 20 m, and possibly as far out as 200 m, particularly in very shallow inner shelf sites. (2) Future activities in the Gulf associated with the

OCS oil and gas industry are contributing to some regional contamination of waters and sediments in the Central Gulf of Mexico.

The MMS is preparing to examine the sublethal, chronic, long-term impacts of discharges around oil and gas production sites. The area that will be studied is the northwestern Gulf of Mexico, far enough west to be outside of the constant, confounding influences of the Mississippi River plume. Besides using standard methodologies that assess the fate and effect of OCS discharges, this multiyear suite of studies will examine the biological uptake, accumulation, toxicity, and metabolism of contaminants in the discharges. The studies will hopefully clarify many of the issues raised by earlier efforts, specifically regarding any chronic, sublethal perturbations that may be associated with long-term OCS Program production sites.

(f) Air Emissions

Offshore air emissions related to the OCS program result from platform operations; drilling of development, exploration, and delineation wells; helicopters, service vessels, shuttle tanker and barging of crude oil. Other air emissions result from catastrophic events such as oil spills and blowouts. Emissions related to OCS operations occur mainly from combustion or burning of fuels and natural gas and from venting or evaporation of hydrocarbons. The combustion of fuels occurs primarily on diesel-powered generators, pumps, or motors and from lighter fuel motors. Venting or evaporation of hydrocarbons occurs during loading, storage, and transportation of crude oil. Other emissions of hydrocarbons occurs during evaporation from oil spills and discharge of bilge water, and direct release of gases during blowouts. Emission rates for OCS infrastructures are presented in Section IV.A.2.d.(7). Total air emissions over the 35-year OCS program are listed in Tables IV-7 and IV-8.

Emission factors of primary pollutants for accidental releases of oil or blowouts are presented also in Section IV.A.2.d.(7). These catastrophic events generally produce high-level emissions over a very short time in a localized area. Events such as oil spills or blowouts, with or without fire, are nonroutine in nature and are unpredictable. The release of air pollutants from oil spills is high during the first hour and decreases rapidly thereafter. A blowout that results in a gas discharge without fire releases only hydrocarbons, natural gas, or hydrogen sulfides if present. If the blowout occurs with fire, combustion by-products, including all primary pollutants, would be released. The number of blowouts estimated to occur during the OCS program are 130 in the CPA and 74 in the WPA (Tables IV-7 and IV-8).

(g) Noise

In addition to noise emissions from OCS oil and gas activities that result only from the proposed action, noise emissions originate from the on-going OCS program (for general discussion of noise levels see Section IV.A.2.d.(7)). Noise emissions are associated with the operation of offshore platforms, drilling rigs, seismic surveys, and helicopter and service-vessel traffic (Helicopter Safety Advisory Conference, 1991). The absolute amount of noise emissions from the on-going OCS program is unknown and may vary seasonally. Noise emissions associated with non-OCS activities are variable and may be loud or soft, transient or constant (in particular areas such as entrance fairways to major harbors). Noise emitted from these activities may also affect fish resources, marine turtles and mammals proximate to the activities.

(h) Blowouts

Section IV.A.2.d.(8) provides general information on blowout events, their expected duration, statistics on types of operations that have resulted in blowouts, and data on historical occurrences. Expected impacts associated with blowouts are described, especially the potential for associated oil spills. Blowouts can occur during any phase of oil development: exploratory drilling, development drilling, production, and workover operations. This information was used to estimate the number of blowouts that could occur from future OCS Program operations during the 35-year life of the proposed actions. Tables IV-7 and IV-8 provide the total numbers projected over this time period: 130 blowouts are expected to occur in the CPA, with 7 during the peak year of activity; 74 blowouts are expected to occur in the WPA, with 6 occurring during the peak year.

(i) Offshore Spills

Hydrocarbon development activities that occur as a result of the OCS Program create concerns about crude oil, diesel, and condensate spills. A spill event can occur on OCS waters, and because of oceanographic and meteorological processes, it can be transported to nearshore or coastal areas. Besides spills, there are chronic leaks from offshore facilities, transportation, and or processing facilities. These leaks are in general less than or equal to 1 bbl. Materials that can be spilled during the activities include crude oil, condensates, diesel, and other pollutants. These spill events occur in a random fashion in time and space; therefore, any attempt in describing these random processes use statistical procedures and techniques. Section IV.C. presents a discussion of the statistical techniques, rates, probabilities, and assumptions about OCS spills in offshore areas. Also, the section presents details of the historic occurrence of spills, processes, and characteristics of the spills discussed in this document. The estimated number of occurrences of oil spills of different size categories under the OCS Program scenario in the CPA and WPA is shown in Tables IV-7 and IV-8.

c. Description of Onshore/Coastal Operations and Impacting Factors

(1) Onshore Infrastructure and Activities

The high concentration of oil and gas activity that has occurred in the CPA and WPA has been accompanied by extensive development of onshore service and support facilities. Section IV.A.3.a. describes the types of onshore infrastructure operations and facilities that have been used to support these offshore operations. It is expected that the vast majority of the onshore service, support, and hydrocarbon-processing facilities already in existence will be sufficient to explore, develop, and produce the oil and gas resources that are projected to result from prior, proposed, and future sales in the CPA and WPA. No new infrastructure is expected to be constructed in coastal areas adjacent to mature offshore areas, i.e., areas that have routinely experienced years of active oil production and development. There is some minor infrastructure projected to be constructed to support new oil and gas development operations in offshore areas not yet developed (the Western Gulf oil fields and the area east of the Mississippi River). Tables IV-12, IV-13, and IV-14 provide the number of existing and projected onshore facilities expected to be utilized to support future OCS Program activities by coastal subarea for the CPA, WPA, and the total Gulf, respectively. Subareas C-4 (Mississippi/Alabama), W-1 (Mustang and Matagorda Islands), and W-2 (Matagorda Peninsula and adjacent lands) are expected to have new pipeline landfalls with associated gas processing, separation, and terminal facilities.

The future status of the existing facilities is not shown in Tables IV-12 through IV-14. This status is most important to socioeconomic conditions in the future. Projections of OCS Program activities in mature areas of the Gulf depict a significant decline in offshore operations over the next several decades, occurring in association with projected declines in the hydrocarbon resources of the Gulf. This offshore activity decline will likely lead to closures of existing onshore infrastructure in coastal areas that support existing development.

(a) Service and Construction Facilities

These facilities include platform fabrication yards, pipecoating yards, service bases, and heliports. No new facilities in any of these categories are expected to be constructed under the OCS Program scenario, as shown in Tables IV-12 through IV-14. In fact, both existing construction and service facilities are expected to decline significantly over the next several decades in association with projected declines in the hydrocarbon resources of the Gulf. Evidence of this trend is already appearing. During the last 4 years, for example, 4 pipeyards have closed and 11 platform fabrication yards have either closed or been temporarily idled. Although the total number of active platforms in the Gulf has been increasing each year through 1990, the rate of annual increase

Table IV-12

Onshore Scenario Information Related to OCS Program Activities in the Central Planning Area for the Years 1993-2027

	Onshore Subarea*					
Onshore (Total / Peak Year)	C-1 OCS Program Activities	C-2 OCS Program Activities	C-3 OCS Program Activities	C-4 OCS Program Activities	W-2 OCS Program Activities	Total CPA OCS Program Activities
Oil Landings				**		
Pipeline Transported Oil (MMbbl)	212 / 9	3,182 / 139	1,663 / 73	118 / 5	0 / 0	5,175 / 227
Shuttle Tanker Offloadings						
From CPA	0 / 0	0 / 0	45 / 2	0 / 0	0 / 0	45 / 2
From EPA	0 / 0	0 / 0	488 / 22	42 / 2	0 / 0	530 / 26
Total Shuttle Tanker Offloadings	0 / 0	0 / 0	533 / 24	42 / 2	0 / 0	575 / 28
Barge Offloadings	3,410 / 150	1,710 / 70	1,540 / 70	0 / 0	170 / 10	6,828 / 299
Onshore Accidents						
Onshore Oil Spills						***
>1 and <50 bbl	****NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	20-35 / 2
>50 and <1,000 bbl	****NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	3-5 / 1
>1,000 bbl	****NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	1 / 1
Support Activities						
Helicopter Land Crossings (1,000's)	3,434 / 167	7,822 / 379	6,868 / 333	572 / 28	382 / 19	19,079 / 925
Service Vessels						
Landings (1,000's)	248 / 13	250 / 13	157 / 8	19 / 1	26 / 1	701 / 36
Discharged Bilge Water (B liter)	1,454 / 58	1,454 / 58	930 / 58	116 / 6	174 / 6	4,076 / 209
Onshore Disposal of Offshore Wastes						
Produced Sands (1,000 bbl)	****NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	2,731 / 120
Produced Waters (MMbbl)	94 / NA	1 / NA	2,344 / NA	0 / NA	0 / NA	2,439 / NA
Drilling Fluids (1,000 bbl)	****NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	13,872 / 804
Onshore Infrastructure Construction (existing/new)						
Refineries	5 / 0	3 / 0	7 / 0	2 / 0	14 / 0	31 / 0
Gas Processing Plants	13 / 0	8 / 0	5 / 0	0 / 2	0 / 0	26 / 2
Terminals	32 / 0	23 / 0	25 / 0	0 / 1	0 / 0	80 / 1
Pipe Yards	3 / 0	4 / 0	2 / 0	0 / 0	3 / 0	12 / 0
Platform Yards	3 / 0	7 / 0	1 / 0	3 / 0	6 / 0	20 / 0
Service Bases	5 / 0	10 / 0	4 / 0	4 / 0	5 / 0	28 / 0
Separation Facilities	23 / 0	10 / 0	17 / 0	0 / 2	0 / 0	50 / 2
Navigation Channels	4 / 0	4 / 0	10 / 0	3 / 0	3 / 0	24 / 0
Pipeline Landfalls	49 / 0	53 / 0	42 / 0	2 / 3**	14 / 0	160 / 3
Onshore Pipelines (km)	1,453 / 0	1,571 / 0	1,246 / 0	179 / 48	NA / 0	4,449 / 48
Helicopter Hub	8 / 0	8 / 0	4 / 0	1 / 0	6 / 0	27 / 0

* See Figure IV-1.
** The oil transported to Subarea C-4 by pipeline includes 18 MMbbl originating in the EPA. Also, two new pipeline landfalls in C-4 (one oil and one gas) will be transporting some hydrocarbons from the EPA, and a proportionately small amount of service vessel and helicopter traffic will utilize shore bases in coastal areas adjacent to the CPA for activities in the EPA.
*** Assumptions are derived from historical trends but are not based on statistical analyses.
**** Data are not shown by subarea because of statistical uncertainties.

Table IV-13

Onshore Scenario Information Related to OCS Program Activities in the Western Planning Area for the Years 1993-2027

Onshore (Total / Peak Year)	Onshore Subareas* W-1 OCS Program Activities	W-2 OCS Program Activities	C-1 OCS Program Activities	C-2 OCS Program Activities	C-3 OCS Program Activities	Total WPA OCS Program Activities
Pipeline Transported Oil (MMbbl)	242 / 8	673 / 23	0 / 0	133 / 5	0 / 0	1,049 / 36
Shuttle Tanker Traffic (trips)	437 / 15	434 / 15	73 / 3	0 / 0	16 / 1	960 / 33
Barge Traffic (trips)	0 / 0	607 / 21	152 / 5	0 / 0	0 / 0	759 / 26
Onshore Accidents						
Oil Spills						**
>1 and <50 bbl	***NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	5-7 / 1
>50 and <1,000 bbl	***NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	1 / 1
>1,000 bbl	***NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	1 / 1
Support Activities						
Helicopter Land Crossings (1,000's)	848 / 32	1,007 / 38	795 / 30	0 / 0	0 / 0	2,650 / 100
Service Vessels						
Trips (1,000's)	64 / 4	88 / 5	47 / 3	13 / 1	0 / 0	211 / 12
Discharged Bilge Water (B liter)	203 / 13	279 / 16	149 / 10	41 / 3	0 / 0	669 / 38
OCS Waste Disposal						
Drilling Fluids (1,000 bbl)	***NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	9,322 / 619
Produced Sands (1,000 bbl)	***NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	602 / 20
Onshore Infrastructure Construction (existing/new)						
Refineries	6 / 0	14 / 0	5 / 0	3 / 0	2 / 0	30 / 0
Gas Processing Plants	0 / 0	2 / 0	4 / 0	2 / 0	0 / 0	8 / 0
Terminals	5 / 2	9 / 1	2 / 0	0 / 0	0 / 0	16 / 3
Pipe Yards	5 / 0	3 / 0	3 / 0	4 / 0	2 / 0	17 / 0
Platform Yards	5 / 0	6 / 0	3 / 0	7 / 0	1 / 0	22 / 0
Service Bases	7 / 0	5 / 0	5 / 0	10 / 0	0 / 0	27 / 0
Separation Facilities	5 / 0	8 / 0	3 / 0	0 / 0	0 / 0	16 / 0
Navigation Channels	6 / 0	3 / 0	4 / 0	4 / 0	3 / 0	20 / 0
Pipeline Landfalls	5 / 2	14 / 1	2 / 0	0 / 0	0 / 0	21 / 3
Onshore Pipelines (km)	NA / 80	NA / 40	NA / 0	0 / 0	0 / 0	NA / 120
Helicopter Hub	6 / 0	6 / 0	8 / 0	0 / 0	0 / 0	20 / 0

*   See Figure IV-1.
** Assumptions are derived from historical trends but are not based on statistical analyses.
*** Data are not shown by subarea because of statistical uncertainties.

Table IV-14

Onshore Scenario Information Related to OCS Program Activities in the Gulf of Mexico for the Years 1993-2027

Onshore (Total / Peak Year)	Onshore Subarea* C-1 OCS Program Activities	C-2 OCS Program Activities	C-3 OCS Program Activities	C-4 OCS Program Activities **	W-1 OCS Program Activities	W-2 OCS Program Activities	Total OCS Program Activities
Oil Landings							
Pipeline Transported Oil (MMbbl)	212 / 9	3,315 / 145	1,663 / 73	118 / 5	242 / 8	673 / 23	5,981 / 262
Shuttle Tanker Offloadings							
From CPA	0 / 0	0 / 0	45 / 2	0 / 0	0 / 0	0 / 0	45 / 2
From EPA	0 / 0	0 / 0	488 / 22	42 / 2	0 / 0	0 / 0	530 / 26
From WPA	73 / 7	0 / 0	16 / 2	0 / 0	437 / 10	434 / 14	960 / 33
Total Shuttle Tanker Trips	73 / 3	0 / 0	549 / 22	42 / 2	437 / 17	434 / 17	1535 / 61
Barge Offloadings	3,562 / 155	1,710 / 70	1,540 / 70	0 / 0	0 / 0	777 / 31	7,587 / 325
Onshore Accidents							
Onshore Oil Spills						***	
>1 and <50 bbl	****NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	25-40 / 2
>50 and <1,000 bbl	****NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	4-6 / 1
>1,000 bbl	****NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	2 / 1
Support Activities							
Helicopter Land Crossings (1,000's)	4,229 / 199	7,822 / 379	6,868 / 333	572 / 28	848 / 32	1,389 / 51	21,729 / 1,025
Service Vessels							
Dockings (1,000's)	295 / 14	263 / 11	157 / 10	19 / 1	64 / 4	114 / 6	912 / 48
Discharged Bilge Water (B liter)	1,603 / 68	1,495 / 61	930 / 58	116 / 6	203 / 13	453 / 22	4,745 / 247
Onshore Disposal of Offshore Wastes							
Produced Sands (1,000 bbl)	****NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	3,333 / 140
Produced Waters (MMbbl)	94 / NA	1 / NA	2,344 / NA	0 / NA	0 / NA	0 / NA	2,439 / NA
Drilling Fluids (1,000 bbl)	****NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	23,194 / 1,423
Onshore Infrastructure Construction (existing/new)							
Refineries	5 / 0	3 / 0	7 / 0	2 / 0	6 / 0	14 / 0	37 / 0
Gas Processing Plants	13 / 0	8 / 0	5 / 0	0 / 2	0 / 0	2 / 0	28 / 2
Terminals	32 / 0	23 / 0	25 / 0	0 / 1	5 / 2	9 / 1	94 / 4
Pipe Yards	3 / 0	4 / 0	2 / 0	0 / 0	5 / 0	3 / 0	17 / 0
Platform Yards	3 / 0	7 / 0	1 / 0	3 / 0	5 / 0	6 / 0	25 / 0
Service Bases	5 / 0	10 / 0	4 / 0	4 / 0	7 / 0	5 / 0	35 / 0
Separation Facilities	23 / 0	10 / 0	17 / 0	0 / 2	5 / 0	8 / 0	63 / 2
Navigation Channels	4 / 0	4 / 0	10 / 0	3 / 0	6 / 0	3 / 0	30 / 0
Pipeline Landfalls	49 / 0	53 / 0	42 / 0	2 / 3**	5 / 2	14 / 1	165 / 6
Onshore Pipelines (km)	1,453 / 0	1,571 / 0	1,246 / 0	179 / 48	NA / 80	NA / 40	4,449 / 168
Helicopter Hub	8 / 0	8 / 0	4 / 0	1 / 0	6 / 0	6 / 0	33 / 0

* See Figure IV-1.
** The oil transported to Subarea C-4 by pipeline includes 18 MMbbl originating in the EPA. Also, two new pipeline landfalls in C-4 (one oil and one gas) will be transporting some hydrocarbons from the EPA, and a proportionately small amount of service vessel and helicopter traffic will utilize shore bases in coastal areas adjacent to the CPA for activities in the EPA.
*** Assumptions are derived from historical trends but are not based on statistical analyses.
**** Insufficient data are available to permit calculations for individual coastal subareas.

has slowed markedly in recent years. Whereas from 1977 to 1985 the increase in the total number of platforms averaged 5.2 percent per annum; from 1986 to 1990, the rate of increase dropped by one-half to 2.6 percent. During the first six months of 1991, the rate of increase was 1.6 percent if projected to a full year. The MMS predicts the number of active platforms to begin to decline each year beginning in 1993. The reader must keep in mind that the changes in the number of active platforms in the Gulf from one year to the next reflect both the number of new platforms added and the number of old platforms removed during the year. The decline in the rate of increase in the number of platforms seen during the past several years could, to some extent, be the result of increased rates of platform removal rather than solely to decreased rates of new platform installations. Although increased rates of platform removals may be a factor contributing to declines in annual active platform counts, MMS does project a decline in the number of new platforms that will be installed each year. This decline should become precipitous during the second half of the first decade of the next century. Both platform removal and a decline in new platform installations are related to the onshore infrastructure decline.

Although the number of miles of pipelines installed in the Gulf has shown no apparent trend during the past 20 or so years, pipeyard activity has declined as witnessed by the closure of 4 out of 26 operating pipe yards in the Gulf area during the past several years. The pipecoating industry anticipates no expansion in business during the timeframe of the proposed actions (Jones, personal comm., 1991). This outlook is supported by MMS projections, which show a decline in the number of miles of pipelines installed each year in the Gulf over the next few decades (Table IV-7).

Another factor that could contribute slightly to the decline in traditional construction facility activity levels over the life of the proposed actions is the use of floating production systems, rather than fixed platforms and pipelines, in the Gulf for deep-water operations. The use of these production facilities will replace the platforms that would otherwise be needed for producing offshore fields, and will reduce the rate of new pipeline installations because production from floating production systems is assumed to be transported to shore by shuttle tanker. Also, industry has been increasingly using compliant structures for deep-water production. These structures, which use less steel than traditional rigid platforms, result in less activity at fabrication facilities. Industry has also been purchasing some compliant structural components from overseas manufacturers.

Although it is difficult to quantify the magnitude of the projected decline in the number of platform fabrication facilities over the 35-year time period analyzed, the range is likely to go from a few closures to a major decline in the industry. If a major decline occurs, this trend will not likely be initiated until the first decade of the next century. This document assumes that 90 percent of the platform fabrication yard capacity and 88 percent of the pipeyard capacity will be used for all future OCS Program activities during the life of the proposed actions.

Declines in the use of service facilities is also anticipated, based on the decline in the amounts of OCS activities that will require support from onshore. It is difficult to anticipate the closures of individual service bases, since the locations indicated in Table IV-15 could include up to several docking areas used by different oil and gas exploration and production companies and/or mud companies. It is likely, however, that some dock space will be abandoned during the next few decades. With the increasing interest in deep-water tracts, it is likely that service base activity will remain high at locations that can be used by deeper draft service vessels. These bases include Galveston, Texas, and Venice, Cameron, Fourchon, and Berwick, Louisiana (the base at Fourchon will be accessible for deep draft service vessels pending implementation of the COE's plans to deepen the channel to 5.5-6.7 m). Any service base closures are assumed to occur at other locations. It is assumed that, during the 35-year life of the proposed actions, 60 percent of the existing service base capacity will continue to be used to support OCS Program activities. This is based on the ratio of tideland to OCS oil production for the year 1989.

Heliport closures are not expected to occur, although the total number of trips will decline. The number of helicopter trips occurring to support OCS operations is also expected to decline during the life of the proposed actions. In 1989, approximately 2,000,000 trips took place in the Gulf area, most of which were related to offshore oil and gas operations. An estimate of the average activity level expected during the life of the proposed actions can be obtained by adding the total number of projected trips in the CPA and WPA (Tables IV-7 and IV-8) and dividing by the 35-year life of the proposed actions. These calculations show an average annual activity level of 1,100,000 trips, or nearly a 50 percent reduction compared to current activity levels. These numbers do not include the use of heliports located in Louisiana, Mississippi, and Alabama to service projected OCS operations in the Eastern Gulf. Activity levels in the EPA, however, are expected to be much less than levels in either the CPA or WPA (Table IV-9), and including EPA-related activity, would not change the numbers significantly. It is assumed that 90 percent of Gulf fleet helicopter trips are related to OCS Program activities.

Although the total number of helicopter trips is expected to decline, the duration of the typical trip will increase as activity moves into deeper water. Travelling times to deep-water activities will obviously be much longer. This document assumes that, although total trips will decline by about 50 percent over the life of the proposed actions under the OCS Program scenario, the total amount of flying time will remain constant. Therefore, no major declines in the size of the helicopter fleet is projected, and no heliports will close.

(b) Processing and Storage Facilities

As discussed in Section IV.A.3.a.(2)(d), a terminal is defined as the onshore metering station and storage site of liquid hydrocarbons transported to shore by either barges or pipelines. Four new terminals are projected to be built to meter and store oil from the four new oil pipeline systems making landfall in onshore areas adjacent to offshore areas not yet developed (Section IV.B.1.c.(2)). A new terminal will be built to support the projected oil pipeline landfall in Jackson County, Mississippi. This terminal could be located in wetland areas. Three new terminals will be built in Texas to support the oil pipeline systems terminating along the Texas Coast. One terminal is assumed to be constructed on Mustang Island, one on Matagorda Island, and one across the bay from the Matagorda Peninsula. Since OCS barging activity is expected to remain at current levels, no new barge terminals are expected.

Although new terminals will be constructed in onshore areas distant from the major concentration of support infrastructure, some existing terminals are projected to be closed as a result in the projected decline in OCS oil resource production. Future volumes of OCS oil and condensate transported by pipeline will decline in proportion to the decline in resources projected to be produced. Most pipeline systems in the Gulf carry oil from a number of leases and fields at any one time. It is assumed that enough oil from future leases will be transported through most existing pipeline systems to maintain the system in operation along with its shoreline terminal. This is especially true of existing pipeline systems projected to be connected to new pipelines carrying oil from leases in deeper water. It is unclear what will happen with shorter pipeline systems tied to one or two existing fields that will no longer carry any produced oil or gas to shore. Despite this uncertainty, it is expected that some terminals will probably close in the future given the overall decline in the offshore oil industry. For analysis purposes, maps of the existing and projected pipeline network were compared to find pipeline systems currently making landfall that only carry oil from one or two fields located close to State waters. Use of these systems is assumed to be discontinued in the next several decades and associated onshore processing facilities to be shut down along with the pipeline closures. Systems discontinued include 8 terminals in Louisiana, 5 in C-1 and 3 in C-2, and none in Texas. It is assumed that, for those terminals remaining open, 90 percent of the capacity of existing terminals will continue to service the OCS oil industry, with the remaining percentage servicing State offshore production.

Processing facilities include refineries, gas processing plants, and separation facilities. No new refinery construction is anticipated under the OCS Program scenario. A general discussion of the factors that enter into the decision to construct a new refinery and the regulatory and economic environment for new refinery construction is presented in Section IV.A.3.a.(2)(a). Although the percent of refinery capacity accounted for by OCS crude will decline in the future, refineries are expected to remain at current capacity by switching to foreign crude sources. This has already occurred at some refineries in the Gulf area, such as the Exxon facility in Baton Rouge, Louisiana, and the Chevron facility in Pascagoula, Mississippi, which almost exclusively use foreign crude sources. Therefore, no decline in refinery operations are anticipated during the 35-year life of the proposed actions. It is assumed that 10 percent of the refinery capacity along the Gulf Coast will be used for OCS Program production over the life of the proposed action, based on the current ratio of OCS oil production to all other oil sources entering the Gulf and on projected declines in OCS production in the future.

As discussed in Section IV.A.3.a.(2)(b), whenever a new gas pipeline system makes landfall, a new gas processing plant is anticipated. Two new gas pipeline landfalls are projected for Subarea C-4 (Section IV.B.1.c.(2)). Applying the assumptions described in Section IV.A.3.a.(2)(b), two new processing plants are expected to be built under the OCS Program scenario in coastal Subarea C-4. Two processing plants, rather than one, are assumed to be constructed because new production from leases in offshore Subarea C-3 east of the Mississippi River and nearby areas of the EPA are associated with gas containing impurities (primarily hydrogen sulfide) that will require the construction of a separate processing facility for each field and associated pipeline landfall.

While two new facilities are assumed to be constructed in Subarea C-4 to support activities in offshore areas not yet developed, the utilized capacity of existing gas plants will decline and may result in closures as total gas production offshore declines elsewhere in the Gulf. As an operating assumption in this document, plants are expected to close when the utilized capacity of OCS-related gas processing plants declines to less than 25 percent. This number was chosen because it is the current minimum capacity at which an existing plant is operating. Under this assumption, 14 plants are assumed to close during the next 35 years, beginning during the first decade of the next century. The gas processing plants associated with OCS production are assumed to process only OCS gas.

Separation facilities are co-located with terminals or gas processing plants. However, it is anticipated that most oil production will have separation components offshore on production complexes and that future onshore separation will serve gas processing plants. Given this, two new separation facilities are expected to be constructed under the OCS Program scenario, both to be built in Mobile County, Alabama, to separate the water from the gas resources projected to be transported to this area.

There are 63 existing separation facilities located in the Texas and Louisiana coastal area, with the vast majority (50) occurring in Louisiana. Of these 50 facilities, there are 15 separation facilities located in Louisiana that have historically discharged large amounts of OCS produced waters to surrounding waters (Rabalais et al., 1991). Based on new State regulations that have discontinued this practice, three have closed recently and another nine of these will close when the fields carrying produced water to them are abandoned. Besides these nine closures, separation facilities located at terminals or gas processing plants will close, along with these facilities. Without a knowledge of the co-location of separation facilities at the terminals or gas processing plants projected to be closed, it is assumed that there is a 50 percent chance that a separation facility would be co-located. Therefore, another 11 more separation facilities will close. This total projected closure of separation facilities represents a significant percentage (27%) of the total number of separation facilities currently in operation (63).

(2) Landings and Coastal Transport Operations

A general discussion of the movement of OCS liquid hydrocarbons onshore and at coastal landfalls is contained in Section IV.A.3.b. Tables IV-7 and IV-8 show the projected percentages of the liquid hydrocarbons expected to be produced under the OCS Program scenario that will be transported by pipeline, barge, and shuttle tanker. Tables IV-12, IV-13, and IV-14 show the number of barge and shuttle tanker landings and the amount of pipeline transported oil projected to occur in the various coastal subareas of the Gulf under the OCS Program scenario. Table IV-15 shows the number of landings of shuttle tankers and oil barges (as well as service vessels) by waterway and terminal.

Projected new offshore pipeline systems in the Gulf will result both in new pipeline landfalls and new onshore connected pipeline segments being installed in both the CPA and WPA. In the CPA, three new pipeline landfalls are projected for coastal Subarea C-4--the Mississippi-Alabama Gulf Coast in Jackson County, Mississippi (1--oil), and Mobile County, Alabama (2--gas). These landfalls will account for the installation of three onshore pipeline segments, totaling 48 km (Table IV-12). Two of these pipelines will be used to transport gas and one to transport oil. In the WPA, prior sales will account for the installation of 120 km of onshore pipe and three new pipeline landfalls (Table IV-13). Three new offshore oil pipelines are projected to make landfall in Matagorda County (Matagorda Peninsula)(W-1), Calhoun County (Matagorda Island) (W-1), and Nueces County (Mustang Island)(W-2).

Table IV-15

Waterway Usage by OCS-Related Navigation Associated With the OCS Program for the Years 1993-2027

Coastal Subarea	Waterway Usage	Landings: Service Base/Terminal	% OCS Usage OCS	Number of Service Vessel Offloadings: CPA OCS Program	Number of Service Vessel Offloadings: WPA OCS Program	Number of Barge Offloadings: CPA OCS Program	Number of Barge Offloadings: WPA OCS Program	Number of Shuttle Tanker: CPA & EPA OCS Program	Number of Shuttle Tanker: WPA OCS Program
C-1	Calcasieu Ship Channel		<10%						73
		Cameron		154,010	28,990				
		Lake Charles				1,366	114		
		Gibbstown				683	38		
	Freshwater Bayou		<10%						
		Intracoastal City		84,580	15,920				
		Kaplan		1,920	360				
	Mermentau Navigation Channel		<10%						
		Grand Chenier		5,770	1,090				
	Vermilion Bay/Bayou Teche		69%						
		Louisa		1,920	360				
		Weeks Island				1,366			
C-2	Atchafalaya River		33%						
		Amelia		4,470	230				
		Bayou Boeuf		2,240	120				
		Berwick		2,240	120				
		Freshwater City		4,470	230				
		Morgan City		143,060	7,470				
		Gibson				512			
	Bayou Lafourche/Belle Pass		42%						
		Fourchon		24,590	1,280				
		Leeville		13,410	700				
	Houma/Caillou/Terrebonne		31%						
		Dulac		31,290	1,630				
		Houma		22,350	1,170				
		Theriot		2,240	120				
		Gibson				512			
		Cocodrie				683			
C-3	Barataria Waterway/LaLoutre		<10%						
		Grand Isle		13,110					
	Miss. River Gulf Outlet		<10%						
		Hopedale		2,190					
	Miss. River Passes		<10%					533	16
		Venice		139,880					
	Empire Waterway		21%						
		Empire				1,536			
	La Loutre/St Malo/Ycloskey Miss. River/Harvey Canal		19%						
		Harvey		2,190					
C-4	Bayou LaBatre		<10%						
		Bayou LaBatre		1,120					
	Mobile Bay		<10%					29	
		Mobile		14,590					
		Theodore		1,120					
	Pascagoula/Bayou Casotte		<10%					13	
		Pascagoula		2,240					
W-1	Aransas Pass		<10%						
		Port Aransas			1,870				
		Ingleside			20,540				
		Rockport			1,870				
	Brazos Santiago Pass		<10%						
		Port Isabel			3,730				
	Corpus Christi Ship Channel		<10%						437
		Corpus Christi			1,870				
	Matagorda Ship Channel		<10%						
		Port O'Connor			31,740				
	Port Mansfield Cut		<10%						
		Port Mansfield			1,870				
W-2	Freeport Harbor Channel		<10%						143
		Freeport		6,330	21,180				
	Houston/Galv Channel		<10%						217
		Surfside		900	3,030				
		Galveston/Texas City		7,690	25,720		340		
		Pelican Island		3,170	10,590				
	Sabine Pass Ship Channel		<10%						74
		Sabine Pass		8,140	27,240				
		Port Arthur				171	267		
			TOTAL	701,200	211,000	6,828	759	575 *	960

*This number includes 530 shuttle tanker trips that originate in the EPA.

Table IV-14 shows the subareas receiving oil transported from all future OCS Program production during the 35-year life of the proposed actions. Subarea C-2 will receive over one-half of the pipeline transported oil produced under the OCS Program scenario; and over one-fourth of this oil is projected to make landfall in Subarea C-3. The other subareas in the CPA and WPA Gulf coastline will receive only proportionately small amounts of oil via pipeline.

One activity of concern under the OCS Program scenario is the repair and maintenance of older pipelines carrying OCS petroleum hydrocarbons in coastal waters and onshore. Figure IV-2 shows the age distribution of pipeline landfalls from OCS activities. This figure shows that over one-half of all pipeline landfalls are over 20 years old. Since 1970, all pipelines have been installed with cathodic protection with sacrificial anodes to protect the line from corrosion. Pipelines installed before 1970 are protected by running an electric current through the pipeline. Although these measures greatly extend the life of a marine pipeline, and industry does not anticipate a widespread effort to repair all aging lines, pipeline repairs in coastal areas may be needed in the future. Also, pipelines can become exposed at the shoreface or on the bottom of coastal waters as a result of shoreline erosion and bottom scour.

It is difficult to obtain data on the amount of repair work that has been conducted in recent years for these problems because many of these pipelines were permitted with a right to perpetual maintenance, or the original right to maintenance had been extended years ago and has not expired. In these situations, repairs and maintenance operations can be conducted without obtaining permits from COE or State agencies. As such, records on the frequency of occurrence of these activities are not readily available. The MMS is attempting to collect information on these activities, and the information will be included in the EIS when it is collected and compiled.

Section IV.A.3.b.(3) describes the navigation channel network available for use by OCS-related vessel traffic. Table IV-15 provides projections of the average usage of all major navigational channels along the Gulf Coast in support of OCS activities. Seven of these channels are used by the OCS oil and gas industry more than 10 percent of the time: Bayou Terrebonne, Bayou Lafourche, Empire Waterway, Bayou La Loutre/St. Malo/Yscloskey, Vermilion Bay/GIWW 159-160, the Houma/LeCorpe/Caillou waterway, and the Atchafalaya River/GIWW 79-95. All of these waterways are located in Louisiana. The Vermilion Bay/Bayou Teche system is projected to receive the most OCS traffic under the OCS Program scenario at 69 percent OCS usage. It is assumed that OCS usage of these channels under the OCS Program will be 12 percent.

(3) Onshore/Coastal Impacting Factors Related to the OCS Program Activities

(a) Disturbances from the Use of Existing and New Infrastructure

New onshore infrastructure construction, described above, is projected to occur in Mississippi, Alabama, and Texas (Table IV-14). The construction of the terminal in Jackson County, Mississippi, could occur in coastal wetlands and result in the conversion of wetlands habitat to dry land as a result of filling operations to prepare the construction site. It is expected that mitigation would be required that would replace wetland acreage lost acre by acre because of recent regulatory wetland protection measures. Onshore construction of the gas processing plants and separation facilities in Mobile County, Alabama, should be sited in upland areas because of the availability of ample upland space. Construction of the pipelines and terminals on Texas barrier beaches could alter coastal sedimentation and erosion patterns if the site was protected from erosion by armoring of the site.

Construction of these onshore support bases and ancillary access facilities and all associated hydrologic modifications would result in some runoff and other nonpoint source pollution to the surrounding bodies of water. Navigation channels and canals and other bodies of water may be diked, leveed, or impounded; piers, bulkheads, and beach-stabilization actions may be undertaken. To construct the support facility, the site must be prepared, roadways and bridges may need to be built, sewage and storm water systems installed, and groundwater or adjoining bodies of water accessed for water use. During preparation in upland areas, the vegetation is cleared from the area, the topsoil exposed, and the soil profile is altered by grading and leveling operations. The soil is compacted by the constant movement of heavy machinery, which in turn alters the retention properties of the soil and gives rise to increased erosion and runoff from the site.

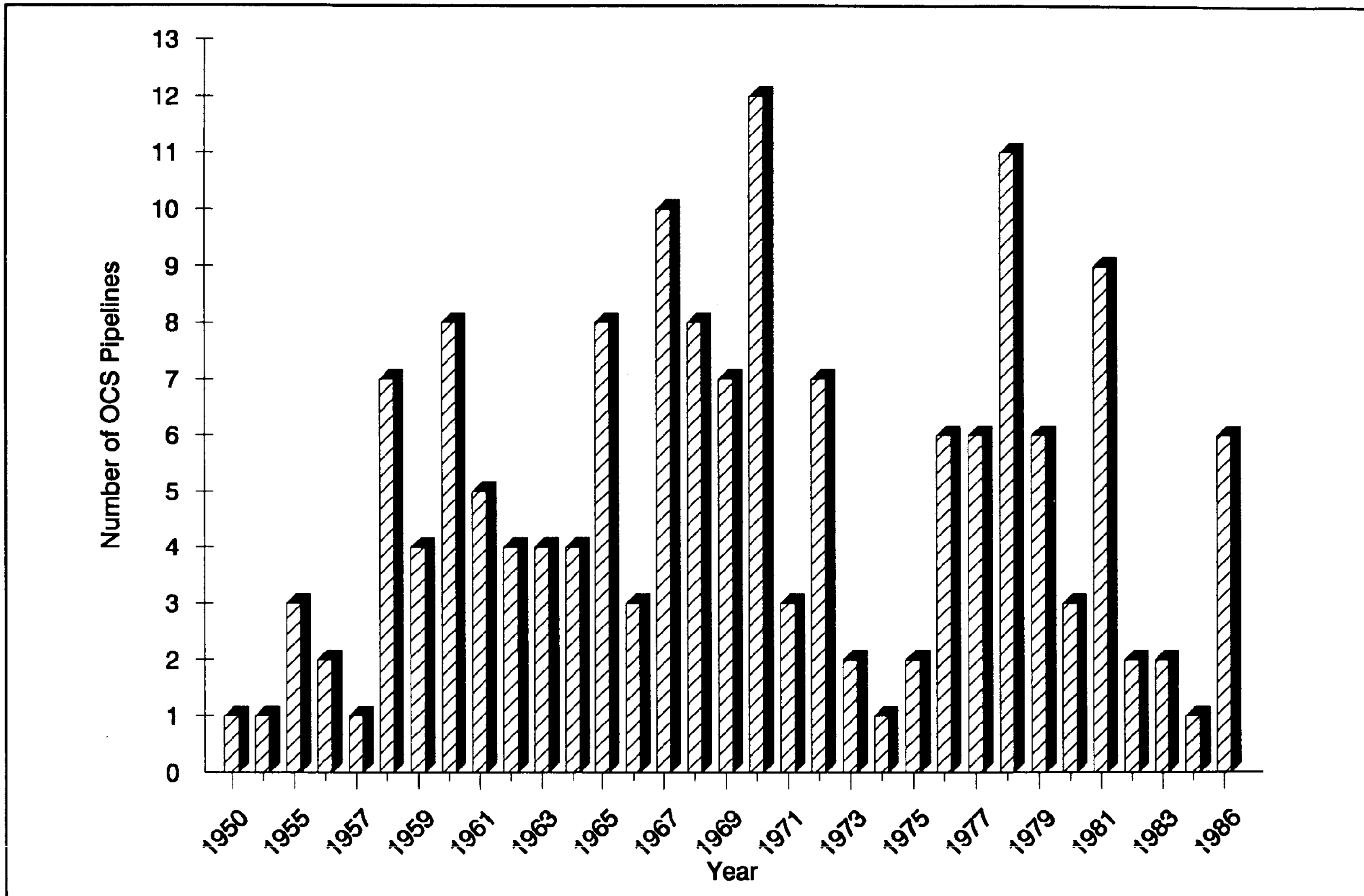


Figure IV-2. Number of OCS Pipeline Landfalls (based on Wicker et al., 1989).

The three projected coastal pipelines in Mississippi and Alabama will all be built across coastal wetlands and can result in direct and indirect impacts. These impacts have been discussed in EIS 139 and 141 in Section IV.A.5.(3)(a), and are hearby incorporated by reference. The direct impacts of new pipeline installation projects in wetlands has been reduced in recent years by virtue of new pipeline projects being back-filled after the pipeline is installed. Back-filling, by partially filling in the canal cut and levelling spoil banks, reduces the amount of wetland area converted to non-wetland habitat, and reduces indirect impacts by reducing salt water intrusion and removing the drainage interference effects of spoil banks. Turner and Cahoon (1987) have shown a reduction from 2.49 ha/km of average direct impacts in the past, to projected impacts of 0.68 ha/km in the Chenier Plain and 1.05 ha/km in the Deltaic Plain with backfilling.

Once constructed, the new infrastructure along with all existing infrastructure, as described above in IV.B.1.c.(1) can generate air emissions, routine point and nonpoint source discharges, and other operational liquid and solid wastes, as well as experience accidental spills, which can contaminant the coastal environment, as well as affect coastal landfill capacities. Other activities associated with onshore infrastructure that could affect the coastal environment include the movement of oil via pipeline, barge, and shuttle tanker; the offloading of oil at terminals; and the use of navigation channels by OCS-related traffic.

Operational discharges are discussed under each facility description in Section IV.A.2.d.(3).but are summarized here also. At service bases and marine terminals, hydrocarbons and other pollutants are discharged in the bilge and ballast waters of support vessels docking at these facilities. The bases and support vessels also contribute contaminants through their use of antifouling marine paints and through accidental oil-spillage events and the release of heavy metals and contaminated sludge. Pipecoating yards, platform-construction facilities, and repair and maintenance yards contaminate surroundingwaters by releasing thermal effluents, radioactive substances, antifouling paint chemicals, heavy metals, and a variety of process waters, as well as solid waste such as packaging materials, metal scraps, and other debris. Gas processing plants and refineries discharge a number of types of waste waters, including cooling and boiler waters, sanitary and domestic waste waters, and process waters. These waters may be contaminated with dissolved hydrocarbons, sulfuric acid, chromium, zinc, phosphates, alkaline substances, and suspended solids.

The NORM deposits may also accumulate in gas-plant equipment, separation facilities, and pipe yards. In gas-plant equipment, the NORM deposits may accumulate from radon-222 (radon) gas progeny. The gas is dissolved in the organic petroleum fractions in the gas plant and partitioned mainly into the propane and ethane fractions by its solubility (Rogers & Associates, 1990). Components having the highest levels of NORM include reflux pumps, propane pumps and tanks, and other pumps and product lines. In separation facilities where the separation of water occurs onshore, water handling equipment can become contaminated with NORM. Heater treaters, water knockouts, liquid product tanks, separators, tubing and piping, water transfer pumps, and other produced-water handling equipment accumulate radium isotopes in the form of scale.

Onshore point source discharges will be subject to treatment by municipal and industrial facilities in compliance with Federal and State discharge permit requirements. The NPDES permits are issued on a facility-by-facility basis, limiting the quantities of contaminants in and the temperature of each facility's effluent. These limits reflect a site-by-site specific analysis of flushing- and mixing-zone rates of the receiving body and the indigenous population's ability to tolerate elevations of temperature and pollutant concentrations.

The ongoing operation of these onshore facilities used in support of the proposed actions is expected to result in some routine nonpoint source pollution. The facility's presence, along with access routes, alters the natural hydrology and geography of the area over time. The volume and rate of storm-water runoff will remain greater than before construction; saltwater intrusion may occur; and, with existing vegetation modified, greater erosion around the facility may take place.

Increases of nonpointsource pollution due to runoff at support facilities may contribute particulate matter, heavy metals, petroleum products, chemicals, and radionuclides (particularly from pipe yards) to local streams, estuaries, and bays, causing temporary elevations in pollutant and turbidity levels. Two major pollutants are contained in this runoff--suspended solids (organic and inorganic) from exposed soil at the site and contaminants such as heavy metals.

(b) Vessel Usage of Navigation Channels

Vessel usage of navigation channels can cause impacts as a result of erosion of the channel bank from vessel traffic, operational discharges from vessels within the channels, and maintenance dredging or new dredging required in support of OCS onshore support vessel activity. Section IV.A.3.c.(3)(b) discusses expected characteristics of operational discharges from service vessels. Quantities estimated to be discharged during the 35-year life of the proposed actions from all OCS Program service vessel traffic are found in Tables IV-12 through IV-14.

Once dredged, navigation channels can continue to cause impacts to adjacent wetlands by widening of the channel. Johnson and Gosselink (1982) have shown that channels with high navigation usage in coastal Louisiana widen about 1.5 m/yr more rapidly than channels with little usage. The contribution of the OCS traffic under the OCS Program scenario is assumed to account for 12 percent of the vessel traffic in coastal channels, and a corresponding proportional contribution to the overall channel widening problem along the coast.

No new channels are projected to be dredged under the OCS Program scenario. As discussed in Section IV.A.3.c.(3)(c), the amount of maintenance dredging that can be attributed to OCS operations cannot be quantified at the current time. It is assumed that the navigation channels used by OCS vessel traffic (Table IV-15) will be dredged every other year. It can be assumed that 12 percent of the maintenance dredging in these channels can be attributed to OCS operations.

In the future, some deepening of navigation channels may occur as a result of the need for providing access to service and supply bases for deeper draft vessels needed for deep-water operations (Section IV.A.3.c.(3)(c)). Based on the locations of projected oil and gas resources under the OCS Program scenario and existing plans by the U.S. Army Corps of Engineers to deepen existing channels, it is assumed that two navigation channels will be deepened from 5.5 to 6.7 m (17-22 ft) to provide access to service bases for deep-draft service vessel movement directly related to OCS program operations. These channels are projected to be located in coastal Subarea W-1 near Corpus Christi, Texas, and at Subarea C-2 in Fourchon, Louisiana.

(c) Onshore/Coastal Disposal of Offshore Wastes

The issue of onshore waste disposal is more related to future OCS Program activities than to a specific sale because it is the annual large quantities of such wastes brought onshore that presents the problem.

If OCS drilling and production wastes cannot meet the U.S. Environmental Protection Agency's NPDES effluent limitations or if these limitations require zero offshore discharge, offshore operational wastes must be transported to shore for onshore disposal. New proposed effluent limitations and their changes to current disposal practices is discussed in Section IV.A.2.d.(5). If USEPA finalizes its proposed effluent limitations, these limitations would greatly increase the amount of both drilling and production solid wastes brought onshore. Wastes are either piped ashore or loaded on supply boats or barges and transported to shorebases. Once onshore they may be loaded on trucks or other barges to reach a commercial facility. Onshore disposal alternatives include landspreading, landspreading with dilution, burial with unrestricted site use, burial in plugged and abandoned wells, well injection, hydraulic fracturing, or injection into salt domes. Because of NORM contamination, a large quantity of a variety of wastes are being temporary stored within drums in Louisiana until a final disposal site can be approved.

Waste disposal is one of the most difficult problems expected to face the United States public in future years. There is currently considerable concern in the Gulf region about OCS waste onshore disposal practices, primarily because of known past impacts to land use and environmental damage near disposal sites.

Section IV.A.3.c.(4). discusses documented damage from oilfield waste disposal, current regulations by MMS relating to waste disposal, and discusses current efforts to resolve the disposal of NORM-contaminated wastes.

Nonhazardous Oil-field Waste Facility Capacities

Most oil-field operational wastes, such as produced sands and drilling muds, generated by the Gulf of Mexico oil and gas industry are landfarmed or placed in landfills located at oil-field waste commercial facilities, called nonhazardous oil-field waste (NOW) sites. These sites are nonhazardous because of their exemption from hazardous waste regulations under RCRA (Section I.B.3.d.(3)(e)). Oil-field waste disposal is regulated by the State of Louisiana who requires that most operational wastes be disposed of at NOW facilities permitted by the State of Louisiana, Department of Natural Resources (State regulations 29-b). An analysis was completed by the MMS regional staff to evaluate the capacity of such solid-waste disposal facilities located along the Gulf Coast to handle future onshore waste disposal. The disposal in onshore landfills of common trash and debris generated from the OCS oil industry is discussed separately below.

The MMS analysis relied heavily upon an assessment prepared for the USEPA by ERCE as part of their regulatory analysis for their effluent limitation regulations (USEPA, 1991). The USEPA considered eight NOW facilities in operation at the time; three more disposal sites permitted to receive oil and gas wastes but not yet receiving such wastes; and five hazardous waste disposal sites that they felt could accept nonhazardous oil-field wastes. The USEPA analysis only addressed the disposal of offshore drilling wastes. The ERCE report (ERCE, 1991) concluded that there will be adequate capacity at Gulf region commercial facilities to handle estimated volumes of drilling wastes requiring onshore disposal (projections through the year 1995). The report did not account for the use of these landfills by other industries or municipalities, did not account for production wastes and trash and debris disposal needs, and considered no dewatering of the wastes prior to landfarming.

The MMS analysis did not include the capacities of hazardous waste facilities located in the Gulf region in their total capacity estimate because the State of Louisiana felt these facilities would be unsuitable and too costly for oil and gas wastes disposal. The MMS analysis did include the disposal of all projected OCS-generated production solids at NOW sites, although no attempt was made to account for that portion of solids contaminated with NORM and therefore rejected by NOW sites. Thus, estimates of volumes of production wastes are conservative and likely larger than the volumes that will be received at NOW sites. Drilling muds were expected to be dewatered by 50 percent prior to disposal by landfarming or landfill.

Telephone conversations were made to the largest facilities identified in the State of Louisiana Approved Commercial Facilities NOW Site listing, and the listing of facilities from the USEPA analysis were modified to account for more recent information regarding capacities and number of NOW facilities. As of January 1992, there are six NOW facilities in operation (3 facilities were consolidated) and three not in operation but having disposal capabilities, with a total capacity of 43.11 MMbbl per year. Of the nine commercial facilities handling drilling muds and cuttings for the Gulf OCS oil industry, three dispose of the waste by landfills and six by waste treatment and landfarming. Of these, one also has incineration activities and one uses wells for some disposal.

Through conversations with the largest facility (Brazzel, personal comm., 1992), it was learned that about 25 percent of the total volume of oil-field wastes received at the facility was attributable to the OCS oil and gas industry. Applying this 25 percent to all NOW site capacities reduces the total NOW site waste disposal capacity available for future OCS solid-waste disposal to 10.8 MMbbl per year.

The total volume of dewatered drilling muds and produced sands requiring onshore disposal and generated from activities associated with total OCS Program activities is calculated from Table IV-14 and totals 14.93 MMbbl during the next 35 years, which averages about 0.427 MMbbl per year. Although not included in the table, if 18 percent of drill cuttings are also brought onshore (Jordan, personal comm., 1992), this number can increase to 0.586 MMbbl per year.

It is noted that this analysis does not consider one type of OCS waste brought to NOW facilities--production storage tank sludges--primarily because no future estimates are available. However, it is assumed that tank sludges are a very small portion of the total wastes disposed of onshore, and this omission is not expected to greatly change the estimated total volume of solid-wastes to be disposed of onshore in the future.

Comparing the known Gulf Coast capacity for OCS solid-waste disposal (10.8 MMbbl/year) to the estimated total OCS Program volume of these wastes (0.586 MMbbl/yr) indicates that there is excess capacity at Gulf Coast commercial facilities for receipt of future operational wastes.

Municipal Landfill Capacity

Trash and debris, as defined above, are not allowed to be disposed of at NOW facilities, according to State of Louisiana regulations. Discussion with industry shows that these wastes are disposed of at municipal landfills largely located in the coastal zone. At present, there is no estimate of the volumes of trash and debris being brought onshore for disposal. Without such estimates, it is difficult to determine if future disposal will exceed landfill capacity. Given the uncertainties, but being aware of the problem with landfills in general, it is assumed that one landfill will need to be developed to receive OCS trash and debris generated from all future OCS Program activities. This landfill will be built in the Louisiana coastal zone but not in any wetlands.

The creation of one landfill is not expected to result in adverse effects to public services and community infrastructure. It may, however, result in emotional stress to those persons living in proximity to the new landfill sites. The disposal of offshore wastes would, in this case, result in adverse impacts to social patterns in a limited area near the newly created landfills. This adverse effect could be mitigated by properly planning future landfill locations.

The following discussions provide further information on specific types of OCS offshore operational wastes disposed of in onshore areas.

Produced Waters

Realizing that USEPA's effluent limitationsregulations are not finalized nor that industry has complied with the State of Louisiana's new regulations, this document assumes that these regulations will be successful in limiting the quantities of produced waters discharged into coastal surface waters. It is assumed that there will not be any OCS produced waters shipped onshore and discharged into inland surface waters after the year 1997.

Although not discharged into surface waters, about 20 percent of OCS produced waters generated as a result of future OCS Program oil and gas production will continue to be piped onshore to Louisiana for disposal (2,439 MMbbl) (Table IV-12). Disposal methods will be very different from past practices. This projection is based on the future operating status of the 15 largest, existing coastal OCS produced-water separation facilities. The locations of some of these OCS coastal separation facilities are on barrier islands or in State nearshore, open waters; and in areas near the shoreline, as in Pass Fourchon. These facilities either receive produced waters mixed with oil from a number of pipeline systems serving a number of fields and operators or they are field specific. For instance, the Fourchon terminal receives produced waters from 20 blocks. These multi-field facilities all gave some indication that they hoped to receive produced waters from new leases in deeper waters. The facilities receiving waters from a number of systems are upgrading, expanding, and/or centralizing their processing components. Most are improving their pit systems and changing their discharge points as the result of consultations with the State of Louisiana. Two of these sites, the Grand Isle and Sabine Pass separation facilities, will inject future produced waters into wells. The Pass Fourchon and Timbalier Island multi-field facilities will continue to operate but will ship the separated produced waters back out to OCS waters. Four of the 15 facilities do not, at present, fall under the criteria for prohibition as outlined by the State of Louisiana (one discharges into open waters and three into the Mississippi River or its passes). Two facilities are shutting down. Seven of the 15 major separation facilities only receive produced waters transported from one or two large fields leased by one operator and usually located in waters near the 3-mi State boundary. These facilities would not receive produced waters from future leases but are included in this analysis because they will continue to discharge produced waters from future oil production from the existing leases until the fields are depleted.

Production and Drilling Solids

It is projected that 18 percent of drilling muds and cuttings generated during drilling operations associated with future OCS Program drilling activities will be shipped onshore for disposal. This is based on the following assumptions: (1) oil-based drilling muds will be used when drilling wells beyond 10,000 in depth; (2) exploration and delineation wells will be drilled to an average of 13,500 ft; (3) all oil-based muds will be shipped onshore; and (4) the proposed effluent limitations preferred options will be finalized, therefore, all muds generated within 4 mi from shore will be shipped onshore. Total quantities of drilling muds and cuttings disposed of onshore are provided in Tables IV-12, IV-13, and IV-14.

It is projected that 100 percent of production solids will be disposed of onshore. This projection is based on USEPA's proposed effluent limitation for produced sands is zero offshore discharge. Section IV.A.2.d.(5)(d) discusses produced solids in more detail. Because of NORM contamination of these solids, many of the solids have been temporarily stored in drums at service bases until an approved disposal site can be found.

Production Equipment

Not all scale is removed from equipment and disposed of with produced sands. Scale is a hard, rock-like flow restrictive substance that may form and adhere to downhole tubulars and in association with above-ground processing and transparent equipment and piping. As wells and facilities reach the end of their economic life, plugging and abandonment procedures are performed on the wells, and the production facilities are removed. Pipes removed from the wells and the process equipment may have accumulations of scales within. These scales may contain Ra-226 and Ra-228 in concentrations averaging 0.1-2,800 picoCuries per gram (pCi/g). Some of these levels have been measured as high as 100,000 pCi/g. Presently, such accumulations prohibit the sale of this equipment either as scrap metal or for reuse in ways other than which they were originally intended. Therefore, these tubular goods must be cleaned to remove the contaminants before the transfer of ownership. Once removed, the contaminated wastes are returned to the operators for appropriate disposal. Because of the cost involved in contaminant removal, many operators have elected to stockpile the tubulars and process vessels at operator-owned facilities or NOW sites until a cost-effective method of radioactive scale removal is found. Although no estimate of the number of pipe stored onshore from OCS Program operations is available, some minor impacts to land use from this operation are expected to occur.

Other Solid-wastes

Besides drilling and production wastes, the State of Louisiana has expressed concern for the transport to shore of other types of solid-wastes, such as mud bags, drums, crates, and a variety of domestic wastes that often are disposed of at municipal landfills.

Regarding the trash and debris subcomponent of solid-wastes, MMS has been very active in promoting industry reduction. We issued NTL 86-11, *Guidelines for Reducing or Eliminating Trash*, recommending that operators and their contractors and subcontractors develop and implement proper trash handling education and training programs. The NTL also recommended reduction and compaction for all waste materials sent to onshore disposal sites. In May 1990, MMS contacted all lessees and operators, strongly encouraging use of large containers/bulk storage offshore. Recent evidence available from industry indicates a widespread cooperation with our recommendations.

(d) Onshore/Coastal Spills

The impact from oil spills associated with the OCS oil leasing program to the environmental resources identified in this document is one of the greatest concerns identified by the public. Although beyond the regulatory authority of MMS, spills can occur from onshore activities supporting the production of OCS oil and gas. Impacts from those spills are analyzed in Section IV.D. These spills are most likely to occur at coastal or onshore storage and processing facilities, particularly at the terminal transfer points and from coastal pipelines and barges moving OCS oil to processing facilities. Because MMS does not maintain records of these spills, the U.S. Coast Guard database on spills was used. This database does not distinguish the source of the spill incident, so projected onshore spill occurrences occurring from proposed action activities are estimates of the likely subset of the larger database. Assumptions of spills occurring from OCS Program onshore support operations occurring during the 35-year life of the proposed actions are provided in Section IV.C.1.

2. State Oil and Gas Activities

a. Leasing, Production, and Associated Infrastructure

Comprehensive information on oil and gas activities in State offshore and coastal waters in the Gulf of Mexico Region has not been compiled. Many activities carried out in State waters prior to the 1950's were neither documented nor permitted in the way they are now, and information is scarce or lacking (Groat, personal comm., 1984).

In Texas State offshore waters, accumulated oil and gas production through October 1989 was 22.2 MMbbl of oil and 2,888 Bcf of wet gas (gas that includes condensate). Annual oil production peaked in 1977 at 2.6 MMbbl; whereas, annual gas production peaked in 1980 at 254 Bcf. Of the some 280 rigs operating within the State, 15 were located in offshore waters and none were located in inland waters (Oil and Gas Journal, 1991). In addition, no inland drilling barges were operating in Texas coastal waters at that time. Approximately 1.95 MMbbl/day of crude oil and lease condensate are produced within the State (Oil and Gas Journal, 1991).

In Louisiana State offshore waters, accumulated oil and gas production to January 1, 1988, was 1.442 Bbbl and 10,657 Bcf, respectively. Annual oil production peaked at 72.1 MMbbl, whereas annual gas production reached a peak of 604 Bcf in 1972 and thereafter steadily declined. The Louisiana Mineral Board conducts lease sales monthly. Of the some 90 rigs operating within the State, 43 were located in offshore waters and 13 were located in State inland waters (Oil and Gas Journal, 1991). In addition, 29 inland drilling barges were operating in Louisiana coastal waters at that time. Approximately one million barrels per day of crude oil and lease condensate are produced within the State (Oil and Gas Journal, 1991).

The State of Mississippi has experienced a limited amount of offshore activity. Three exploratory wells were drilled in the 1950's; all were dry holes, and the relevant leases have expired. In late August 1986, an exploratory oil and gas well was drilled in Mississippi coastal waters 7 km (4.5 mi) south of Ship Island. Fifteen days after drilling had begun, the drilling was terminated. Currently, 14 land-based rigs are operating in the State, with no active leases in Mississippi State waters. Thirteen rigs are operating within State onshore areas (Oil and Gas Journal, 1990). Approximately 73,000 bbl/day of crude oil and lease condensate are produced within the State (Oil and Gas Journal, 1991).

Oil and gas activity in the State of Alabama's offshore waters has increased over the past few years. The Lower Mobile Bay Mary Ann Field was discovered in 1979. Since that initial discovery, several others have been made, confirming the commercial potential of natural gas in Mobile Bay. There are two producing fields in Alabama State waters--the Lower Mobile Bay Mary Ann Field and the South East Mobile Bay Field. Of approximately eight rigs operating within the State, three are located in offshore and inland waters (Oil and Gas Journal, 1990). Approximately 49,000 bbl/day of crude oil and lease condensate are produced within the State (Oil and Gas Journal, 1991).

The State of Florida has experienced a limited amount of drilling in State coastal waters. Between 1945 and 1983, 29 exploratory wells were drilled in waters under Florida jurisdiction at sites extending along the entire Gulf Coast from Pensacola to the Keys and Dry Tortugas. None of these wells resulted in development or production. Coastal Petroleum Company holds the only two active leases in Florida waters as of January 1989. These leases, which date back to the 1940's, are large in size and geographic coverage. Currently, there is a moratorium on drilling activity in Florida State waters, and the State has no plans for lease sales in the future. One rig is now operating within State onshore areas (Oil and Gas Journal, 1991). Approximately 10,000 bbl/day of crude oil and lease condensate are produced within the State (Oil and Gas Journal, 1991).

b. Related Concerns

(1) Drilling-Related Wastes

In 1989, the Louisiana Department of Natural Resource estimated that approximately 13,000 oil-field waste pits existed in the State. Other projections have been as high as 20,000. Traditionally, reserve pits associated with onshore drilling operations consist of one large pit into which drilling muds and cuttings, wash water, rainwater, and other liquid wastes are placed and stored until operations begin. Problems associated with managing these pits result from contaminated materials being introduced into uncontaminated materials, rendering the contents of the pit unsuitable for on-site treatment or disposal. Closed mud systems are often employed in situations where total haul-off of all drilling wastes is anticipated. Use of these systems reduces not only waste volumes, but disposal costs as well (Spell, 1990).

On-site pits are often used to handle categories of oil and gas wastes other than produced water, including drilling muds and associated oil-field wastes (fracking fluids, emulsifiers, workover fluids, biocides, mud additives, etc.). A number of problems have arisen from the use of these "multi-purpose" pits. As a result of poor pit design (improper lining and retaining wall construction) and management, many of these pits contaminate surrounding surface and groundwaters and adversely impact proximate wetland and agricultural areas. Unlined pits are banned in certain areas of some States because of high soil permeability and relatively shallow, unconfined groundwater. Closure of production pits containing oily materials requires dewatering and removal of oily sludges from pit bottoms. This material is then land-spread or buried on-site or taken to an off-site, licensed oil-field waste disposal site for burial. The remaining pit is filled and capped with clean soil graded to blend with the surrounding terrain. A recent concern involving oil-field waste pits was brought about by a U.S. Fish and Wildlife study that estimates that up to 500,000 animals, mostly waterfowl and migratory birds, are killed annually from landing in open waste pits (Hall, 1990). The solution to this problem is to cover the pits and tanks with mesh to prevent animals from entering. A number of states have enacted regulations or have developed guidelines for this approach.

Many oil-field wastes are transported via truck to adjacent parishes, counties, or even States for off-site storage and disposal. As with on-site disposal, disposal of such wastes is accomplished through a variety of methods, including reinjection, containment in surface impoundments, land application, landfill, and burial. Crawley and Branch (1990) suggest that land treatment has proven successful for treating organic wastes and conservative pollutants (heavy metals). However, a primary concern with this method is the potential for highly soluble salt concentrations to move out of the treatment zone. Impoundments are traditionally used for containment of these wastes. Subra (1990) reports that at one such disposal site in Vermilion Parish, Louisiana (designated Superfund site), 442 companies were identified by USEPA as being potentially responsible parties. Of these, 69 percent (approximately 305 companies) were from Louisiana, yet only 9 were located in the parish.

Improper storage or disposal of drums containing solvents, corrosion inhibitors, and biocides used in drilling operations also presents a potential for environmental problems. Likewise, the improper design and management of storage tanks at commercial oil-field disposal facilities poses the potential for causing adverse impacts to surrounding surface and ground waters and wetland areas.

(2) Production-Related Wastes

Boesch and Rabalais (1989a) indicated that, of the 2 MMbbl (434,772 bbl/day [BPD] from OCS activities) of produced waters discharged into Louisiana waters daily during 1986-1989, 23 percent was discharged into fresh marsh, 22 percent into brackish marsh, and 17 percent into salt marsh environments. The remaining 38 percent was discharged into open embayments or nearshore Gulf waters. The largest number of discharges were located in the Terrebonne (199 discharge points) and Barataria (136 discharge points) estuarine systems. The largest aggregate volumes were reportedly discharged in Chandeleur Sound (416,000 BPD), the Mississippi River Delta (402,000 BPD), and Barataria Bay (363,000 BPD) estuarine systems (Figure IV-3). The report further estimated the total volume of produced waters discharged into Texas waters at 823,575 BPD, including 87,721 BPD (11%) into those designated as "inland." The Texas Railroad Commission stated there were no discharges of OCS-generated produced waters in Texas coastal waters. By far the greatest volume of these waters were discharged into the Galveston-Trinity estuarine system (Figure IV-4). Within this estuary there were 208 discharge points that delivered an estimated 400,000 BPD. Matagorda-Lavaca and Corpus Christi-Nueces estuarine systems received substantial produced-water discharges from 32 discharge points (approximately 200,000 BPD) and 54 discharge points (approximately 60,000 BPD), respectively.

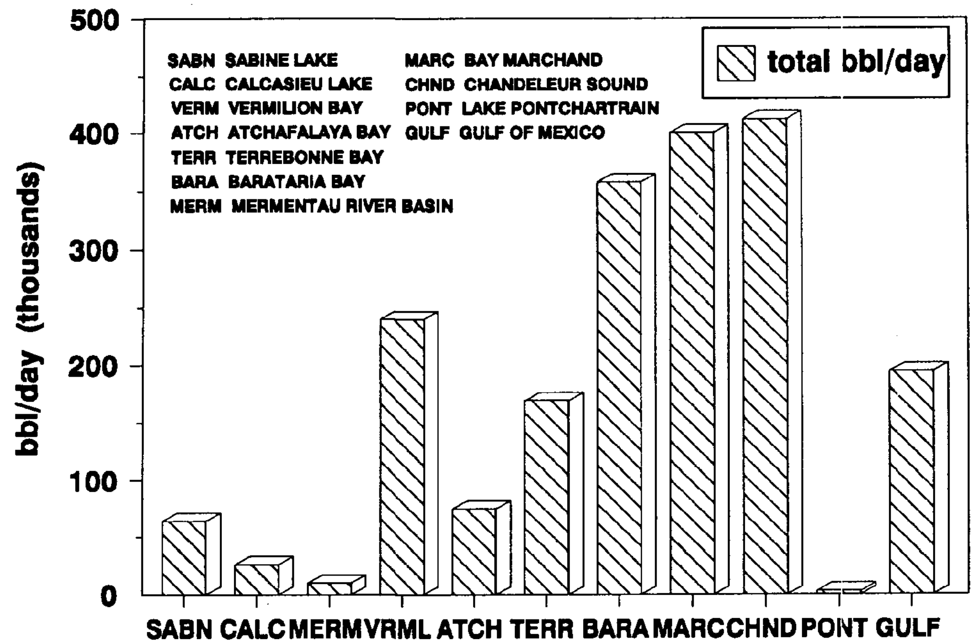


Figure IV-3. Distribution of Produced Water Discharges in Louisiana's Estuarine Basins (Boesch and Rabalais, 1989a).

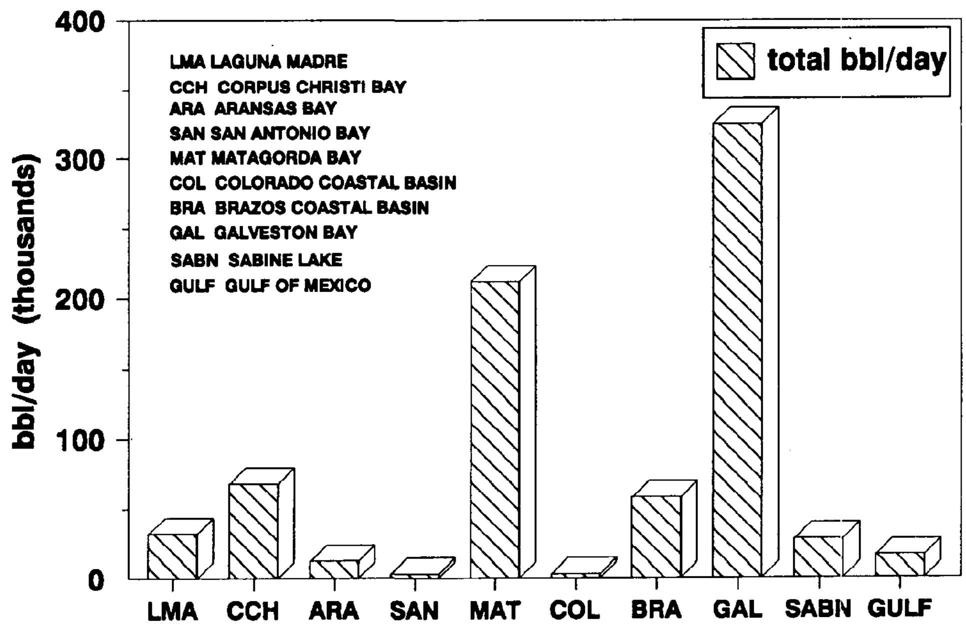


Figure IV-4. Distribution of Produced Water Discharges in Texas Coastal Waters (Boesch and Rabalais, 1989a).

Due to their high salinities, Gulf Coast produced waters are generally much denser than Louisiana inland waters. Boesch and Rabalais concluded that produced-water discharges can act as dense plumes after discharge into estuarine waters. Produced waters can contain various radionuclide and volatile and semivolatile organic hydrocarboncontaminants. Boesch and Rabalais demonstrated that produced waters discharged into Louisiana waters contained high concentrations of petrogenic hydrocarbons, with sediments near these effluents contaminated with semivolatile organic hydrocarbons. Petroleum contamination was noted in sediments up to 1 km from discharge sites. Reid surveyed several Louisiana produced water effluents and found radium 226 levels ranging from 131 $\pm$ 3 pCi/l to 393 $\pm$ 7 pCi/l. The natural radium 226 activity in Louisiana surface waters is below 1.0 pCi/1 and in Louisiana soils from less than 1.0 to 7.0 pCi/l (Louisiana Dept. of Environmental Quality, 1989). Some of these discharges have been found to contain high levels of toxic metals (vanadium, copper, and arsenic) and organics; these levels represent a significant negative impact to confined (poorly flushed) waterways. Because of the hydrology of such systems and the particle reactive nature of the metals and organics being discharged, it has been anticipated that these substances will continue to accumulate at high levels within sediments in proximity to the discharge (St. Pé, 1990). A more in-depth discussion of the characteristics and effects of produced-water discharges may be found in Sections IV.A.4. and 5. Three alternatives are employed for disposing of produced waters--injection into disposal wells (90% of U.S. produced waters are injected), storage in tanks, pits, and other containers, and discharge into surface waters. Louisiana DEQ reports indicate that 70 percent of the produced-water from oil-field operations in Louisiana is discharged into surface waters. As previously noted, on-site pits are commonly used to handle categories of oil-field wastes other than produced water, including drilling muds and associated oil-field wastes.

In March 1991, the Louisiana State Legislature approved regulations banning the discharge of all waste-water (primarily produced water) associated with oil and natural gas exploration and production activities. The State's effluent guideline standards have been amended such that there shall be no discharge of produced water into State waters after January 1, 1995, unless the discharge(s) is authorized in an approved elimination schedule or is in effluent limitation compliance. Produced water shall not be discharged within 1,300 ft of an active oyster lease, live natural oyster or molluscan reef, designated oyster seed bed, or seagrass bed.

Discarded oil-field equipment may pose a potential environmental threat to areas surroundingstorage and cleaning sites, scrap-yards, and metal reclamation yards. Surfaces of production tubing, holding tanks, separators, heater treaters, and other like equipment may be contaminated with scale material. Scale restricts production, causes equipment inefficiency, and is costly and time-consuming to remove. Scale problems cost industry on the order of a billion dollars annually. Recently, another problem associated with scale formation has surfaced--radioactivity. The health risks and environmental consequences associated with the disposal of NORM-contaminated oil-field wastes are largely unknown at this time. A growing awareness of this problem was raised when reports surfaced of contaminated pipe being used to construct bleachers, school and public park playground equipment, and as work material in welding classes at schools. The NORM regulation and management is an issue of concern to both Federal and State governments and the oil and gas industry. A more detailed discussion of NORM may be found in Section IV.A.5.b.(5).

3. Other Major Offshore Activities

a. Ocean Dumping

All ocean dumping is regulated by the Marine Protection, Research, and Sanctuaries Act of 1972, as amended (33 U.S.C. 1401 et seq.). Regulations (40 CFR 220 et seq.) implementing the Act require a USEPA permit for all ocean dumping of industrial wastes and municipal sludge materials. The termination of ocean dumping of sewage sludge and industrial wastes by December 31, 1981, was mandated by 33 U.S.C. 1412a. The designated ocean areas in which wastes may be disposed are listed in 40 CFR 228. Further, USEPA has published an annual report entitled *Ocean Dumping in the United States*. This report includes information on permit holders, types of waste approved for disposal under the permit, and yearly waste volumes disposed. There are no designated deep-water disposal areas in the Gulf of Mexico.

The current interim designated Dredged Material Disposal Sites are now being converted by USEPA into formally-designated sites. These sites, used for the disposal of dredged material from the U.S. Army Corps of Engineers channel-dredging programs, have, in most cases, been used for this purpose for as long as 25 years.

b. Deep-water Ports

The Deepwater Port Act of 1974 (33 U.S.C. 1501) gives DOT the authority to license deep-water ports. The purpose of a deep-water port is to provide offshore terminal facilities for offloading oil from tankers too large (typically supertankers with drafts greater than 40 ft and up to 700,000 dwt) for conventional ports and to transport the oil to shore via pipeline, thus avoiding the need for lightering. The Louisiana Offshore Oil Port (LOOP) is the only deep-water port in the Gulf. It is located in 35 m (115 ft) of water in Grand Isle Block 59, approximately 30 km (19 mi) from shore. Vessel access to LOOP is by means of the designated fairway and safety zone. No mobile drilling operations or installation of permanent structures may take place in these areas. An anchorage area is also designated in the vicinity of LOOP. Fixed and mobile structures may be placed in anchorages under certain spacing limitations. Fairways associated with LOOP are designated in 33 CFR 166 (Shipping Safety Fairways). This information was published in the *Federal Register* on July 1, 1985 (50 FR 28989).

c. Non-energy Minerals Program in the Gulf of Mexico

Sulfur Program in the Gulf of Mexico

Presently, there is sulphur produced from leases in Federal and State waters offshore Louisiana. Caminada Mine, owned by Freeport Sulphur Company, lies in Federal waters in Grand Isle Blocks 16, 17, 22, and 23. Production was first initiated in March 1969, with 90 sulphur wells, 7 bleedwater wells, and 1 brine well drilled to date. The produced sulphur is to be transported to the Grand Isle shore base by barge. The Caminada Mine consists of a power plant platform, a shop/warehouse platform, a living quarters/office platform, two production platforms, and a bleedwater/brine-well platform. Production at Caminada Mine is projected to continue until approximately 1999.

Main Pass Sulphur Mine, another Federal lease owned by Freeport McMoran and partners, lies in Main Pass Block 299. Drilling at Main Pass began in December 1988, with sulphur encountered in 19 of the 20 wells drilled. Transportation and shipments of sulphur from the mine are handled by the Port Sulphur terminal. Ten production platforms are expected for all drilling activities, with production of sulphur expected to begin January 1992. Recoverable reserves of 67 million long tons (MMLT) is anticipated so that the Main Pass Sulphur Mine should produce for 30 years or more.

Grand Isle Mine, also owned by Freeport Sulphur Company, lies in State waters in Grand Isle Blocks 9, 10, 18, and 19. The Grand Isle Mine consists of 5 large platforms and 10 smaller ones connected by nearly a mile and a half of bridges. Ten test wells, 437 sulphur wells, 35 bleed wells, and 3 brine wells have been drilled at the Grand Isle Mine, with 97 more sulphur wells to be drilled in the future. The sulphur is transported by barge to Grand Isle, Louisiana. From the shore base at Grand Isle, the sulphur is transferred to the Port Sulphur terminal by barge.

The Frasch technique is used for the mining of sulphur. Heated seawater, injected into the mineral-bearing formation, results in melting of the elemental sulphur. Air, pumped to the level of the molten sulphur, lifts the sulphur to the surface. A steam-heated generator discharges air and other gases in the sulphur to the atmosphere. Sulphur is subsequently collected in vessels known as "pans," where it is pumped to storage tanks and then to barges.

Other Mineral Programs

On December 31, 1986, Secretary of the Interior Donald P. Hodel and the Governors of Alabama, Mississippi, Louisiana, and Texas announced an agreement to establish a joint Federal/State task force to study the occurrence, location, and economic feasibility of developing marine mineral resources offshore the aforementioned states. The Task Force is jointly co-chaired by representatives from the Alabama Geological Survey, the Texas Bureau of Economic Geology, and MMS.

The Task Force spent a year developing an inventory of the publicly available geologic and geophysical data, identifying mineral commodities and the particular areas of potential commercial interest, and performing a preliminary economic feasibility study. A draft report was completed in November 1988, and a final report with recommendations for further action was submitted to the Secretary of the Interior and the Governors in March 1989. This report summarized the work of the Task Force, projected future work to be undertaken, and made recommendations on the engineering, environmental, and economic feasibility of mineral extraction on the OCS.

The Task Force currently is studying OCS sources of beach nourishment materials around Ship Shoal. Sand dredging in the Ship Shoal/Isles Dernieres area is being studied for beach replenishment and barrier island restoration. This is needed for coastal restoration and protection against the accelerating rate of wetlands loss in Louisiana.

d. Marine Transportation

Vessels operating offshore often use the network of established safety fairways. Over the years, an extensive shipping pattern has developed among the major Gulf ports and between the ports and destinations outside the northern Gulf via the Straits of Florida, the Yucatan Channel, and the Bay of Campeche. As oil and gas development began to move offshore, the potential for conflicts between marine transportation and oil and gas activities increased.

Marine transportation is not projected to increase in future years, but it has fluctuated from year to year. Marine-transportation traffic can contribute to operational errors, which might result in oil spills, groundings or in collisions involving other vessels or fixed structures such as platforms and rigs. Section IV.B.6. discusses oil spills from marine transportation of both imported crude oil and petroleum products.

Collisions may lead to pollution and possibly loss of lives and property. Records of vessel mishaps concerned with OCS operations show that 85 vessel mishaps occurred between 1960 and 1986, a 26-year period. Of these 85 events, 10 were noncontact events, that is, the vessel did not come into contact with an OCS structure or another vessel. Of the remaining 75 vessel mishaps, 46 (61%) resulted in minor property damage and 29 (39%) resulted in major property damage. Most of the vessel mishaps are the result of a service vessel (crewboat) bumping into the superstructure of a platform. Based on the descriptions in the MMS database on accidents (the Events File), 77 percent (58 vessel mishaps) were OCS vessels and 23 percent (17 mishaps) were non-OCS vessels. The 26-year record shows that an annual average of 1.5 vessel mishaps involve major property damage resulting from both OCS and non-OCS events Gulfwide. When OCS events are examined, less than one mishap (0.8%) occurs per year. Non-OCS events average about one vessel mishap every other year. Five accidents involving fatalities have occurred. Three of the five accidents were non-contact events, one involved no property damage, and the fifth (included in the figures above) resulted in major property damage.

The key mitigation factor for this problem was the establishment of a series of safety fairways and anchorages to provide unobstructed approach for vessels using U.S. ports. Fairways play an important role in the avoidance of collisions on the OCS, particularly in the case of the larger oceangoing vessels, but not all vessels stay within the fairways. Many vessels, such as fishing boats and vessels supporting offshore oil and gas operations, travel through areas with high concentrations of fixed structures. In such cases, the most important mitigation factor is the requirement for adequate marking and lighting of structures. After a structure has been in place for a while, it often becomes a landmark and an aid to navigation for vessels that operate in the area on a regular basis.

There is a substantial amount of domestic waterborne commerce along the Gulf Coast that does not always use open Gulf waters. Vessels engaged in this activity generally use the Gulf Intracoastal Waterway (GIWW), which follows the coastline inshore and through bays and estuaries, and in some cases offshore from Fort Myers, Florida, to Brownsville, Texas (Visuals Nos. 1 and 1E).

The most significant contributions of marine transportation to cumulative impacts in the Gulf are from the tanker transport of imported crude oil. Extensive refinery capacity, easy port access, and a well-developed, onshore-transportation system have contributed to the development of the Gulf Coast region as an important center for handling imported oil and production from other domestic sources such as Alaska and California (henceforth included in the category of imports). The area also includes the Nation's Strategic Petroleum Reserve and LOOP, the only deep-water crude-oil terminal in the country (Section IV.B.3.).

e. Military Activities

The air space over the Gulf of Mexico is used extensively by DOD for conducting various air-to-air and air-to-surface mission operations. A series of nine military warning areas and five water test areas are located within the Gulf. These warning and water test areas are multiple-use areas, wherein military operations and oil and gas development have coexisted without conflict for many years.

Utilization of offshore areas by DOD is provided for in 32 CFR 252. The DOD policy of joint usage and coordination with DOI to ensure compatibility between agencies' programs is expressed within this regulation.

Military warning areas are established through the Federal Aviation Administration (FAA) Handbook 7400.2B, Part 5, Chapter 15, which sets aside an air space area by the FAA for use by the military. The military is not given a first use or a priority use of any area. The areas of military use are set aside so that the FAA can direct air traffic over or around them. The Federal Aviation Administration Handbook also refers to an Executive Order that calls for coordination among the Departments of Transportation, State, and Defense on the establishment and use of warning areas in international waters (international waters are considered by the FAA as anything beyond the State/Federal boundaries). By the mechanisms through which the military warning areas are established and maintained, DOD or any other agency cannot restrict the use of a warning area. Also, the mechanisms for the establishment of a warning area do not provide any means for the area's enforcement. For all warning areas, the using agency, boundaries, and times of use are published by the Defense Mapping Agency in the semiannual Department of Defense Flight Information Publication, *Special Use Airspace, North and South America*.

The Eglin Water Test Areas were established by a letter of agreement among the Jacksonville Armament Research and Test Center (ARTC), Houston ARTC, Miami ARTC, and Eglin Armament Division on April 26, 1971.

Central Gulf of Mexico

The Central Gulf has three warning areas that are used for military operations. They total approximately 4 million acres, or 7.6 percent, of the water and air space of the sale area. The portions of the Eglin Water Test Areas comprise another 4 million acres, or 7.3 percent, of the Central Gulf.

Warning Areas	Defense Operations Conducted
W-92	Air-to-air gunnery, rocket firing, sonar buoy operations
W-453	Air National Guard training
W-155	Carrier operations, carrier pilot training
EWTA-1	Rocket and missile testing and research
EWTA-2	Rocket and missile testing and research

Western Gulf of Mexico

The Western Gulf has two warning areas that are used for military operations. They total approximately 12 million acres, or 33 percent, of the water and air space of the sale area. Proposed Alternative C excludes a 340-block polygon (about 1.8 million acres) off Corpus Christi, Texas. (Section II.D.2.c. describes this alternative.) This carrier operations area was deferred for Sale 141 in a November 1990 agreement between the MMS and the Department of Navy.

Warning Areas	Defense Operations Conducted
W-228	Carrier operations, air-to-air gunnery, rocket firing, aircraft operations, submarine operations
W-602	High-altitude training

4. Other Major Onshore/Coastal Activities

a. River Development and Flood Control Projects

In recent decades, alterations in the upstream hydrology of the rivers that drain into the northern Gulf of Mexico have resulted in coastal impacts. Changes in the hydrology of the Mississippi River basin, in particular, have caused declines in sedimentation rates along the coast and have contributed to marsh deterioration in the coastal wetlands of Louisiana. Coastal wetlands appear to expand or diminish in areal extent according to the amount of sediment available, and sedimentation can be a limiting factor controlling marsh growth. In a natural system, overbank flooding is a mechanism of introducing sediment-laden waters into adjoining wetlands. Flood control levees on the lower Mississippi River and its distributaries have contributed to wetland loss in the Gulf because levees eliminate regular episodes of overbank flooding and prevent the distribution of alluvial sediments across the Mississippi River Delta. In pre-channelization times, the flow of the river was distributed among several distributary channels that delivered sediment to the coast over a broad area during high river stages. Today, sediment from the river is discharged to the coast only through the main channel of the river, which discharges directly out into the deep waters of the continental slope and through the Atchafalaya system.

As an example of this effect, Bayou Lafourche, in coastal Subarea C-2, was cut off from the Mississippi River as a result of levee construction shortly after the turn of the century. Cleveland et al. (1981) have used simulation models to demonstrate that if sediment from the Mississippi River were reintroduced into the Barataria basin, an area experiencing high rates of land loss and fed by Bayou Lafourche, the basin would experience net wetland gain during the next century.

In addition, the construction of dams and reservoirs on upstream tributaries of the reservoir has trapped much of the sediment load of the river prior to reaching the coast. The suspended sediment load of the Mississippi River has decreased nearly 60 percent since the 1950's, largely as a result of dam and reservoir construction upstream (Tuttle and Combe, 1981; Turner and Cahoon, 1987).

As part of the Cumulative Analysis, sediment deprivation will continue as a major impacting factor in Louisiana during the period of analysis. Although the reintroduction of sediments to coastal areas has been considered as a means of restoring wetlands in Louisiana, the great expense of these projects and the legal problems associated with a reduction in flood protection that will result from altering the river's levees and from discharging riverine waters across private property will prevent a sediment reintroduction plan from being implemented in the near future. Furthermore, even if sediment from the Mississippi River were discharged into coastal wetlands, the river is currently discharging less than half of its original sediment load.

Hydrologic alterations of river basins in the WPA have also been implicated as a factor affecting coastal erosion in Texas.

b. Submergence and Natural Subsidence of Wetlands

The submergence of coastal wetlands in the Gulf of Mexico region contributes to the wetland loss problems of the region. If submergence occurs faster than the rate at which sedimentation and peat formation can build the marsh surface upward, marsh survival is threatened by the waterlogging and ultimate flooding of the marsh. The submergence rate that is critical for the survival of wetlands in different parts of the Gulf has not been determined.

Submergence in the Gulf is occurring most rapidly along the coast of Louisiana. The submergence rate in Louisiana has two components: the rate of eustatic sea-level rise and the rate at which the land itself is subsiding beneath the sea. During this century, the eustatic rate of sea-level rise along the Louisiana coast has been relatively constant at 2.3 mm/yr (23 cm/century), although the rate has varied from a sea-level decrease of 3 mm/yr to a maximum increase of 10 mm/yr over decade-long periods (Turner and Cahoon, 1987). Depending on local geologic conditions, the subsidence rate varies across coastal Louisiana from 3 to 10 mm/yr. The primary natural processes responsible for land subsidence include geosynclinal downwarping, compaction, dewatering, and the horizontal flow of recent sediments. Anthropogenic factors, such as fluid withdrawals from oil and gas reservoirs, appear to have only a localized influence on subsidence directly above the reservoirs. In coastal Louisiana, the total area of wetlands with a subsidence potential related to fluid withdrawals greater than 10 cm is about 400 km^2 (Turner and Cahoon, 1987).

Submergence of wetlands is also considered a factor in the erosion of wetlands in Texas (White et al., 1985). In addition to submergence associated with eustatic sea-level rise, submergence along the Texas coast has been compounded in some areas by human-induced land subsidence from groundwater withdrawals (Ratzlaff, 1980) and natural compactional subsidence (Swanson and Thurlow, 1973).

c. Contributors to Coastal Water Quality Problems

Contaminants can be natural components of the marine environment--such as trace metals--that affect the use of the water body only when they exceed certain levels. Others, such as synthetic organics, are anthropogenic inputs whose presence alone is considered contamination because they serve no purpose in the natural mechanisms of the ecological components. Parameters usually measured to determine water quality degradation include salinity, biochemical oxygen demand (BOD), chemical oxygen demand, petroleum hydrocarbons (oil and grease), total suspended solids, total dissolved solids, nutrient loadings, heavy and trace metal concentrations, coliform bacteria, synthetic organics, tributyltins from marine paints, toxic substances and hazardous wastes, radionuclides, toxins, and solid-wastes (trash).

Major point and nonpoint sources of contaminants occurring along the Gulf Coast include the petrochemical industry; hazardous waste sites and disposal facilities; agricultural and livestock farming; citrus processors; chemical manufacturing industry operations; fossil fuel and nuclear power plant operations; pulp and paper mill plants; silviculture; commercial and recreational fishing; municipal waste-water treatment and individual septic-tank effluents; coastal maritime commerce activities, especially at ports; dredging of harbors, docks, navigation channels, and pipeline canals; the USEPA dredged-material disposal-site program; and urban expansion. The petrochemical industry operations include oil and gas exploration, development, and production operations; pipeline transport; tanker and barge movement of both imported and domestic petroleum products and crude oils; petroleum and petrochemical refinery and processing operations; and oil-field waste disposal. These topics are discussed elsewhere in this document.

The discharge of sewage and wastes from boats and vessels in coastal waters may impact water quality by increasing BOD locally and introducing pathogens into the water column. Although the Federal Water Pollution Control Act requires recreational boats to be equipped with approved marine sanitation devices, boats still discharge treated legally and untreated waste illegally into coastal waterbodies. Although the waste water generated by recreational boats is small, the organics are concentrated and, therefore, the BOD levels are much higher than that of raw or treated municipal sewage. When this occurs in poorly flushed waters, the DO concentrations of the water may decrease. In the more temperate regions, these effects are exacerbated due to increased boat traffic, higher water temperatures, and higher metabolism rates for marine organisms.

The addition of disease-carrying pathogens from fecal matter in boat sewage poses a potential problem with regards to human health impacts. Humans are put at risk from either contacting contaminated waters through swimming or eating shell fish taken from such waters. Bacteria, viruses, and other water-borne diseases can be attributed to sewage pollution.

Antifouling paints and coatings containing copper and organotin biocides are used to prevent the buildup of barnacles and other encrusting organisms on vessels and docks. Other toxic compounds such as mercury, arsenic, and PCB's are no longer used due to their extreme toxicity. By 1985, up to 30 percent of the vessels world-wide used tributyltin-containing antifouling paints. A 1987 survey found that 97 percent of the tributyltin use was on vessels or boats less than 65 feet and that 93 percent of this was on recreational boats. The environmental impact of organotins as a group of compounds has been the subject of research and study for almost a decade. Much of the work has focused on the fate of tributyltin compounds in the marine environment. Tributyltins are a class of organic tins used in antifouling paints. There are two classes of these paints--conventional or those that leach continuously and copolymer which are released to the aquatic environment at much slower rates. Due to the rapid leaching of these compounds, elevated levels of tributyltin and its breakdown products have been found in the water, sediments and organisms where there are high concentrations of vessels and more specifically, recreational boats.

Studies indicate organotin is highly toxic to marine and freshwater organisms at very low levels. Tributyltins have been reported to cause acute and chronic toxicity to marine organisms, especially in small crustaceans (zooplankton) and bivalves. Bacteria and phytoplankton bioaccumulate tributyltin at concentrations of 600 to 30,000 times the exposure concentration, while bioaccumulation in bivalves has been reported up to 4,000 times the exposure concentration. Bivalves are extremely susceptible because of their ability to metabolize these compounds and they are found in nearly anoxic sediments that lack the bacterial species necessary to degrade these compounds.

Unlike copper, tributyltin in seawater degrades rapidly with a half-life of 3-15 days (seawater). Within the water column, the primary means of degradation in the presence of light appears to be debutylation by planktonic algae, especially diatoms. While in the absence of light, degradation is primarily by bacteria. Tributyltins tend to concentrate in the surface microlayer and are found at higher levels than found in the subsurface. Once these compounds adsorb to particulate matter and sinks into the sediments, it tends to concentrate and slowly degrade.

Tributyltin paints are now regulated in the United States by the Organotin Antifouling Paint Control Act of 1988. The Act prohibits the use of certain antifouling paints containing organotin and the use of organotin compounds, purchased at retail, used to make paints. The Act prohibits the application of antifouling paints to vessels less than 25 m in length, with the following exceptions: the aluminum hull of a vessel less 25 m in length or the outboard motor or lower drive unit of a vessel less than 25 m in length. All antifouling paints must be certified by the Administrator of USEPA not to have a release rate of more than 4.0 micrograms per square centimeter per day.

5. Activities Outside the Planning Areas Affecting Migratory Species

a. Coastal and Marine Birds

Endangered and Threatened Species

The piping plover, whooping crane, and peregrine falcon are migratory species protected by the Endangered Species Act. Although none of the threatened or endangered species inhabiting the Gulf crosses more than one OCS planning area (USDOC, NMFS, 1990b), their wide-ranging movements make them susceptible to a variety of adverse impacts from outside of the planning area. The activities impacting these species are the same as for nonendangered and nonthreatened birds.

Nonendangered and Nonthreatened Species

Populations of the three major types of Gulf of Mexico coastal and marine birds--waterfowl, wading birds, and shorebirds--are augmented by seasonal migrants. All North American migrating birds tend to use specific flight corridors to reach the Gulf of Mexico; the Central or Mississippi Flyway is the corridor of greatest importance. Migrating waterfowl and wading birds reach the Gulf from south-central Canada and north-central United States. Migrating shorebirds reach the Gulf from as far away as the Arctic Circle. Migrating coastal and marine birds may continue migration into Central and South America or may exhibit a limited degree of coastal movement within their terminal locality. Migrating coastal and marine birds do not cross planning areas within the Gulf of Mexico; however, they could be affected by activities outside the planning areas.

All three types of migratory species have experienced decreases in population (National Geographic Society, 1983a; USDOI, FWS, 1988). The loss and degradation of nesting habitat in the north-central United States and south-central Canada from encroaching agriculture and drought may reduce populations of over-wintering migrant waterfowl. The loss and degradation of Gulf wetlands as feeding and resting habitats may reduce populations of migratory wading birds. Disturbances to and loss of barrier islands and beaches may adversely affect populations of migratory shorebirds.

The storage of oily industrial waste in open pits within five southwestern states may seriously deplete populations of birds migrating to the Gulf Coast. Migrating waterfowl are especially susceptible because they apparently mistake the reflection of uncovered oil pits and tanks for freshwater. Activities connected with State oil and gas production within Gulf Coastal marshes or nearshore during the winter have the greatest potential to damage populations of migratory coastal and marine birds.

b. Marine Turtles

Marine turtles are exposed to adverse impacts throughout the Atlantic Northern Hemisphere because of their pan-oceanic distribution and wide-ranging movements. These impacts include the activities associated with OCS oil and gas exploration and development described in the Base Case Analysis (Section IV.D.) and a wide variety of other activities. In general, the projected level of development in the Central and Western Gulf will decrease because of declining resource estimates. However, oil and gas exploration and development will advance into deeper water, resulting in less activity in areas frequented by all but the leatherback turtle. The explosive removal of platforms will increase nearshore, but the implementation of procedures for the protection of sea turtles is assumed to avoid harassment or injury. Development in the Eastern Gulf and Atlantic is expected to proceed slowly because of the absence of an oil and gas infrastructure and the lack of public support. A consequence of slow development in these areas is a minimal impact on marine turtles. Marine turtles are adversely impacted by oil spills from foreign oil transported by tanker to the Gulf, production from State waters, and OCS production. The OSRA data indicate that foreign oil tankered to the Gulf is the source of most spillage.

The major activities outside the planning areas that affect marine turtles include habitat loss and direct mortality from dredging; pollutant discharge; commercial fishing; hopper dredge activities; nearshore boat traffic; human consumption; contact with foreign, inshore, or processed oil; and ingestion of or entanglement in anthropogenic debris (NRC, 1990). Dredge and fill activities occur throughout the nearshore areas of the United States. They range in scope from propeller dredging by recreational boats to large-scale navigation dredging and fill for land reclamation. Pollution resulting in loss of coastal aquatic vegetation is discussed in Sections IV.D.1.a.(1) and IV.D.2.a.(1). The causes of aquatic vegetation loss include the alteration of salinity, as in Florida Bay, as well as man-induced increases in turbidity witnessed in Tampa Bay. Disturbances to nesting beaches occur from a variety of sources, including construction, vehicle traffic, and deprivation of sand. A more extensive discussion of the factors impacting barrier island beaches can be found in Sections IV.D.1.a.(1) and IV.D.2.a.(1). Natural catastrophes, including storms, floods, droughts, and hurricanes (Continental Shelf Associates, 1987), can result in substantial damage to sea turtle habitat. Drowning that results from entanglement in commercial fishing gear has a significant impact on sea turtle populations. Shrimp trawling in the southeastern United States has received extensive scrutiny because of its incidental turtle catch

(Center for Environmental Education, undated). The National Research Council (1990) has identified shrimp trawling as the greatest cause of human-induced mortality in sea turtles. The use of Turtle Excluder Devices is legislatively mandated in order to decrease losses. Unknown numbers of turtles also drown in driftnet and long-line fisheries.

Dismemberment of turtles by hopper dredging has resulted in turtle mortalities. Specific dredging projects include the Canaveral Ship Channel in Florida, the King's Bay Submarine Channel in Georgia, and channel dredging of ports throughout the Gulf. Data from the Sea Turtle Stranding Network indicate a large number of turtles are hit by boats. Although some of the records may include turtles already dead before being struck, boat traffic is considered to have a substantial impact (Teas, personal comm., 1989). The inshore and nearshore distribution of most sea turtle species, the locations of the strandings, and the composition of the boating traffic suggest that most collisions that occur in the Gulf are a result of recreational boating in Florida. The human consumption of turtle eggs, meat, or by-products occurs worldwide (Mack and Duplaix, 1979; Cato et al., 1978). Human use is probably substantial, but the frequently illegal nature of the activity suggests unreliable estimates of mortality. Marine debris is discussed in the Base Case Analysis. In addition to the incremental amount of trash and debris generated by the OCS program, trash and debris find their way into the marine environment from South and Central America, Europe, and North Africa. The volume of marine debris from these sources is unknown, as is its impact on sea turtles (USDOC, NMFS, 1989a; Heneman and the Center for Environmental Education, 1988).

c. Cetaceans

Great whales and several species of smaller cetaceans are susceptible to adverse impacts from OCS oil and gas exploration and development and other activities in the Gulf, Caribbean and Atlantic because of their wide-ranging movements. In general, the projected level of development will be less than the year of greatest OCS oil and gas activity, 1972. Existing oil and gas activities in the Atlantic and Eastern Gulf are minimal and are not expected to become extensive. Development in the Central and Western Gulf is not expected to increase significantly over present levels. However, the move toward exploration and development in deeper water could result in more interactions with marine mammals. The effects of oil contact or oil ingestion are discussed in Sections IV.D.1.a.(5)(a) and IV.D.2.a.(5)(a). The OSRA data indicate that foreign oil tankered to the Gulf is the source of most spills.

Commercial fishing, maritime commerce, toxins that accumulate through the food chain, and whale watching are other sources of adverse impacts (Tucker & Associates, Inc., 1990). Entanglement in commercial fishing gear can result in the death or injury of marine mammals. Limited commercial or subsistence whaling also results in some whale mortality; however, the small number of individuals affected and the infrequency of the interaction suggest that the impact is low. Maritime commerce can cause a variety of impacts, including collisions, noise disturbance, and marine pollution. Conflicts are most likely at the convergence of shipping lanes and migration routes, such as the Florida and Yucatan Straits and the migration routes of the Eastern Seaboard. The concentration of toxins through the food chain has been found in marine mammals. These toxins include hydrocarbon and heavy metal compounds from a multitude of sources including oil spills, ocean dumping, industrial and municipal effluents, and agricultural runoff. Sources of marine pollution are worldwide. Recreational whale-watching cruise vessels can disturb or collide with whales (Freeman, 1991). Although these activities are not popular in the Gulf, they do occur on the Eastern Seaboard.

d. Fish Resources

Those nonestuary-dependent species of fish that are commercially important, such as mackerel, cobia, and crevalle, are called coastal pelagics. These species are distributed and spawn over a large geographic area and depth range within the Gulf of Mexico; they range throughout the Gulf and move seasonally (Gulf of Mexico Fishery Management Council, 1985). In general, pelagic populations exhibit some degree of coastal movement restricted to the Gulf of Mexico. This movement is not considered oceanic migration, as is the case with salmon. The coastal movements of these species are related to reproductive activity, seasonal changes in water temperature, or other oceanographic conditions. However, coastal pelagics could be affected by activities outside the planning areas.

Competition between large numbers of commercial fishermen, between commercial operations employing different fishing methods, and between commercial and recreational fishermen for a given fishery resource, as well as natural phenomena such as weather, hypoxia, and red tides, may reduce standing populations of coastal pelagics. Fishing techniques such as trawling, gill netting, or purse seining, when practiced nonselectively, may reduce the standing stocks of the desired target species as well as significantly affect other species. Hurricanes may change physical characteristics of offshore ecosystems used by coastal pelagics (Continental Shelf Associates, 1987).

The majority of commercial species, including coastal pelagics, harvested from the Gulf of Mexico are believed to be in serious decline from overfishing. Continued fishing at the present levels may result in rapid declines in commercial landings and eventual failure of certain fisheries. Commercial landings of traditional fisheries, such as shrimp, red snapper, and spiny lobster, have declined over the past decade despite substantial increases in fishing effort. Commercial landings of recent fisheries, such as shark, black drum, and tuna, have increased exponentially over the past five years. Those fisheries are thought to be in danger of collapse (Angelovic, written comm., 1989; USDOC, NMFS, 1991a).

Oil spills that occur within the Gulf of Mexico when high concentrations of fish eggs and larvae are present have the greatest potential to damage populations of coastal pelagic species. Therefore, those activities connected with nearshore State oil and gas production and foreign and domestic oil tanker movements throughout the Gulf may adversely affect coastal pelagic species.

6. Major Sources of Oil Contamination in the Gulf of Mexico

Petroleum hydrocarbon contamination of the Gulf of Mexico is occurring from a number of offshore, coastal, and land-based sources. Major sources of petroleum hydrocarbons into Gulf waters include natural seeps; offshore and coastal oil production activities; atmospheric inputs; marine transportation (especially tanker operations); coastal, municipal, and industrial wastes; and urban and river runoff. The presence of petroleum hydrocarbons in the marine environment is, to some extent, unavoidable. Hydrocarbons measured in Gulf waters have been identified as generated by both natural, geochemical processes and by anthropogenic inputs (pyrogenic and petrogenic). Although the Gulf comprises one of the world's most prolific offshore oil-producing provinces, onshore sources of hydrocarbons to Gulf waters far outweigh the contributions from offshore domestic production of oil.

While large spills capture the public attention and can cause serious short-term detrimental effects, chronic, low-level inputs of petroleum hydrocarbons represent the greatest source of petroleum contamination to the Gulf of Mexico. Major sources of such discharges include operational discharges from tankers while at sea, natural seepage, and coastal, municipal, and industrial discharges and runoff.

An examination of all major sources of oil contamination in the Gulf puts into perspective the relationship between petroleum loadings to Gulf waters from federally supervised oil-production activities and from other anthropogenic sources and compares the relative contribution of OCS operations to other sources of petroleum in Gulf waters. It is important to understand that this exercise provides only order of magnitude rough estimates. There are major problems associated with any attempt to establish values for the inputs and flux of petroleum into the Gulf. The approach taken here is to use the concepts, assumptions, and estimates developed by the National Academy of Sciences (NRC, 1985) and to apply them to Gulf of Mexico values, when appropriate. Furthermore, the contribution from petroleum sources in Mexico and Cuba was not calculated.

a. Other Sources of Oil Spills

The MMS database on spills from OCS operations (USDOI, MMS, 1991d) shows that the contribution from spills from OCS oil exploration, development, and production operations during the years 1964-1989 has been 371,040 bbl of oil, condensation, diesel, and other oil-contaminated materials. This is an average of 14, 271 bbl per year, or 0.002 million metric tons annually (Mta).

Besides OCS-related spills, spills entering Gulf waters can occur from State oil and gas development in offshore and coastal waters; from other types of marine transportation, especially the importation and coastwise transport of petroleum products and crude oil; and from non-OCS-related onshore oil processing and storage facilities such as refineries and storage tanks.

The following estimates of future spill occurrence was formulated from two primary data sources: the U.S. Coast Guard's database on spill incidents in all navigable waters maintained in a national computerized database (USDOT, CG, 1989) and the Minerals Management Services' Environmental Policy and Programs Division, Washington, D.C., database on crude oil and petroleum product spills greater than 1,000 bbls from worldwide tanker operations. These databases were supported often by personal communication with a number of individuals dealing with oil-spill incidents in the Gulf of Mexico area.

The following observations can be made after examining U.S. Coast Guard spill data for the entire U.S. waters. Locations of the spills kept in this database include open sheltered waters, river channels, ports and harbors, territorial seas, contiguous zone, and high seas. For the years 1984-1986, river channels had the most number of occurrences and the largest spills. This observation held true also for the Gulf region. Types of oil include both crude oil and petroleum products and can even include vegetable oils used in cooking. In general, crude oil spills are the most common occurrence followed closely by diesel and fuel oil spills. Sources of spills include marine vessels, land vehicles, non-transportationactivities (refineries, bulk storage, onshore and offshore production), and marine terminals. The data show that non-transportation facilities underwent the most spill incidents during 1984-1986, while marine vessels and terminals spilled the largest volumes averaged over a year.

Small Spills

Much of the U.S. Coast Guard's data are not broken down for the Gulf of Mexico area. The following information about small spills in the Gulf is either derived from the above USCG reports or from personal communication with the USCG. In the Gulf area, there were about 1,484 small spills occurring per year. The offloading and onloading of oil during transfer operations result in many minor spills. Conversations with the U.S. Coast Guard indicate that the major cause of spills less than 1 bbl in the Louisiana coastal and offshore areas is transfer operations (Westcott, personal comm., 1989). In 1988, the U.S. Coast Guard reported that the current discharge rate for oil during transfer operations is approximately 7.7 spills per 1,000 transfers (Oil Spill Intelligence Report, 1988). About four spills per year occur from transfer operations, the vast majority of these spills being less than 50 bbl (Oil Spill Intelligence Report, 1988; Westcott, personal comm., 1989).

The projected annual number of small (less than 1,000 bbl) crude oil and petroleum product spills occurring in the CPA and WPA during the 35-year life of the proposed actions are 670 and 500, respectively. The great majority of these spills will occur in the coastal states bordering the Gulf. In the CPA Area, almost all of the spills will occur in Louisiana's coastal zone. The greatest majority of these spills will occur in the coastal states bordering the Gulf. In the CPA, almost all of the spills will occur in Louisiana's Coastal zone.

Large Spills from Tankers and Barges

The catastrophic oil spill and the detrimental effects that resulted from the *Exxon Valdez* accident in Alaska have increased the public's perception of the risks associated with oil-tankering activities. Major causes of worldwide tanker spills have included the following (in order of frequency): groundings, 32.6 percent; collisions, 24.4 percent; contacts, 18.6 percent; oil transfer operations, 8.3 percent; fire and explosions, 7.9 percent; weather, 6.2 percent; and mechanical problems, 2 percent (Bao-Kang, 1987). (Collision means the striking of two ships; contact means the striking of an external object by a ship.)

Import Tanker Spills

The import tanker spill rates for spills 1,000 bbl or greater are as follows: at sea, 0.45; and near port, 0.40. The import tankering spill rate (at sea in the Gulf) is one-half the worldwide tanker spill rate (at sea) and is based on the assumption that 50 percent of the spills related to import tankering will occur on the inbound portion of the journey in the Gulf of Mexico study area.

The following provides projections of future large spills from import tankers occurring over the 35-year life of the proposed actions:

It is estimated that 37 large offshore crude oil spills with a median size of 22,728 bbl are estimated to occur from import tankering activities. Also, 21 petroleum product spills of 11,000 bbl are estimated to occur from import tanker activities in the Gulf, mainly in restricted waters.

- Information on large offshore crude oil spills from import tankering contact with environmentally sensitive resources were analyzed by the Mineral Management Service's OSRA model. Table IV-21 and IV-22 in Section IV.C. provides the probabilities of one or more spills 1,000 bbl or greater and the estimated number of spills (mean) for import tankers occurring and contacting land segments over the life of the proposed actions within 10 days.

- It is estimated that 16 crude oil spills of 7,665 bbl (median size) will occur from import tankering activities in the coastal and nearshore areas of the Gulf of Mexico.

- Spills occurring over the 35-year life of the proposed actions near major ports receiving imported crude oil are broken down by port area.

Import Tanker Spill Occurrence (spills greater than or equal to 1,000 bbl)
for Major Ports Receiving Crude Oil (35-year estimates)

Port	Mean No. of Spills	Probability (percent)
Corpus Christi, Tex.	1.70	0.82
Freeport, Tex	0.43	0.35
Galveston/Houston, Tex.	3.91	0.98
Port Arthur, Tex./ Lake Charles, La.	2.92	0.95
Miss. River Ports, La.	2.66	0.93
LOOP	3.47	0.97
Pascagoula, Miss.	1.32	0.73
Mobile, Ala.	1.10	0.10

Other Types of Barge and Tanker Spills

Figure IV-5 shows the distribution of the 82 tanker and barge spills greater than 1,000 bbl that have occurred in the Gulf region since 1974 (USDOI, MMS, 1991d). Thirty-four of these spills were crude oil and 48 were petroleum product. Thirty-five were from tankers and 47 were from barges. Louisiana has experienced the majority of these spills, having had 18 crude oil spills and 19 petroleum product spills in its coastal area. The majority of these spills have occurred on the Mississippi River. Barge spills are estimated to be about 1,500 bbl. The barge spill size is calculated from crude and barge spills that have occurred in the Gulf of Mexico area since 1974. The average barge spill size is 6,000 bbl.

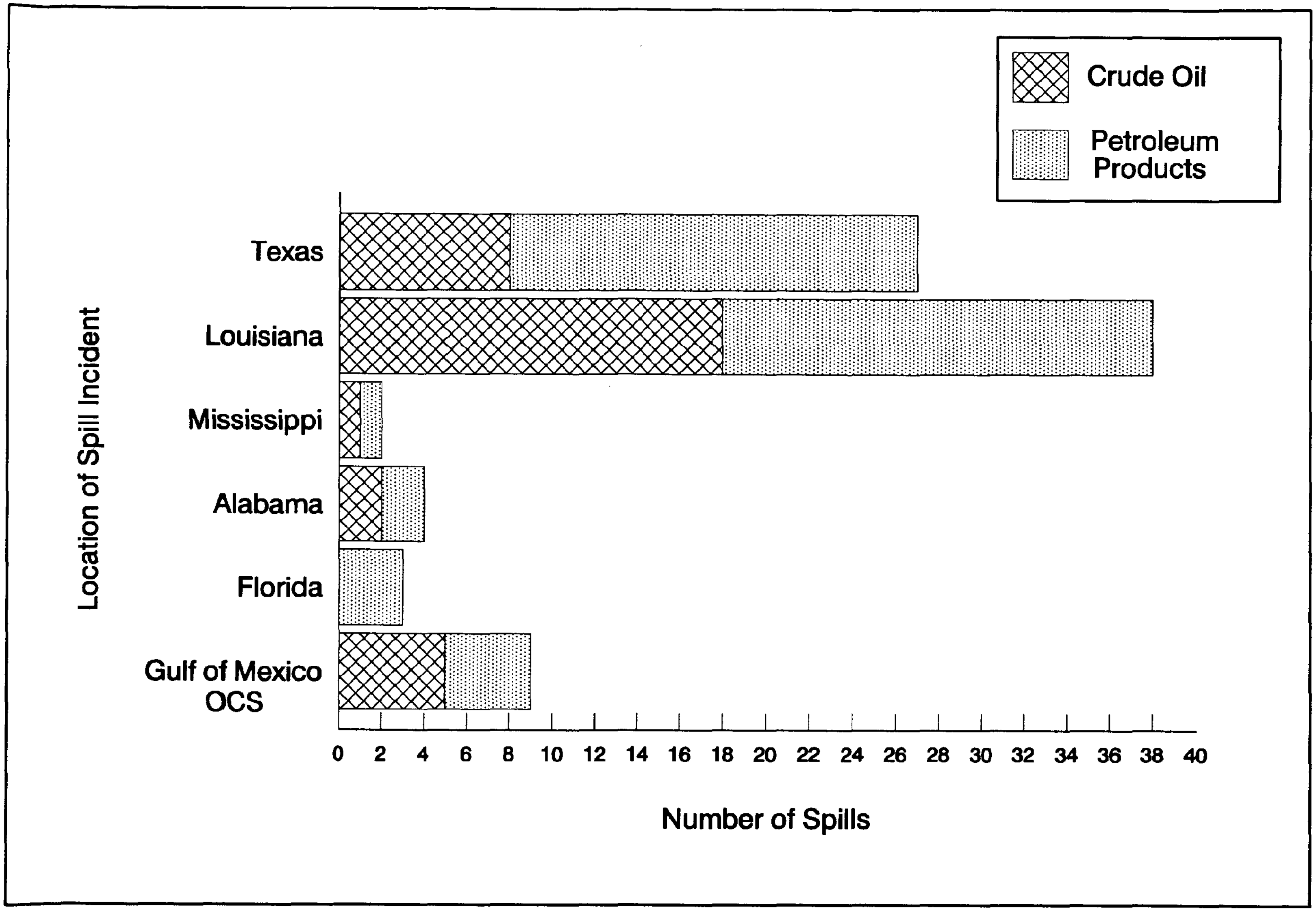


Figure IV-5. Location of Oil Spills (greater than or equal to 1,000 bbl) from Barges and Tankers in or near the Gulf of Mexico from 1974 to July 1990 (USDOI, MMS, 1990, unpublished information).

It is estimated that the coastwise movement of oil between ports or terminals may cause another 60 large spills from barges (18 in the WPA and 42 in the CPA) whose average size is 5,000 bbl. Further, it is assumed that 104 spills (44 in the WPA and 60 in the CPA) with an average size of 10,000 bbl may occur from the movement of petroleum products in restricted waters of the Gulf.

In order to obtain a mass balance of oil in the Gulf of Mexico, the National Academy of Sciences estimates for spills in the Gulf of Mexico were used. Oil spillage from tanker accidents accounted for only about 7 percent (Gulf of Mexico) to 20 percent (World Oceans) of the total oil pollution occurring due to tankering (USDOC, NOAA, 1984; NRC, 1985). Given this, accidental spills of any size from tankers contributes about 0.004 Mta to the petroleum hydrocarbon contamination of the Gulf of Mexico.

b. Operational Discharges

While casualty spills, especially the grounding or sinking of tankers, capture the attention of the general public and policy makers and can cause serious detrimental effects, operational discharges occurring from marine-tanker transportation have accounted for most of the oil discharges from tankers in the past (NRC, 1985). Operational discharges are routine and intentional discharges during normal operating procedures, and they are allowed by law (although some limitations imposed by regulation may be exceeded during the discharge). Routine tank washing and ballasting operations make up most of the operational discharges associated with tankering activities.

The National Academy of Sciences' (NRC, 1985) report estimates that total oil losses from barge and tanker operations are much larger than what is accounted for by oil spillage. Total discharges of petroleum to world waters range from 7.4 to 19.2 MMbbl per year, with a best estimate of 10.7 MMbbl per year, or 1.45 Mta. About one-half of this is attributed to operational discharges from oil tankers (about 5 MMbbl annually); the remainder is attributed to bilge water and fuel oil release from all ships (about 2.2 MMbbl annually) (considered an operational discharge), terminal operations (about 150,000 bbl annually), dry-docking (about 222,000 bbl annually), and accidental spillage (about 3 MMbbl annually). If we assume the ratio of spills in world waters to spills in Gulf waters (20:7) from transportation sources can be applied to the total contribution of petroleum hydrocarbons from transportation sources in world waters, we can calculate the total contribution from all transportation sources in Gulf of Mexico waters. Total discharges of petroleum from all transportation sources, which are dominated by operational discharges from tankers, are projected to be 0.5 Mta.

Besides oil spills from OCS operations, oil may enter Gulf waters from OCS operational discharges of produced waters. Produced water discharged (after treatment that removes the majority of the entrained oil content) contains, on an average, 89 ppm oil content (USEPA, 1991). The projected amount of OCS produced water discharged (Tables IV-12 and IV-13) was multiplied by the average amount of entrained oil (89 ppm) to determine the contribution to the petroleum loading of Gulf waters from OCS discharged produced waters. This calculation results in an estimate of 54,633 bbl annually, or 0.007 Mta, of petroleum hydrocarbons entering Gulf waters from operational produced-water discharges associated with OCS production.

c. Other

The Mississippi River is the major source of petroleum contamination in the Gulf of Mexico, carrying large quantities of petroleum hydrocarbons into Gulf waters. Gulf of Mexico sediment samples collected within a broad crescent around the River reflect petroleum contamination from the river's discharge (Southwest Research Institute, 1981; Brooks and Giammona, 1988). The NAS (NRC, 1985) states that 0.13 Mta of hydrocarbons enter the world ocean from river runoff that drains the interior of the United States. Accounting for the fact that the Mississippi River drains two-thirds of the U.S., petroleum hydrocarbons in the River's discharge due to upriver drainage alone could be assumed to be approximately two-thirds of 0.13 Mta; i.e., it could be estimated to be approximately 0.009 Mta. However, much of the hydrocarbon burden measured at the mouth of the Mississippi River as it empties into the Gulf is due to coastal inputs. Urban runoff and routine, low-level effluents from industry wastewaters and municipalities located along the river in the area near the Gulf of Mexico contribute large quantities of petroleum hydrocarbons. These sources are accounted for in the following estimates of inputs from other chronic, low-level sources.

Man's extensive use of fossil fuels, as well as lack of recycling of discarded oils, is reflected in the large contributions of petroleum hydrocarbons found in municipal wastewaters and urban runoff. Significant amounts of petroleum hydrocarbons are deposited in urban areas from a variety of sources--asphaltic roads; the protective asphaltic coatings used for roofs, pipes, etc.; oil used in two-cycle engines, especially outboard boat motors; gas station runoff; and unburned hydrocarbons in car exhaust. These sources are either directly flushed by rainfall and runoff into storm drains and into coastal waters or rivers or are weathered, broken down, and then dispersed. The Automotive Information Council recently estimated that 8.3 MMbbl (approximately 1.2 Mta) of used motor oil is generated annually in the U.S. by do-it-yourselfers. They estimated that 60 percent of this is poured on the ground, thereby adding 5.7 MMbbl of oil to the urban environment annually (0.814 Mta). Much of this discarded oil contributes to the petroleum loading found in municipal wastewaters and urban runoff. The NRC (1985) determined that municipal wastewaters and urban runoff contributes almost 26 percent of petroleum contamination to the world ocean. To determine an estimate of the amount of petroleum entering the Gulf from urban runoff and municipal wastewaters, the NRC methodology was applied to Gulf of Mexico statistics. Using a Gulf of Mexico U.S. coastal population of 14.7 million people (USDOC, NOAA, 1990), calculations result in a rough estimate of 0.024 Mta and 0.005 Mta from U.S. municipal wastewaters and urban runoff, respectively.

Other major land-based sources of petroleum hydrocarbons in Gulf waters include refineries and other industry effluents. Coastal refineries in the Gulf area have a total design capacity of $3.1\backslash 10^{5}$ Mta). Using a discharge rate for U.S. refineries of 0.005 kg/Mta capacity (NRC, 1985), the contribution of petroleum hydrocarbons from Gulf Coastal refineries is negligible (1.5×10^{-6} Mta). These discharges enter coastal rivers (particularly the Mississippi River) that drain into the Gulf or directly drain into coastal waters. The NRC did not provide a methodology for estimating the contribution of nonrefinery industrial wastes. The number they generated was based on an average from several data sources. If one assumes that such industries are evenly distributed in the U.S. coastal zone, and if the NRC's estimate of nonrefinery industrial waste input (0.2 Mta) is multiplied by one-third (the NRC's estimate of U.S. waters compared to world waters) and then multiplied by the ratio of the U.S. coastal population to the Gulf of Mexico's population, an estimate of 0.009 Mta of industrial effluent petroleum hydrocarbon contribution can be made.

C. OIL SPILLS OCCURRING IN CONNECTION WITH OCS OPERATIONS

Accidental discharge of oil can occur during almost any stage of exploration, development, or production on the OCS. Oil spills occur as a result of many causes (i.e., equipment malfunctions, ship collisions, pipeline breaks, human error, severe storms, etc.). Although many oil spills are not directly attributable to the oil-extraction process, they are indirectly related through the support activities necessary for recovery and transmission of the resource. Of the various potential OCS-related spill sources, the great majority of accidental discharges have resulted from production and transportation activities.

Impacts to sensitive resources from an accidental crude oil spill will depend on such factors as the initial size of the spill; the duration of the spill; whether the spill originated at the seafloor, surface, or at some point in between; the degree of weathering and dispersion that has occurred; and the degree of contact and sensitivity of a resource to the various components of the crude oil. Impacts range from direct effects, such as the smothering of organisms and toxic effects, to such indirect effects as disruption of a critical food source or interference with the ability to attach to a particular substrate. Impacts to a sensitive resource depend on the combination of factors present when the spilled crude contacts that resource. Refer to the analyses in Section IV.D. for a discussion of the variety of possible impacts to any specific resource.

The size of an oil spill can vary greatly from less than one barrel to hundreds of thousands of barrels being released over a period of time as a result of a single event. It is currently unknown if there is a direct relationship between the size of a spill and the event responsible for it. Because of this, discussions of estimates of the number, volume, location, and impacts resulting from accidental oil spills are based on spill size rather than source.

The OCS Lands Act requires the Secretary of the Interior to investigate and prepare a public report on each large oil spill. The MMS has issued regulations (30 CFR 250.41) requiring operators to report all accidents orally to the District Supervisor and to confirm in writing spills greater than one barrel. The report must include the cause, location, volume of spill, and action taken. In the case of spills greater than 50 bbl, the sea state, meteorological conditions, and size and appearance of the slick must also be included in the report.

Offshore oil spills greater than or equal to 1,000 bbl are modeled by the Oil Spill Risk Analysis computer model that was constructed to model spills large enough to persist for several days.

The OSRA is a three-step process designed to assess the potential risk of contact of spilled oil with sensitive environmental resources. This assessment is a long-term, statistical approach that is intended to estimate both the likelihood of spill occurrence and the probability of contact with the resources over the estimated 35-year life of the proposed action. The first OSRA step estimates the likelihood that one or more oil spills will occur using a rate based on historic spills and past OCS production. In the second step, seasonal contact probabilities are estimated using trajectories determined by mean surface currents and surface drift induced by the winds. The third step combines the occurrence and contact probabilities to estimate the combined likelihood of occurrence and contact for a given resource.

1. Historical Spill Occurrence and Assumptions

It was not until 1978 that Congress charged DOI with the responsibility to report publicly on major OCS accidents. However, some statistics on oil-spill events occurring in connection with OCS activities have been maintained since 1964. Requirements for reporting spills to MMS have varied through time as to size classes reported and protocols for reporting. At present, 30 CFR 250.41 requires that industry report in writing to MMS all spills over 1 bbl. Because of the historical variations on the reporting requirements for spills of less than 1,000 bbl, the statistics should not be viewed as an accurate record of all possible spills; however, they should be helpful in establishing limits on spill occurrence. For purposes of this analysis, spills are subdivided into three categories--spills greater than 1 bbl and less than or equal to 50 bbl, spills greater than 50 bbl and less than 1,000 bbl, and spills greater than or equal to 1,000 bbl. No complete database on spills less than or equal to 1 bbl exists; therefore, it will not be considered in the discussions described in this section.

Spill Occurrence

Offshore Spills Less Than 1,000 bbl Occurring in Connection with OCS Operations

Spill sources include pipeline leaks or breaks on the OCS and platform mishaps. The spill rates for spills less than 1,000 bbl are relative to OCS production of crude and condensate data. No information is maintained by MMS on small spills from shuttle-tankering operations because there has been no shuttle tanker activities to date. The spill-rate calculations employed information on the number of spills and the adjusted annual OCS production from 1971 to 1988. These spill rates differ from rates calculated for spills of 1,000 bbl or greater (Section IV.C.1. below) because they are arithmetic averages rather than rates estimated using statistical and trend analysis techniques. Implementation of improved safety practices in the OCS oil industry has apparently contributed to a reduction of large spill events(Anderson and Labelle, 1990). Because it is then conceivable that such safety practices may also influence the number of small spill events, these small-spill rates should be viewed as conservative estimates. The small-spill rates for the two categories are as follows:

Spill Size	Spill Rate (spills/Bbbl produced)
greater than 1 and less than or equal to 50 bbl	152
greater than 50 and less than 1,000 bbl	6

Experience shows that small spills occur in the vicinity of pipelines and platforms, and that these spills probably will occur at random during the 35-year life of the proposed action. The duration or life span of an oil spill depends, among other factors, on the initial volume of spilled oil. The former result imposes a restriction on the likelihood that a small spill would contact coastal resources and shorelines, that is, only those small spills close enough to resources or coastlines could make contact. The probable number of small spills that could occur in the OCS planning areas was calculated by multiplying the adequate spill rate by the estimated oil production. The number of spills in the size class of greater than 1 and less than or equal to 50 bbl calculated to occur for the Base Case and High Case for Sales 142 and 143, and the appropriate planning areas over the expected 35-year life of the proposed action are as follows (numbers are rounded means):

Number of Spills
(greater than 1 and less than or equal to 50 bbl)

	Base Case	High Case
WPA	8	20
CPA	21	47

The probable number of spills in the size class of greater than 50 and less than 1,000 bbl calculated for Sales 142 and 143 for the Base and High Cases and appropriate planning areas over the expected 35-year life of the proposed action are as follows (numbers are rounded means):

Number of Spills
(greater than 50 and less than 1,000 bbl)

	Base Case	High Case
WPA	0	1
CPA	1	2

Using the above figures, qualitative assumptions regarding the probable numbers of small spills occurring and contacting resources were made to provide a consistent basis for the analysis of the impacts of small spills occurring in the Gulf of Mexico.

Since the duration or life span of an oil spill depends on the initial volume of spilled oil, only those areas close to shorelines can significantly contribute to the number of spills that may contact land. Launch areas close to the Federal-State boundary line are the closest sources of oil spills that may contact land.

For the Base Case in the CPA, it is assumed that three small spills of the size category of greater than 1 and less than or equal to 50 bbl are likely to occur every 5 years, that a low percentage of these spills will occur in proximity to coastal resources, and that a few of the total spills that will occur during the 35-year life of the proposed action will contact the CPA coastline. In the WPA, it is assumed that a small spill of the size category of greater than 1 and less than 50 bbl will occur every 5 years and that no spill in this size category will contact the WPA coastline during the 35-year life of the proposed action. For the small-spill category of greater than 50 and less than 1,000 bbl, it is assumed that one spill of this size will occur in the CPA during the 35-year life of the proposed action but will not contact the coastline or resources. In the WPA, it is assumed that no spills in this size category will occur and/or contact the resources or shoreline.

For the High Case in the CPA, it is assumed that seven spills in the size class of greater than 1 and less than or equal to 50 bbl will occur every 5 years, that a low percentage of these spills will occur in proximity to coastal resources, and that a few of these spills will contact the coastline of the CPA during the 35-year life of the proposed action. For the WPA it is assumed that about three small spills every 5 years in this category will occur, that a low percentage of these spills will occur in proximity to coastal resources, and that none of them will contact the coastline of the planning area during the lease life. For the small-spill size class of greater than 50 and less than 1,000 bbl, it is assumed that one spill will occur in the WPA and that two spills will occur in the CPA during the 35-year life of the proposed actions, none of these spills will contact the coastline of either planning area.

It is assumed that a moderate number (between 5 and 25) of small spills in the size class of greater than 1 and less than or equal to 50 bbl will occur each year from OCS program activities in the CPA and WPA analysis area in proximity to coastal environments and that a few of these spills will contact both coastlines each year.

For the CPA, it is assumed that about one spill in the size class of greater than 50 and less than 1,000 bbl will occur each year from OCS program activities. None of these spills are assumed to contact the CPA coastline during the 35-year life. For the WPA, it is assumed that no spill will occur and/or contact the resources or coastline during the 35-year life from OCS program activities.

It is assumed that spills of one barrel or less will not significantly contribute to the short-term impact of oil spills on sensitive environmental resources. This is because such small spills will weather rapidly, exhibiting an extremely short life as a slick. However, once the oil components are dissipated into the atmosphere and water column, they can contribute to the overall hydrocarbon loadings in the air and water. Impacts from chronic long-term contamination by petroleum hydrocarbons on air and water quality are analyzed in this EIS.

Onshore Spills Occurring from OCS Coastal Operations

For the spill category greaer than 1 and less than or equal to 50 bbl, it is assumed that less than 10 spills in each planning area spills will occur in the coastal zone from pipelines. These spills can occur from pipelines, shuttle tankers, and barge operations near terminals in the coastal zone. For the spill category greater than 50 and less than 1,000 bbl, it is assumed that no spills from pipelines, shuttle tankers, barge operations or onshore storage and processing facilities will occur in the inshore area.

Due to OCS Program activities, it is assumed that oil spills of greater than or equal to 1 and less than 50 bbl from OCS onshore transport, processing, or storage will occur about once a year (averaging between 25 and 42 spills). The operation of pipelines, tankers, and barges in the onshore areas will result in about one OCS-related spill greater than or equal to 50 and less than 1,000 bbl every 10 years (averaging 4-6 spills).

Spills related to the OCS program can occur at onshore storage, processing, or transport facilities. However, MMS does not regulate such activities, and the MMS spill database contains only spill incidents that occur in Federal waters. The following observations can be made after examining oil-spill statistics contained in the Emergency Response Notification System and published in several U.S. Coast Guard reports (USDOT, CG, 1989). Locations of the spills kept in this database include open sheltered waters, river channels, ports and harbors, territorial seas, contiguous zone, and high seas. For the years 1984-1986, river channels had the most number of occurrences and the largest spills. This observation held true also for the Gulf region. Types of oil include both crude oil and petroleum products and can even include vegetable oils used in cooking. In general, crude oil spills are the most common occurrence followed closely by diesel and fuel oil spills. Sources of spills include marine vessels, land vehicles, nontransportation activities (refineries, bulk storage, onshore and offshore production), and marine terminals. The data show that nontransportation facilities underwent more spill incidents during 1984-1986, while marine vessels and terminals spill the largest volumes averaged over a year.

Many of these categories are not broken down for the Gulf of Mexico area. The following information about small spills in the Gulf is either derived from the above USCG reports or from personal communication with the USCG. In the Gulf area, there were about 1,484 small spills occurring per year. About four spills per year occur from transfer operations, or about 8 spills per 1,000 transfers; the vast majority of these spills are less than 50 bbl (Oil Spill Intelligence Report, 1988; Westcott, personal comm., 1989).

Offshore Spills Greater Than or Equal to 1,000 bbl Occurring in Connection with OCS Operations

Data on spills of 1,000 bbl or greater from offshore platforms and pipelines have been kept accurately since 1964. Since 1964 there have been 10 oil spills of 1,000 bbl or more from platforms on the OCS, the last one occurring in 1980. The majority of these are related to bad weather conditions. There have been 11 spills of 1,000 bbl or more from pipelines on the OCS; the last two spills occurred on January 24, 1990 (14,423 bbl) and on May 6, 1990 (4,569 bbl). The majority of the 11 spills occurred due to anchor or trawl damage. These spill-event data, in conjunction with the historic production of OCS leases, allow the estimation of a spill rate with a significant degree of accuracy. This rate has not been uniform through time, and several revisions have been carried out (Nakassis, 1982; Lanfear and Amstutz, 1983; Anderson and LaBelle, 1990). The latest revision (Anderson and LaBelle, 1990) found a decrease in the spill rate of 40 percent for platforms and 50 percent for pipelines. These reductions were attributed to improved safety practices in the oil industry. The shuttle tanker spill rate is based on worldwide tanker spills from 1974 through 1985 (Anderson and LaBelle, 1990) (see the table below). The spill-rate values are as follows:

Spill Rates from Offshore OCS Operations
(1,000 bbl or greater/billion bbl produced and transported)

Platforms	0.60
Pipelines	0.67
Shuttle Tankering (at sea)	0.90
Shuttle Tankering (near port)	0.40

Large OCS Oil Spill Assumptions of Contact and Occurrence

Large oil spill occurrences do not follow a deterministic law; they occur at random as stated earlier. In such cases, any attempt at spill prediction must use the methods of probability and statistics. Application of these methods results in a measure of the likelihood of spill occurrence. The analyst, using his/her insight, must interpret the meaning of the likelihood in applying the spill statistics to the analysis of spill impact on resources.

Large Offshore OCS Spill Assumptions

This section presents assumptions to be used for analytical purposes regarding the occurrences of large (1,000 bbl or greater) oil spills from OCS sources over the 35-year life of the proposed actions. Many of the assumptions regarding the occurrence of large spills from OCS activities are derived from the OSRA model results presented in Table IV-19. These assumptions are as follows:

(1) Base Case

- Central Gulf of Mexico - One large offshore crude oil spill is assumed to occur from OCS activities (either from a platform or a pipeline) over the 35-year life of the proposed action based on a probability of occurrence of one or more spills of 16 percent. The median size of this spill is 6,500 bbl, and it is assumed to be subsurface.

- Western Gulf of Mexico - No large offshore crude oil spills are assumed to occur from OCS activities over the 35-year life of the proposed action based on a probability of occurrence of one or more spills of 6 percent.

(2) High Case

- Central Gulf of Mexico - One large offshore crude oil spill is assumed to occur from OCS activities (either from a platform or a pipeline) over the 35-year life of the proposed action based on a probability of occurrence of one or more spills of 32 percent. This is assumed to be a subsurface spill with a median size of 6,500 bbl.

- Western Gulf of Mexico - One large offshore crude oil spill is assumed to occur from OCS activities (either from a platform or pipeline) over the 35-year life of the proposed action based on a probability of occurrence of one or more spills of 16 percent.

The large spill assumptions from all OCS Program activities are as follows:

- Central Gulf of Mexico - It is assumed that there will be no large spills from shuttle tankers. Four large crude oil spills of 6,000 bbl from offshore pipelines and three large oil spills of 7,000 bbl from platforms are assumed to occur.

- Western Gulf of Mexico - It is assumed that there will be no large spills from shuttle tankers. One large crude oil spill of 6,000 bbl from pipelines and one large oil spill of 7,000 bbl from platforms are assumed to occur.

The tankering values presented in this table represent only that portion of the route covered away from the coastal and port areas. For the major Gulf ports accepting tankered crude oil, the values in Table IV-16 represent the probable spill occurrence in the nearshore/port area itself.

Table IV-16

Shuttle Tanker Spill Occurrence for Major Ports
Receiving OCS-Produced Crude Oil (spills greater than 1,000 bbl)

Port	Base Cases (35 years) Mean No.	Base Cases (35 years) Prob. 1+	High Cases (35 years) Mean No.	High Cases (35 years) Prob. 1+	OCS Program Activities (35 years) Mean No.	OCS Program Activities (35 years) Prob. 1+
Corpus Christi, Tex.	--	--	--	--	0.01	1%
Freeport, Tex.	--	--	--	--	--	--
Galveston/Houston, Tex.	--	--	--	--	--	--
Port Arthur, Tex./	--	--	--	--	0.01	1%
Lake Charles, La.	--	--	--	--	--	--
Miss. River Ports, La.	--	--	--	--	0.06	6%
Pascagoula, Miss.	--	--	--	--	0.01	1%
Mobile, Ala.	--	--	--	--	--	--

Note: -- equals a value of less than 0.005 for both a mean number of spills and a probability.

Source: Price, 1991.

Large Onshore OCS Spill Assumptions

(1) Base Case

- Central Gulf of Mexico - No onshore large pipeline, barge, or shuttle tanker spills are assumed to occur.

- Western Gulf of Mexico - No onshore pipeline, barge, or shuttle tanker spills are assumed to occur.

(2) High Case

- Central Gulf of Mexico - No onshore large pipeline, barge, or shuttle tanker spills are assumed to occur.

- Western Gulf of Mexico - No onshore pipeline, barge, or shuttle tanker spills are assumed to occur.

The large spill assumptions from all OCS Program activities are as follows:

- Central Gulf of Mexico - No large pipeline spills are assumed to occur onshore. At least two spills from the barging of OCS crude are assumed to occur in Louisiana waters.

- Western Gulf of Mexico - No large spills from onshore pipelines are assumed. At least one spill from the barging of OCS crude is estimated to occur in Texas waters.

Very Large Offshore Spills Greater Than or Equal to 100,000 bbl Occurring in Connection with OCS Operations

For EIS purposes, a very large oil spill is defined as a spill of 100,000 bbl or greater. Only one very large spill, a 160,638-bbl pipeline spill, has occurred in the Gulf of Mexico from OCS operations. This spill occurred in 1967 and lasted 12 days, prior to the implementation of more expanded and stringent Federal regulations of OCS activities. From the above discussion it can be inferred that the probability of occurrence of an OCS-related oil spill in excess of 100,000 bbl in the Gulf of Mexico is very low. The historical record shows that there have been seven large spills exceeding 10,000 bbl--four from pipelines and three from platforms. The three platform spills resulted from blowouts, which, along with the Santa Barbara blowout incident, prompted the implementation of new and stringent operation regulations pertaining to drilling procedures, subsurface safety valves, and platform safety devices. Also, the training requirements and inspections by MMS personnel were increased as a result of the above incidents. The four pipeline spills occurred from anchor dragging across pipelines. A brief description of some of the earlier spills mentioned above can be found in Sections IV.C.1.c.(1) and (2) of the Final EIS for Sales 131, 135, and 137. An analysis of one possible very large oil spill is presented in Section IV.E.

Projected Spill Sizes

Despite inherent variability, an expected "typical" size spill is useful in order to project the fate and effects of spills occurring in association with the OCS oil and gas industry operations. The following table provides a median spill size for spills greater than or equal to 1,000 bbl occurring from pipelines, platforms, tankers, and barges. The "median" of a set of measurements is defined as the middle value when the measurements are arranged in order of magnitude. The median size is used because it is considered a better indicator of a "likely" spill size since the average size is skewed by a few very large oil spill events.

Source	Median Size (bbl)
Pipelines	6,000
Platforms	7,000
Shuttle Tankers	21,000[1]
Barges	1,500[2]

[1]Because no median size spill for shuttle tankers in the two size classes expected to be used is known, a conservative approach has been taken, and the median size spills for all tankers is used here.

[2]Source: Barges: The barge spill size is calculated from crude and barge spills that have occurred in the Gulf of Mexico area since 1974. The average barge spill size is 6,000 bbl.

Source: Anderson, personal comm., 1990, for pipeline, platforms, and tankers spill sizes.

2. Characteristics, Fates, and Effects

The impact, behavior, and ultimate fate of an oil spill depend not only on the ambient physical environment but also on its chemical and physical properties. Oil is a complex mixture of thousands of organic and a few inorganic compounds. These compounds include alkanes (aliphatics), naphthenes (cycloparaffinic), aromatics, and asphaltics (asphaltenes and heterocyclic compounds containing oxygen, sulphur, and nitrogen). A description of the characteristics of crude oil can be found in Section IV.C.2. of the Final EIS for Sales 131, 135, and 137.

South Louisiana Crude

South Louisiana crude is a typical crude oil from the Central Gulf of Mexico. The properties of an API reference South Louisiana crude oil are provided in Table IV-12 of the Final EIS for Sales 131, 135, and 137, as well as other crude oils from different geographical regions in the Gulf of Mexico. Variations in composition can be expected for oils produced from different formations or fields within a region and from different timeframes when sampled. A review of 92 crude oils produced from fields on the CPA OCS and coastal Louisiana shows that a majority (51%) of the crude oils have API gravities between 33° and 38° API. However, the range of variability is great, with the lowest being 21.6° and the highest being 47.3° API.

Short-term Weathering Processes

A number of processes occur when oil is spilled in water, altering the chemical and physical characteristics of the original oil mixture. Collectively, these are referred to as weathering or aging of the oil and will determine, along with physical oceanography, the fate of the spilled oil. Weathering involves a number of physical/chemical and biological processes that change the characteristics of the crude-oil mixture and reduce the concentration of oil components in the slick. These processes include evaporation, dispersion, dissolution, emulsification, biodegradation, photo-oxidation, sinking, and sedimentation. Any or all of these processes can be expected to operate on spilled oil. Their relative importance depends largely on the oil's chemistry and the oceanographic and meteorological conditions at the time of the spill. Eventually, a tar-like residue may be left, which would break up into tar lumps or tarballs. Types of weathering processes and transport pathways of spilled oil at sea are depicted in Figure IV-6.

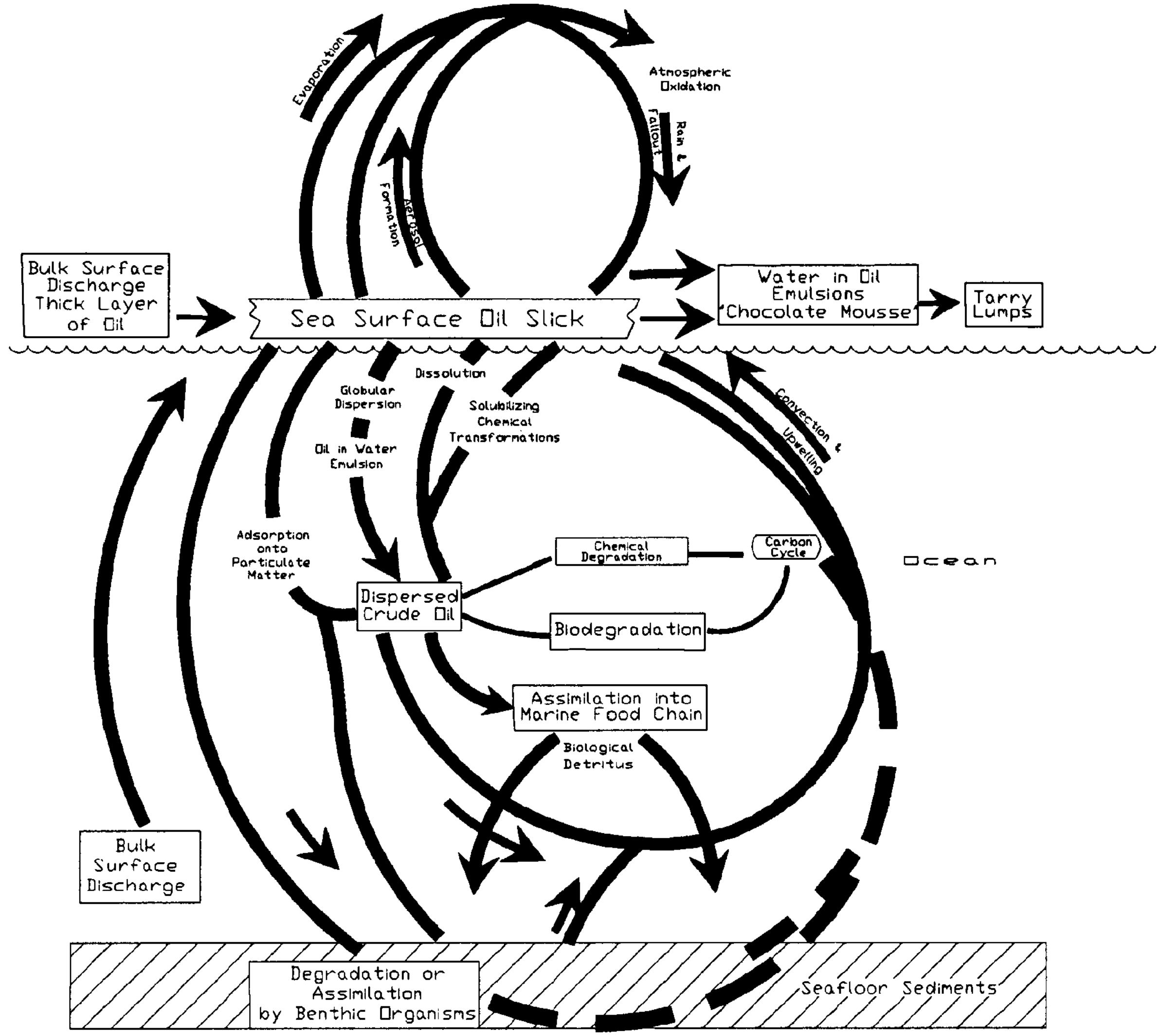


Figure IV-6. Processes Affecting the Fate of Spilled Oil (reprinted from Jordan and Payne, 1980).

Slick Residence Time

Spilled Louisiana crude disperses and degrades rapidly under the influences of the Gulf's warm climatic conditions and due to the properties of the oil. Because Louisiana crude evaporates rapidly, slicks observed in Gulf waters have disappeared within days. Very few oil slicks have ever been tracked for more than 30 days. (Spills from the *Torrey Canyon* tanker, *Amoco Cadiz* tanker, and the *Ixtoc* blowout accidents, which released oil over a long time period, remained on the sea surface longer than 30 days, but the volumes spilled were many times larger than the median spill described in this EIS.) For example, a slick from South Pass Block 60 of 42,000 bbl, spilled on August 2, 1973, was reported dissipated with only small patches remaining after only 5 days. In examining the Chevron Main Pass blowout, only 50 percent of the oil lost could be accounted for--25-30 percent of the oil was estimated lost due to evaporation, 10-20 percent of the oil was removed from the sea surface by skimming and other recovery techniques, less than 1 percent was believed dissolved in seawater, and less than 1 percent sunk and was deposited in the sediment within an 8-km radius of the well. Evidently, the remaining oil became emulsified and dispersed to undetectable levels (less than 1 ppm) or became biodegraded and/or photo-oxidized (McAuliffe et al., 1975). Dispersants were used in the cleanup operations and also in the water sprayed on the burning platform to help disperse the oil. Based on the above, 10 days, is chosen as the most likely sea-surface residence time. Research regarding dominant weathering processes indicate that after 10 days the oil properties have changed extensively and the original volume has decreased greatly (Table IV-17). The floating oil is largely devoid of its volatile (acutely toxic) components, and the slick is breaking up.

Weathering Processes

Table IV-17 summarizes the time periods expected and the percent loss of the original volume of an oil spill due to weathering processes. Section IV.C.2. of the Final EIS for Sales 131, 135, and 137 describes the major weathering processes in detail. The following is a summary of this section.

Weathering Processes Less Than 10 Days

After a spill occurs, a "slick" forms because of the low solubility of most petroleum components. Major processes affecting the slick's volume include spreading, evaporation, dissolution, and dispersion. By far, spreading of the oil to a thin film is the most important process because spreading enhances the ability of other weathering processes to act on the slick. The more volatile hydrocarbons are lost to the atmosphere during the first 24 hours from evaporation of the slick. Based on an analysis by Torgrimson (1981), 48 percent of a typical medium-light crude oil would be lost due to evaporation. Low-molecular-weight compounds will also rapidly dissolve in the water column. Dissolution can occur directly from the floating slick or from dispersed oil in the water column. The process is in competition with evaporation, which is orders of magnitude faster, so many soluble compounds are preferentially removed by evaporation. The agitation of oil slicks due to the breaking of waves, the action of the surf, and the surface turbulence supply the energy to drive oil into the water column, forming small droplets of stable emulsions from 5 micrometers to several millimeters in size that are dispersed into the water column (oil-in-water emulsions). Larger oil droplets probably rise and coalesce with the slick, while the smaller oil droplets are conveyed and permanently incorporated into the water column (NRC, 1985). This process, along with evaporation, largely determines the lifetime of a slick.

For purposes of analysis, the following assumptions about weathering of the projected spills are made: the surface slick will lose about 60 percent of its original volume by 10 days, primarily due to evaporation; and under rough wave conditions, oil will be dispersed 20 m in the water column. If one assumes that 10 percent of the slick is cleaned up, then, by 10 days, 70 percent of the slick is expected to be removed from the surface.

Table IV-17

Mass Balance of a Typical Gulf of Mexico Crude Oil Spill[1]

Process	Time Scale (in days	% Loss of Original Slick Volume (10 days)	% Loss of Original Slick Volume (30 days)
Evaporation	1-10	33%-67%	33%-67%
Dissolution	1-10	1%-5%	1%-5%
Dispersion	1-30	10%-15%	included in sinking and sedimentation rate
Photo/Auto-oxidation	3-365	<1%	5%
Biodegradation	5-720	1%	included in sinking and sedimentation rate
Sinking and Sedimentation	10-365	<1%	20%-34%
Tar Residue	10-365	<1%	1%-30%
Offshore Skimming and Recovery Cleanup Operatins		10%	15%
Total Volume Loss from Water Surface		56%-98%	100%

[1]It is assumed that the spill does not contact land.
[2]Ranges given provide an overview of crude oil fate in general. The most likely percent for Louisiana crude oil due to that process is provided in the narrative entitled "Weathering Processes Less Than 10 Days."

Source: USDOI, MMS, Gulf of Mexico OCS Region estimates, 1989.

Weathering Processes Greater Than 10 Days

Major processes include emulsion formation, sedimentation, chemical- and photo-oxidation, and microbial degradation.

Because most of the components of petroleum are relatively insoluble in water, an important process in weathering of the slick is the formation of emulsions. Facilitated by increased viscosity and density due to evaporation and dissolution, the heavier fractions of oil take on a highly viscous consistency caused by the formation of a water-in-oil emulsion termed "mousse" because of its color and consistency. Emulsification impedes cleanup operations and slows down the weathering process by limiting the exposed surface area. Many Gulf crudes have been found not to form mousse emulsions.

Sedimentation of the dispersed or surface emulsified oil occurs once an increase in density is sufficient to sink the material. In Gulf coastal areas characterized by fine-sediment salt marshes or influenced by the Mississippi River's large sediment plume, the amounts of suspended particles in the water are high, and oil in this turbid area is soon carried to the bottom.

Spilled oil undergoes chemical changes such as photo- and auto-oxidation, producing a number of products including CO_2, carboxylic acids and diacids, esters and lactones, aldehydes, alcohols, hydroperoxides, phenols, sulfoxides, and combinations of these products. Besides influencing the solubility of the components of oil spills, oxidation enhances dispersion and emulsification. The effects of oxidation are complex and may be partially beneficial and partially deleterious.

Biological processes include biodegradation and ingestion by zooplankton and larger forms of marine organisms. The rate of decomposition is dependent on the nature and abundance of the indigenous microbial assemblage, the available inorganic nutrients and oxygen, and the ambient temperature. Bacterial decomposition of oil is the most important long-term, process removing spilled petroleum compounds from the environment. Biodegradation of hydrocarbons occurs on the sea surface, in the water column, in the bottom sediments, and on the coast once the oil is beached. Microbial degradation of oil beached from the *Exxon Valdez* oil spill was accelerated after scientists added fertilizer to enhance microbial growth (USEPA, 1989). Bioremediation of the spilled oil proved one of the most effective cleanup techniques used.

South Louisiana crude oil showed the highest rate of degradation in numerous studies conducted on biodegradation rates of different oils (Zobell and Prokop, 1966). Jeffrey (1977) states that in 1977 Walker and Colwell found as high as a 97 percent loss of oil in only 30 days from Louisiana sediments due to bacterial degradation in one instance.

Subsurface Plume Formation

Not all spills occur at the surface. The Ixtoc subsurface spill resulted in higher concentrations of oil in the water column than usually measured beneath surface slicks. The subsurface plume contained higher concentrations of volatiles, thus showing that the plume was not surface oil driven back into the water column. It was theorized that another mechanism--subsurface plume formation--was responsible for the phenomena.

Long-term Fate/Tar Residue Formation

Natural weathering (evaporation, dissolution, photo-oxidation, and microbial oxidation) and degradation processes will remove nearly all of the original volume of the spilled surface slick within 30 days (Wheeler, 1978). Any tarry residue left behind will break up into smaller fragments from continuing wave action and form tarballs in the water column. Further degradation is retarded since the surface-to-volume ratio of unspread tar is small and tarballs are resistant to microbial degradation; therefore, their lifetime could be on the order of several months to years (Geyer, 1980). Some tarballs reach the coast. An average of 14,000 bbl of floating tar exist in the Gulf of Mexico (Geyer, 1981).

Butler et al. (1973) found that around 30 percent of most oil discharged to the ocean remains in the form of tarballs or lumps. In contrast, Louisiana crude and some other northern Gulf coast crude oils do not seem to form tarballs (Jeffrey et al., 1974) because of low asphaltene and nitrogen-sulphur-oxygen (NSO) components. Tarball formation is limited to spherical accretion caused by persistent convergence and supply to the oil residues (Heaton et al., 1980). Spills from the oil types in the Eastern Gulf may form a significantly higher percentage of tar material because of the different chemical compositions of the oil.

The distribution and long-term fate of an oil slick, if it contacts land before breaking up, is a function of weathering processes and coastal geomorphology, the kinetic energy of the area, the thickness of the beached oil, and the porosity of the shoreline sediments. Oil coming ashore into tidal flats, mangrove swamps, or salt marshes could be spread farther inland by each tidal movement and wave action (Jackson et al., 1989). Once entering inland waters, the oil could either spread out into a thin film or reach areas sheltered from waves and tidal currents and form a thick layer of oil that can remain for years. It is assumed that once oil contacts land, it is already spread into a 1 mm thickness.

Most oil that will reach the Gulf of Mexico shoreline would contact fringing beaches and barrier islands. The distribution and physical dispersion of an oil slick once it contacts a coastal beach is dependent upon the level of kinetic energy of the coastal environment. Often, oiled beaches are cleansed by the natural action of abrasion and sediment scouring by wave activity. Much of the oil beached on the Texas shoreline from the Ixtoc blowout was removed during a hurricane. Stranded oil can be washed back out to sea and can be rolled along the bottom in the shallow-water zone by waves and currents, eventually either emerging somewhere else along the shoreline; washing back onshore in the form of hard, tarry masses (tarballs); or resting offshore in the intertidal zone. Some beached oil becomes buried by the rapid changes in beach morphology that occur from natural cycles of erosion or from deposition of migrating beach sands. The depth of oil burial and the thickness of oiled sediments increases as the grain size increases. Although the entire sand column may become lightly contaminated, most of the oil exists in a highly concentrated band of oil-impregnated sand that can persist for years. These buried oil layers have been shown to migrate downwards within the beach sediment, eventually stabilizing deep within the beach at or near the water table or reaching an impermeable layer and migrating along the layer until emerging in the lower intertidal or subtidal sediments at the foot of the beach (Long et al., 1981). Rates of migration of buried oil studied after the *Amoco Cadiz* spill ranged from 0.25 to 1.0 millimeters per tidal cycle. According to Long et al., these rates agree with rates determined experimentally for a variety of sediment types.

In the 1970 South Timbalier Block 26 oil spill of 53,000 bbl, the self-cleaning phenomena of south Louisiana beaches was the most effective means of removing oil from the beaches. The beaches cleaned themselves in a few days after oil was deposited due to (1) the sand being hard packed and, therefore, resistant to penetration by oil and emulsified oil and (2) the beaches were narrow and shallow; therefore, they were easily swept clean by the changing tides (Berry, 1972).

The ultimate fate of environmentally dispersed petroleum in open water is poorly understood. A study by Energy Resources Co. for BLM (1982) found no Ixtoc oil in offshore South Texas OCS (STOCS) sediments. Only 2 percent of the oil spilled from the Ixtoc blowout was ever accounted for (either found on beaches or residing offshore in tar mats). Perhaps 5-10 times as much oil passed through the Texas OCS region, largely in the form of small patches of emulsified oil. The researchers believed the oil could be tied up with the mobile, suspended sedimentary material (nepheloid layer) that exists near the bottom sediment/water interface or ultimately found its way onto the slope and abyssal plain.

Based on information about Gulf Coast oil spillage, concentrations of spilled petroleum that reach coastal sediments are assumed to be degraded to background levels within 1-2 years (Brown, 1980; McAuliffe et al., 1975; Butler et al., 1976).

Toxic Effects of Oil Spills

Most of the historical oil spills that occurred in connection with OCS oil industry operations in the Gulf have probably resulted in no serious, short-term, deleterious effects. This conclusion is based on a review of the sparse documentation of the effects of Gulf of Mexico oil spills and on the rapidity with which Louisiana crude disperses and degrades.

Each spill is a unique event, with a number of factors interacting to determine its effects; however, all spills occurring in the Gulf could be potentially harmful. The variability documented in the literature regarding environmental effects of oil spills is due to differences in oil components, environmental conditions, and the organisms encountered. The most damage from an oil spill occurs if a spill from the open ocean reaches confined, shallow water bodies where waterfowl or aquatic organisms are concentrated.

The ultimate impact and recovery of an ecosystem from petroleum contamination depend on the physical and chemical form of the oil and the state of the ecosystem at the specific time of impact. The movement of oil into the water, its chemical changes, its effects on aquatic organisms, and its persistence in the sea are all influenced by (1) the type and characteristics of the oil (for example, its viscosity and percent aromatics); (2) the amount and duration of oil spilled; (3) sea state, in particular the tidal cycle and wave activity; (4) the location of the spill, including the physiography of the area and the distance from shore; (5) the geographical and topological configuration of the affected coast, including textural characteristics of shore sediments; (6) the climatic conditions, in particular temperature, wind, and solar radiation; (7) the biota of the area; (8) the season of the spill; (9) the previous exposure of the area to oil; (10) the area's exposure to other pollutants; and (11) the effectiveness of oil response measures taken.

Short-term effects of oil spills that result in biological loss occur by direct kill through coating and asphyxiation; by contact poisoning or by incorporation of water-soluble toxic, carcinogenic, or mutagenic components of oil; by destruction of the generally more sensitive juvenile forms of organisms or of the food source of higher trophic species; and by modification of habitats, delaying or preventing recolonization (Blumer, 1971).

The toxicity of petroleum to marine organisms is dependent on the concentration and composition of its individual hydrocarbons and the exposure length of the various components. The toxicity of the oil will be altered as it weathers, as a result of the changes in its chemical composition.

Table IV-18 contains LC_{50} values for marine organisms indigenous to the Gulf of Mexico, including commercially important species as well as basic components of the food web. Although plants are not usually listed, an LC_{50} value for mangrove propagules (not on the table) is given as 0.5 $1/m^2$ for light Arabian crude oil (Hoi-Chaw and Meow-Chan, 1985). The refined oils, No. 2 fuel oil and Bunker C oil, were more toxic than the crude oils. The WSF's were more toxic than the oil-in-water dispersions.

3. Results of the Oil Spill Risk Analysis

As stated in Section IV.C.1., the historical database for large spills (greater than or equal to 1,000 bbl) is more complete, and the resulting spill rate has greater reliability. Also, more time has been devoted to their study from all aspects because of their dramatic impacts and longer times over the sea surface, among many other factors. As a result, our understanding and experience regarding large spills are considerably more sophisticated than for small spills. Regardless of this emphasis and accumulated knowledge, statistical techniques are used to predict the occurrence of oil spills. For this procedure, it is assumed that spill occurrence can be described as a Poisson process. The parameters of importance become the spill rates (Section IV.C.1.) for the different activities of interest, and the estimated production is distributed or aggregated among the different activities. Using this information, the appropriate computations were performed; and the results for the Base and High Cases and OCS program activities' areas are presented in Table IV-19. This table presents the estimated production, the mean number of spills, and the probability that one or more oil spills of greater than or equal to 1,000 bbl will occur over the 35-year life of the proposed action.

Trajectory Simulation

Oil spill trajectory simulations are conducted using mean seasonal surface currents and surface drift produced by winds sampled every 3 hours for 30 days until land is contacted or the trajectory moves out of the study area. Hypothetical spill trajectories were simulated for each of the potential launch sites across the entire Gulf (Figure IV-7). These simulations presume 500 spills occurring in each of the four seasons of the year from each launch site. The results are presented as probabilities (expressed as percent chance) that an oil spill starting at a particular launch site will contact a certain environmental resource or a land segment within 3, 10, or 30 days. A summary of the trajectory analysis (for 10 days) for all launch sites across the Gulf that present a potential risk to the land segments is given in Table IV-20. This table illustrates that if, for example, an oil spill were to occur in the Western Gulf, the probability (expressed as percent chance) of contact with a certain land segment within 10 days ranges from less than 0.5 percent to 41 percent. The corresponding counties for the highest percent chance of contact are Calhoun County in Texas, and Plaquemines Parish in Louisiana.

Table IV-18

LC$_{50}$ Values for Some Gulf of Mexico Marine Animals

Species	LC$_{50}$ (hours)	Southern Louisiana Crude OWD[7] (ppm)	Southern Louisiana Crude WSF[8] (ppm)	Kuwait Crude OWD (ppm)	Kuwait Crude WSF (ppm)	No. 2 Fuel Oil OWD (ppm)	No. 2 Fuel Oil WSF (ppm)	Bunker C Oil OWD (ppm)	Bunker C Oil WSF (ppm)	Weathered IXTOC I OAS[9] (ppm)
Mysid (*Mysidopsis almyra*)[1]	48	37.5	8.7	63.0	6.6	1.3	0.9	-	0.9	-
Grass shrimp (*Palaemonetes pugio*)[1]	96	200	>16.8	6,000	>10.2	3.0	3.5	-	2.6	-
Brown shrimp postlarvae (*Penaeus aztecus*)[1]	96	>1,000	>19.8	-	-	9.4	4.9	-	1.9	
Sheepshead minnow (*Cyprinodon variegatus*)[1]	96	29,000	>19.8	>80,000	-	93	6.3	-	3.1	
Silverside (*Menidia beryllina*)[1]	96	3,700	5.5	9,400	6.6	-	3.9	-	1.9	-
Longnose killifish (*Fundulus similus*)[1]	96	6,000	16.8	14,800	>10.4	33	3.9	-	1.69	-
Copepods of coastal Texas and laboratory-reared amphipods[2]	96	-	-	-	-	-	-	-	-	>13.5
Red drum eggs and larvae (*Sciaenops ocellata*)[3]	24	-	-	-	-	-	-	-	-	>5.1
Polychaeta (*Capitella capitata*)[4]	96	-	12.0	-	9.8	-	2.3	-	0.9	-
Isopod (*Ligia exotica*)[5]	96	-	-	-	-	36.5	*10	-	-	-
Brown Shrimp (*Penaeus aztecus*)[6]	96									
Postlarvae		-	-	-	-	-	6.6	-	-	-
Early juveniles		-	-	-	-	-	3.7	-	-	-
Late juveniles		-	-	-	-	-	2.9	-	-	-

Table IV-18. LC_{50} Values for Some Gulf of Mexico Marine Animals (continued)

Species	LC_{50} (hours)	Southern Louisiana Crude (ppm) OWD[7]	Southern Louisiana Crude (ppm) WSF[8]	Kuwait Crude (ppm) OWD	Kuwait Crude (ppm) WSF	No. 2 Fuel Oil (ppm) OWD	No. 2 Fuel Oil (ppm) WSF	Bunker C Oil (ppm) OWD	Bunker C Oil (ppm) WSF	Weathered IXTOC I OAS[9] (ppm)
White Shrimp										
(*Penaeus setiferus*)[6]	96									
Postlarvae		-	-	-	-	-	1.4	-	-	-
Juveniles		-	-	-	-	-	1.0	-	-	-
Grass Shrimp										
(*Palaemonetes pugio*)[6]	96									
Larvae		-	-	-	-	-	1.2	-	-	-
Postlarvae		-	-	-	-	-	2.4	-	-	-
Adults		-	-	-	-	-	3.5	-	-	-
Opossum Shrimp										
(*Mysidopsis almyra*)[6]	96									
Postlarvae		-	-	-	-	-	1.75	-	-	-
Adults		-	-	-	-	-	0.65	-	-	-

1 Anderson et al., 1974.
2 Lee et al., 1980.
3 Rabalais et al., 1981.
4 Rossi et al., 1976.
5 Dillon et al., 1978.
6 Neff et al., 1976.
7 Oil-in-water dispersions.
8 Water-soluble fraction.
9 Oil accommodated in seawater.
10 Failed to produce 50% mortality.

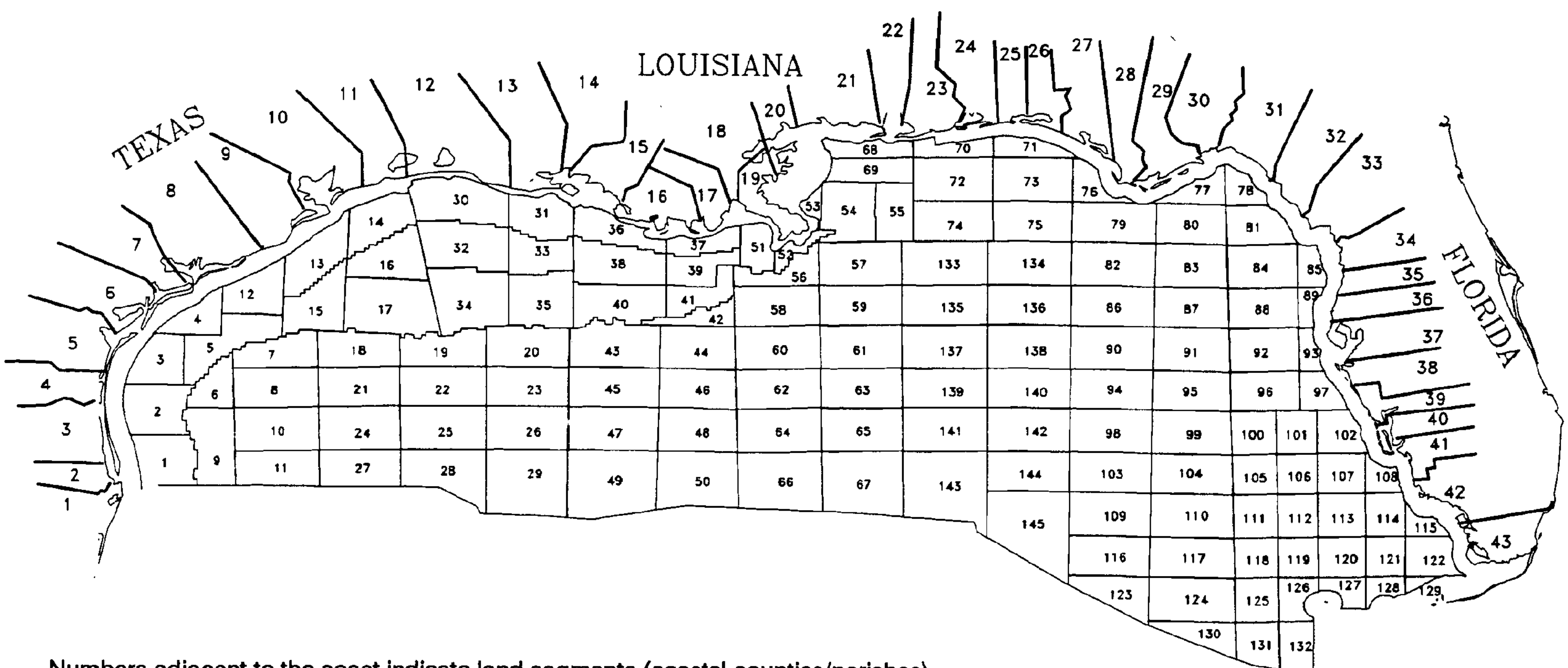
Table IV-19

Oil-spill Occurrence Probability Estimates for Spills Greater than or Equal to 1,000 Barrels Resulting Over the Life of the Proposed Actions, from OCS Program Activities* for Proposed Sales 142 and 143

Source	Volume (BBO)	Mean Number of Spills from Platforms	Mean Number of Spills from Pipelines	Mean Number of Spills from Shuttle Tankers**	Mean Number of Spills (total)	Probability (% chance) of One or More Spills from Platforms	Probability (% chance) of One or More Spills from Pipelines	Probability (% chance) of One or More Spills from Tankers**	Probability (% chance) of One or More Spills (total)
Proposed Actions									
Base Case									
WPA	(0.05)	0.03	0.03	0.01	0.07	3	3	1	7
CPA	(0.14)	0.08	0.09	0.00	0.18	8	9	n	16
High Case									
WPA	(0.13)	0.08	0.07	0.02	0.17	8	7	2	16
CPA	(0.31)	0.19	0.21	0.00	0.39	17	19	n	32
OCS Program Activities**									
WPA	(1.20)	0.72	0.72	0.11	1.56	51	51	11	79
CPA	(5.46)	3.28	3.66	0.01	6.94	96	97	1	99+
EPA	(0.19)	0.11	0.01	0.16	0.28	11	1	15	24

*OCS Program Activities are defined as all oil and gas activities occurring Gulfwide during the life of the proposals as a result of past, proposed, and future sales in the OCS.
**For the proposed actions and OCS Program activities, some transport of OCS produced oil by shuttle tankers is expected.
Note: n - represents equal to or less than 0.5% probability.

Source: Price, written comm., 1990.



Numbers adjacent to the coast indicate land segments (coastal counties/parishes).
Numbers offshore indicate oil spill launch sites.

Figure IV-7. Land Segments and Launch Sites Used in the Minerals Management Service Oil Spill Risk Analysis Model.

Table IV-20

Probabilities (expressed as percent chance) that an Oil Spill (greater than or equal to 1,000 bbl) Starting at a Particular Location Will Contact a Certain Land Segment Within 10 Days (Sales 142 and 143)

Land Segment[1]	Hypothetical Spill Location[2]											
	W01	W02	W03	W04	W05	W06	W07	W12	W13	W14	W15	W16
1	13	1	n	n	n	n	n	n	n	n	n	n
2	5	2	n	n	n	n	n	n	n	n	n	n
3	8	17	2	n	n	n	n	n	n	n	n	n
4	1	12	8	n	n	n	n	n	n	n	n	n
5	n	5	17	1	n	n	n	n	n	n	n	n
6	n	2	22	4	n	n	n	n	n	n	n	n
7	n	n	12	41	8	2	n	1	n	n	n	n
8	n	n	n	23	7	n	1	38	1	n	n	n
9	n	n	n	n	n	n	n	9	12	n	1	n
10	n	n	n	n	n	n	n	n	26	11	1	1
11	n	n	n	n	n	n	n	n	n	16	n	1
12	n	n	n	n	n	n	n	n	n	4	n	n

Land Segment	Hypothetical Spill Location								
	C30	C31	C32	C33	C36	C37	C38	C39	C41
11	2	n	n	n	n	n	n	n	n
12	42	2	2	n	n	n	n	n	n
13	2	25	n	1	n	n	n	n	n
14	n	6	n	n	5	n	n	n	n
15	n	1	n	n	11	n	n	n	n
16	n	n	n	n	27	16	3	3	n
17	n	n	n	n	n	21	n	5	1
18	n	n	n	n	n	6	n	1	n
19	n	n	n	n	n	1	n	n	n

Table IV-20. Probabilities (expressed as percent chance) that an Oil Spill (greater than or equal to 1,000 bbl) Starting at a Particular Location Will Contact a Certain Land Segment Within 10 Days (Sales 142 and 143) (continued)

Land Segment	Hypothetical Spill Location																		
	C51	C52	C53	C54	C55	C56	C57	C58	C59	C60	C61	C62	C63	C64	C65	C66	C67	C68	C69
17	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
18	6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
19	34	65	32	5	n	29	1	12	1	2	n	n	n	n	n	n	n	n	1
20	n	n	10	1	n	n	n	n	n	n	n	n	n	n	n	n	n	4	2
21	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	23	4
22	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	17	5
23	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	9	3

[1]n = less than 0.5 percent.
[2]Some hypothetical spill locations showing less than 0.5 percent chance of contact are not shown.

Note: Rows with all values less than 0.5 percent are not shown.

Estimated Number of Oil Spills Occurring and Contacting Sensitive Resources

The final phase of the OSRA combines the projected mean number of spill occurrences with the probabilities of contact provided by the trajectory analyses. The results are given in a series of tables presenting two values for each land segment (Tables IV-21 and IV-22) and environmental resource across the Gulf within 10 days. The two values represent (a) the probability of one or more spills occurring and contacting the environmental resource and (b) the estimated mean number of spills that might occur and contact the environmental resource. These tables also show only those land segments and environmental resources considered most at risk of contact by an oil spill resulting from OCS program activities or from import operations and reaching these resources within 10 days. In many areas around the Gulf, several sensitive resources occur within the same geographic limits. For the sake of efficiency in running the model, most of these areas were submitted only once, with the results being renamed or combined to represent other resources in the same area. Following is a list of the environmental resources submitted for the OSRA. These environmental resources were also used by the Leasing and Environment staff in the Gulf of Mexico OCS Region to define a second set of resources in the same area.

The results from:	Also represent:
Timbalier Bay	Timbalier Bay Seagrass Beds Isle Dernier/Timbalier Island Coastal Barrier
Chandeleur/Breton Coastal Barrier	Chandeleur Sound Seagrass Beds Chandeleur/Breton Sound
Upper Keys, Lower Keys, and Florida Bay Seagrass Beds	Keys Brown Pelican Nesting/Foraging
Mississippi Sound	Gulf Islands National Seashore Rec. Beaches
West Plaquemines Coastal Barrier and Land Segments 14, 15, 16, 17, and 18	West Deltaic Plains Marshes
Upper Florida Keys Upper Keys Seagrass Beds Upper Keys Coral Reefs	Upper Keys Mangroves
Lower Florida Keys Lower Keys Seagrass Beds Lower Keys Coral Reefs	Lower Keys Mangroves
Land Segment 43 Upper Florida Keys Lower Florida Keys	Monroe County Tourism
Land Segment 21	Hancock County, Miss., Pelican Habitat
Land Segment 22	Mobile County, Ala., Pelican Habitat

Table IV-21

Probabilities (expressed as percent chance) of One or More Spills Greater than or Equal to 1,000 bbl, and the Estimated Number of Spills (mean) Occurring and Contacting Land Segments Over the Life of the Proposed Action Within 10 Days
(Central Gulf Sale 142)

Land Segment/ Environmental Resource	Base Case (CPA) Prob	Base Case (CPA) Mean	High Case (CPA) Prob	High Case (CPA) Mean	Gulfwide Import Tankering Prob	Gulfwide Import Tankering Mean	OCS Program Activities Prob	OCS Program Activities Mean
1 - Cameron, TX	-	-	-	-	n	0.0	n	0.0
2 - Willacy, TX	-	-	-	-	-	-	-	-
3 - Kenedy, TX	-	-	-	-	n	0.0	n	0.0
4 - Kleberg, TX	-	-	-	-	1	0.0	n	0.0
5 - Nueces, TX et al.	-	-	-	-	4	0.0	2	0.0
6 - Aransas, TX	-	-	-	-	9	0.1	2	0.0
7 - Calhoun, TX	-	-	-	-	6	0.1	3	0.0
8 - Matagorda, TX	-	-	-	-	n	0.0	1	0.0
9 - Brazoria, TX	-	-	-	-	3	0.0	1	0.0
10 - Galveston, TX et al.	-	-	-	-	22	0.3	8	0.1
11 - Jefferson, TX	-	-	-	-	3	0.0	1	0.0
12 - Cameron, LA	-	-	-	-	23	0.3	6	0.1
13 - Vermilion, LA	-	-	-	-	n	0.0	6	0.1
14 - New Iberia, LA	-	-	-	-	n	0.0	6	0.1
15 - St. Mary, LA	n	0.0	n	0.0	n	0.0	9	0.1
16 - Terrebonne, LA	1	0.0	2	0.0	n	0.0	32	0.4
17 - Lafourche, LA	n	0.0	n	0.0	1	0.0	10	0.1
18 - Jefferson, LA	-	-	-	-	1	0.0	11	0.1
19 - Plaquemines, LA	1	0.0	1	0.0	21	0.2	54	0.8
20 - St. Bernard, LA et al.	-	-	-	-	1	0.0	1	0.0
21 - Hancock, MS et al.	-	-	-	-	3	0.0	3	0.0
22 - Mobile, AL	-	-	-	-	2	0.0	1	0.0
23 - Baldwin, AL	-	-	-	-	n	0.0	n	0.0
24 - Escambia, FL	-	-	-	-	n	0.0	n	0.0
44 - Dade, FL	-	-	-	-	18	0.2	n	0.0
45 - Broward, FL	-	-	-	-	2	0.0	n	0.0
Land	2	0.0	4	0.0	73	1.3	85	1.9
Western Deepwater Boundary	n	0.0	1	0.0	71	1.2	30	0.4
Aransas Refuge	n	0.0	n	0.0	4	0.0	2	0.0
Tamaulipas, Mexico	n	0.0	n	0.0	n	0.0	n	0.0
Central Deepwater Boundary	5	0.1	11	0.1	96	3.3	59	0.9
Timbalier Bay	1	0.0	2	0.0	1	0.0	30	0.4
Barataria Bay	n	0.0	n	0.0	9	0.1	36	0.4
Mississippi Sound	n	0.0	n	0.0	7	0.1	6	0.1
Caminada Headland	n	0.0	7	0.0	4	0.0	21	0.2
West Plaquemines Coastal Barrier	n	0.0	1	0.0	28	0.3	52	0.7
Chandeleur/Breton Coastal Barrier	n	0.0	n	0.0	6	0.1	12	0.1
East Deltaic Plain Marshes	1	0.0	2	0.0	21	0.2	49	0.7
xd'W. Winter Menhaden Spawning Ground	n	0.0	1	0.0	n	0.0	31	0.4

Table IV-21. Probabilities (expressed as percent chance) of One or More Spills Greater than or Equal to 1,000 bbl, and the Estimated Number of Spills (mean) Occurring and Contacting Land Segments Over the Life of the Proposed Action Within 10 Days (Central Gulf Sale 142) (continued)

Land Segment/ Environmental Resource	Base Case (CPA) Prob	Base Case (CPA) Mean	High Case (CPA) Prob	High Case (CPA) Mean	Gulfwide Import Tankering Prob	Gulfwide Import Tankering Mean	OCS Program Activities Prob	OCS Program Activities Mean
C. Winter Menhaden Spawning Ground	n	0.0	n	0.0	19	0.2	26	0.3
Eastern Deepwater Boundary	n	0.0	n	0.0	57	0.8	7	0.1
Big Bend Seagrass	n	0.0	n	0.0	n	0.0	n	0.0
Florida Bay Seagrass Beds	n	0.0	n	0.0	1	0.0	n	0.0
Dry Tortugas	n	0.0	n	0.0	16	0.2	n	0.0
Upper Florida Keys	n	0.0	n	0.0	9	0.1	n	0.0
Lower Florida Keys	n	0.0	n	0.0	9	0.1	n	0.0
Florida Middle Grounds	n	0.0	n	0.0	n	0.0	n	0.0
Survey Block 1	n	0.0	n	0.0	16	0.2	8	0.1
Survey Block 2	n	0.0	1	0.0	10	0.1	16	0.2
Survey Block 3	1	0.0	1	0.0	30	0.4	25	0.3
Survey Block 4	1	0.0	2	0.0	59	0.9	27	0.3
Survey Block 5	2	0.0	3	0.0	64	1.0	21	0.2
Survey Block 6	3	0.0	4	0.0	39	0.5	28	0.3
Survey Block 7	2	0.0	3	0.0	28	0.3	25	0.3
South Padre Island Coastal Barrier	n	0.0	n	0.0	n	0.0	n	0.0
North Padre Island Coastal Barrier	n	0.0	n	0.0	1	0.0	n	0.0
Mustang Island Coastal Barrier	n	0.0	n	0.0	4	0.0	2	0.0
St. Joseph Island Coastal Barrier	n	0.0	n	0.0	9	0.1	2	0.0
Matagorda Island Coastal Barrier	n	0.0	n	0.0	6	0.1	3	0.0
Matagorda Peninsula Coastal Barrier	n	0.0	n	0.0	n	0.0	1	0.0
Brazos Headland Coastal Barrier	n	0.0	n	0.0	3	0.0	1	0.0
Galveston Is./Bolivar Peninsula Coastal Barrier	n	0.0	n	0.0	22	0.3	8	0.1
Rollover Pass to Sabine Pass Coastal Barrier	n	0.0	n	0.0	3	0.0	1	0.0
Laguna Madre Seagrass Beds	n	0.0	n	0.0	1	0.0	n	0.0
Corpus Christi Bay Seagrass Beds	n	0.0	n	0.0	4	0.0	2	0.0
Espiritu Santos/Matagorda Seagrass Beds	n	0.0	n	0.0	6	0.1	4	0.0
Galveston Seagrass Beds	n	0.0	n	0.0	22	0.3	8	0.1
Espiritu Santos/Matagorda Bays	n	0.0	n	0.0	6	0.1	4	0.0
Galveston Bay	n	0.0	n	0.0	22	0.3	8	0.1
Texas Coastal Marshes - Central	n	0.0	n	0.0	14	0.2	6	0.1
Texas Coastal Marshes - Eastern	n	0.0	n	0.0	27	0.3	9	0.1
Brazoria South Padre Island Rec. Beaches	n	0.0	n	0.0	n	0.0	n	0.0
Padre/Mustang Rec. Beaches	n	0.0	n	0.0	5	0.0	2	0.0
Matagorda Island Rec. Beaches	n	0.0	n	0.0	6	0.1	3	0.0
Matagorda County Rec. Beaches	n	0.0	n	0.0	n	0.0	1	0.0
Brazoria County Rec. Beaches	n	0.0	n	0.0	3	0.0	1	0.0
Galveston Is./Bolivar Peninsula Rec. Beaches	n	0.0	n	0.0	22	0.3	8	0.1
Sea Rim Rec. Beaches	n	0.0	n	0.0	3	0.0	1	0.0
Chenier Plain Coastal Barrier	n	0.0	n	0.0	23	0.3	12	0.1
Grand Isle/Grand Terre Coastal Barrier	n	0.0	n	0.0	1	0.0	11	0.1

Table IV-21. Probabilities (expressed as percent chance) of One or More Spills Greater than or Equal to 1,000 bbl, and the Estimated Number of Spills (mean) Occurring and Contacting Land Segments Over the Life of the Proposed Action Within 10 Days (Central Gulf Sale 142) (continued)

Land Segment/ Environmental Resource	Base Case (CPA) Prob	Base Case (CPA) Mean	High Case (CPA) Prob	High Case (CPA) Mean	Gulfwide Import Tankering Prob	Gulfwide Import Tankering Mean	OCS Program Activities Prob	OCS Program Activities Mean
Dauphin Island Coastal Barrier	n	0.0	n	0.0	2	0.0	1	0.0
Gulf Shores Coastal Barrier	n	0.0	n	0.0	n	0.0	n	0.0
Mobile Bay/Perdido Bay Seagrass Beds	n	0.0	n	0.0	3	0.0	2	0.0
Vermilion/Atchafalaya Bays	n	0.0	n	0.0	n	0.0	14	0.2
Mobile Bay	n	0.0	n	0.0	3	0.0	2	0.0
Chenier Plain Marshes	n	0.0	n	0.0	23	0.3	12	0.1
Cameron Parish Rec. Beaches	n	0.0	n	0.0	23	0.3	6	0.1
Fouchon Rec. Beaches	n	0.0	n	0.0	1	0.0	10	0.1
Grand Isle Rec. Beaches	n	0.0	n	0.0	1	0.0	11	0.1
Mississippi Mainland Rec. Beaches	n	0.0	n	0.0	3	0.0	3	0.0
Dauphin Island Rec. Beaches	n	0.0	n	0.0	2	0.0	1	0.0
Gulf Shores Rec. Beaches	n	0.0	n	0.0	n	0.0	n	0.0

Note: n = less than 0.5% probability; (-) = 0.0% probability: Segments with less than 0.5% probability of one or more contacts within 10 days are not shown.

Source: Price, written comm., 1991.

Table IV-22

Probabilities (expressed as percent chance) of One or More Spills Greater or Equal to 1,000 bbl and the Estimated Number of Spills (mean) Occurring and Contacting Land Segments Over the Life of the Proposed Action Within 10 Days (Western Gulf Sale 143)

Land Segment/ Environmental Resource	Base Case (WPA) Prob	Base Case (WPA) Mean	High Case (WPA) Prob	High Case (WPA) Mean	Gulfwide Import Tankering Prob	Gulfwide Import Tankering Mean	OCS Program Activities Prob	OCS Program Activities Mean
1 - Cameron, Tex.	-	-	-	-	n	0.0	n	0.0
2 - Willacy, Tex.	-	-	-	-	-	-	-	-
3 - Kenedy, Tex.	-	-	-	-	n	0.0	n	0.0
4 - Kleberg, Tex.	-	-	-	-	1	0.0	n	0.0
5 - Nueces, Tex., et al.	n	0.0	n	0.0	4	0.0	2	0.0
6 - Aransas, Tex.	n	0.0	n	0.0	9	0.1	2	0.0
7 - Calhoun, Tex.	n	0.0	n	0.0	6	0.1	3	0.0
8 - Matagorda, Tex.	n	0.0	n	0.0	n	0.0	1	0.0
9 - Brazoria, Tex.	-	-	-	-	3	0.0	1	0.0
10 - Galveston, Tex., et al.	n	0.0	1	0.0	22	0.3	8	0.1
11 - Jefferson, Tex.	-	-	-	-	3	0.0	1	0.0
12 - Cameron, La.	-	-	-	-	23	0.3	6	0.1
13 - Vermilion, La.	-	-	-	-	n	0.0	6	0.1
14 - Iberia, La.	-	-	-	-	n	0.0	6	0.1
15 - St. Mary, La.	-	-	-	-	n	0.0	9	0.1
16 - Terrebonne, La.	-	-	-	-	n	0.0	32	0.4
17 - Lafourche, La.	-	-	-	-	1	0.0	10	0.1
18 - Jefferson, La.	-	-	-	-	1	0.0	11	0.1
19 - Plaquemines, La.	-	-	-	-	21	0.2	54	0.8
20 - St. Bernard, La., et al.	-	-	-	-	1	0.0	1	0.0
21 - Hancock, Miss., et al.	-	-	-	-	3	0.0	3	0.0
22 - Mobile, Ala.	-	-	-	-	2	0.0	1	0.0
23 - Baldwin, Ala.	-	-	-	-	n	0.0	n	0.0
24 - Escambia, Fla.	-	-	-	-	n	0.0	n	0.0
44 - Dade, Fla.	-	-	-	-	18	0.2	n	0.0
45 - Broward, Fla.	-	-	-	-	2	0.0	n	0.0
Land	1	0.0	2	0.0	73	1.3	85	1.9
Western Deepwater Boundary	2	0.0	5	0.1	71	1.2	30	0.4
Aransas Refuge	n	0.0	n	0.0	4	0.0	2	0.0
Tamaulipas, Mexico	n	0.0	n	0.0	n	0.0	n	0.0
Deepwater Bound Cen.	n	0.0	n	0.0	96	3.3	59	0.9
Timbalier Bay	n	0.0	n	0.0	1	0.0	30	0.4
Barataria Bay	n	0.0	n	0.0	9	0.1	36	0.4
Mississippi Sound	n	0.0	n	0.0	7	0.1	6	0.1
Caminada Headland	n	0.0	n	0.0	4	0.0	21	0.2
West Plaquemines Coastal Barrier	n	0.0	n	0.0	28	0.3	52	0.7
Chandeleur/Breton Coastal Barrier	n	0.0	n	0.0	6	0.1	12	0.1
East Deltaic Plain Marshes	n	0.0	n	0.0	21	0.2	49	0.7
W. Winter Menhaden Spawning Ground	n	0.0	n	0.0	n	0.0	31	0.4

Table IV-22. Probabilities (expressed as percent chance) of One or More Spills Greater than or Equal to 1,000 Bbl and the Estimated Number of Spills (mean) Occurring and Contacting Land Segments Over the Life of the Proposed Action Within 10 Days (Western Gulf Sale 143) (continued)

Land Segment/ Environmental Resource	Base Case (WPA) Prob	Base Case (WPA) Mean	High Case (WPA) Prob	High Case (WPA) Mean	Gulfwide Import Tankering Prob	Gulfwide Import Tankering Mean	OCS Program Activities Prob	OCS Program Activities Mean
C. Winter Menhaden Spawning Ground	n	0.0	n	0.0	19	0.2	26	0.3
Eastern Deepwater Boundary	n	0.0	n	0.0	57	0.8	7	0.1
Big Bend Seagrass	n	0.0	n	0.0	n	0.0	n	0.0
Florida Bay Seagrass Beds	n	0.0	n	0.0	1	0.0	n	0.0
Dry Tortugas	n	0.0	n	0.0	16	0.2	n	0.0
Upper Florida Keys	n	0.0	n	0.0	9	0.1	n	0.0
Lower Florida Keys	n	0.0	n	0.0	9	0.1	n	0.0
Florida Middle Grounds	n	0.0	n	0.0	n	0.0	n	0.0
Survey Block1	n	0.0	n	0.0	16	0.2	8	0.1
Survey Block 2	n	0.0	n	0.0	10	0.1	16	0.2
Survey Block 3	n	0.0	n	0.0	30	0.4	25	0.3
Survey Block 4	n	0.0	n	0.0	59	0.9	27	0.3
Survey Block 5	n	0.0	n	0.0	64	1.0	21	0.2
Survey Block 6	n	0.0	n	0.0	39	0.5	28	0.3
Survey Block 7	n	0.0	n	0.0	28	0.3	25	0.3
South Padre Island Coastal Barrier	n	0.0	n	0.0	n	0.0	n	0.0
North Padre Island Coastal Barrier	n	0.0	n	0.0	1	0.0	n	0.0
Mustang Island Coastal Barrier	n	0.0	n	0.0	4	0.0	2	0.0
St. Joseph Island Coastal Barrier	n	0.0	n	0.0	9	0.1	2	0.0
Matagorda Island Coastal Barrier	n	0.0	n	0.0	6	0.1	3	0.0
Matagorda Peninsula Coastal Barrier	n	0.0	n	0.0	n	0.0	1	0.0
Brazos Headland Coastal Barrier	n	0.0	n	0.0	3	0.0	1	0.0
Galveston Is./Bolivar Peninsula Coastal Barrier	n	0.0	1	0.0	22	0.3	8	0.1
Rollover Pass to Sabine Pass Coastal Barrier	n	0.0	n	0.0	3	0.0	1	0.0
Laguna Madre Seagrass Beds	n	0.0	n	0.0	1	0.0	n	0.0
Corpus Christi Bay Seagrass Beds	n	0.0	n	0.0	4	0.0	2	0.0
Espiritu Santos/Matagorda Seagrass Beds	n	0.0	n	0.0	6	0.1	4	0.0
Galveston Seagrass Beds	n	0.0	1	0.0	22	0.3	8	0.1
Espiritu Santos/Matagorda Bays	n	0.0	n	0.0	6	0.1	4	0.0
Galveston Bay	n	0.0	1	0.0	22	0.3	8	0.1
Texas Coastal Marshes - Central	n	0.0	1	0.0	14	0.2	6	0.1
Texas Coastal Marshes - Eastern	n	0.0	1	0.0	27	0.3	9	0.1
Brazoria South Padre Island Rec. Beaches	n	0.0	n	0.0	n	0.0	n	0.0
Padre/Mustang Rec. Beaches	n	0.0	n	0.0	5	0.0	2	0.0
Matagorda Island Rec. Beaches	n	0.0	n	0.0	6	0.1	3	0.0
Matagorda County Rec. Beaches	n	0.0	n	0.0	n	0.0	1	0.0
Brazoria County Rec. Beaches	n	0.0	n	0.0	3	0.0	1	0.0
Galveston Is./Bolivar Peninsula Rec. Beaches	n	0.0	1	0.0	22	0.3	8	0.1
Sea Rim Rec. Beaches	n	0.0	n	0.0	3	0.0	1	0.0
Chenier Plain Coastal Barrier	n	0.0	n	0.0	23	0.3	12	0.1
Grand Isle/Grand Terre Coastal Barrier	n	0.0	n	0.0	1	0.0	11	0.1

Table IV-22. Probabilities (expressed as percent chance) of One or More Spills Greater than or Equal to 1,000 Bbl and the Estimated Number of Spills (mean) Occurring and Contacting Land Segments Over the Life of the Proposed Action Within 10 Days (Western Gulf Sale 143) (continued)

Land Segment/	Base Case (WPA)		High Case (WPA)		Gulfwide Import Tankering		OCS Program Activities	
Environmental Resource	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
Dauphin Island Coastal Barrier	n	0.0	n	0.0	2	0.0	1	0.0
Gulf Shores Coastal Barrier	n	0.0	n	0.0	n	0.0	n	0.0
Mobile Bay/Perdido Bay Seagrass Beds	n	0.0	n	0.0	3	0.0	2	0.0
Vermilion/Atchafalaya Bays	n	0.0	n	0.0	n	0.0	14	0.2
Mobile Bay	n	0.0	n	0.0	3	0.0	2	0.0
Chenier Plain Marshes	n	0.0	n	0.0	23	0.3	12	0.1
Cameron Parish Rec. Beaches	n	0.0	n	0.0	23	0.3	6	0.1
Fouchon Rec. Beaches	n	0.0	n	0.0	1	0.0	10	0.1
Grand Isle Rec. Beaches	n	0.0	n	0.0	1	0.0	11	0.1
Mississippi Mainland Rec. Beaches	n	0.0	n	0.0	3	0.0	3	0.0
Dauphin Island Rec. Beaches	n	0.0	n	0.0	2	0.0	1	0.0
Gulf Shores Rec. Beaches	n	0.0	n	0.0	n	0.0	n	0.0

Note: n = less than 0.5% probability; (-) = 0.0% probability. Segments with less than 0.5% probability of one or more contacts within 10 days are not shown.

Source: Price, written comm., 1991.

The following recreational beach environmental resources were combined to give statewide recreational beach values:

Texas Rec. Beaches Padre Is. National Seashore/Mustang Is. Rec. Beaches Matagorda Is. Rec. Beaches Matagorda County Rec. Beaches Brazoria County Rec. Beaches Galveston Is./Bolivar Peninsula Rec. Beaches Sea Rim Rec. Beaches	Brazos/South Padre Is. Rec. Beaches
Louisiana Rec. Beaches Fourchon Rec. Beaches Grand Isle Rec. Beaches	Cameron Parish Rec. Beaches
Mississippi Rec. Beaches Mississippi Mainland Rec. Beaches	Gulf Is. National Seashore Rec. Beaches
Alabama Rec. Beaches Gulf Shores Rec. Beaches	Dauphin Is. Rec. Beaches
Florida Rec. Beaches Panama City Beach Rec. Beaches St. Joseph Spit Rec. Beaches Franklin County Rec. Beaches Central Florida Rec. Beaches	Emerald Coast Rec. Beaches

For each planning area, the appropriate table shows the risks from several sources of oil, both from within and from outside the planning area. These include the proposed volume assumed to be discovered and produced as a result of this sale, the Base Case, and a High Case for the proposal. Also, for each planning area, the occurrence and contact probabilities of an oil spill from imports and from a Gulfwide perspective were calculated and presented.

The 3-, 10-, and 30-day increments were selected to represent three critical phases of a spill. Because of the characteristics of the crude oil expected to be produced in the Gulf and because the values for "within 10 days" necessarily include the values for the "within 3 days" category, most analyses in this EIS focus on the 10-day values, considering this a conservative approach. In the OSRA run for the Base Case, no land segment shows a detectable chance of a spill occurring and contacting it within 3 days. No spills were estimated to occur and contact any of the land segments in the Western Gulf as a result of the Base Case. In all cases, the probabilities (expressed as a percentage) and mean values are lower than those for 10 days. For the 30-day increment, two land segments in the Central Gulf have detectable values. These land segments are shown below.

Central Gulf

Land Segment	Prob.	Mean
16-Terrebonne, La.	2	0.0
19-Plaquemines, La.	2	0.0

4. Oil Spill Prevention

Oil and gas operations conducted on the Gulf of Mexico OCS are subject to many requirements with regard to providing safety for personnel and the prevention of pollution. The basic government document that addresses these requirements are those regulations contained under 30 CFR 250. Within 30 CFR 250 there are many Subparts addressing specific aspects of these operations, such as Subparts D, E, F, H, and J, which address drilling, completion, workover, production, and pipelines, respectively. Subpart C outlines various procedures and equipment for containment and control of oil spills on drilling and production facilities. In addition, the American Petroleum Institute (API) has published numerous technical specifications and Recommended Practices (RP), which have been incorporated by reference into the aforementioned regulations. The most prominent of these specifications and practices is API RP 14C, which provides design and installation criteria for surface safety systems on offshore platforms.

Production Operations

The purpose of a platform surface safety system is to protect personnel, the environment, and the facility from threats to safety caused by the production process. The major objective of the safety system is to prevent the release of hydrocarbons from the process and to minimize the adverse effects of such releases if they occur. The overall objectives may be enumerated as follows

(a) prevent undesirable events that could lead to a release of hydrocarbons;

(b) shut in the process or affected part of the process to stop the flow of hydrocarbons to a leak or overflow if it occurs;

(c) accumulate and recover hydrocarbon liquids and disperse gases that escape from the process; and

(d) shut in the process in the event of a fire.

The platform safety system provides two levels of protection to prevent or minimize the effects of an equipment failure within the process. The two levels of protection are independent of and in addition to the control devices used in the normal process operation. In general, these two levels are provided by functionally different types of safety devices for a wider spectrum of coverage. These protective measures have been common industry practices and proven through many years of experience.

The majority of threats to safety on a production platform are caused by the release of hydrocarbons. Thus, the analysis and design of a production platform safety system must focus on preventing such releases by stopping the flow of hydrocarbons to a leak and by minimizing the effects of hydrocarbons that are released. To accomplish this, safety systems utilize protection concepts to prevent the occurrence of undesirable events. An undesirable event is an adverse occurrence in a process component which poses a threat to safety and may result in the accidental release of hydrocarbons.

In a production safety system these undesirable events are detected by various types of sensors that initiate shutdown action to prevent or limit the release of hydrocarbons from a well or process vessel. These sensors can be installed on the specific well or process vessel or as part of the Emergency Support System (ESS). The ESS includes

(a) the combustible gas detection system to sense the presence of escaped hydrocarbons and to initiate alarms and platform shutdown before gas concentrations reach the lower explosive limit;

(b) the containment system to collect escaped liquid hydrocarbons and to initiate platform shutdown;

(c) the fire loop system to sense the heat of a fire and to initiate platform shutdown;

(d) the Emergency Shutdown System (ESD) to provide a method to manually initiate platform shut down by personnel observing abnormal conditions or undesirable events; and

(e) the subsurface safety valves (SSSV), which may be self-actuated or actuated by an ESD system and/or a fire loop system, located within the wellbore of every well.

The undesirable events that are addressed in the design of a production platform safety system with regard to pollution prevention are overpressure, leak, liquid overflow, gas blowby, and underpressure.

Overpressure

Overpressure is pressure in a process component in excess of the normal operating pressure range. The primary protection utilized to detect an overpressure condition is a high-pressure sensor (PSH). The PSH is set at a pressure no higher than 15 percent above the highest operating pressure of the pressure component. If an abnormal condition occurs and pressure within this component reaches the PSH set pressure, it invokes shut down of the incoming valve. In cases of primary failure, secondary protection is provided by a pressure relief valve (PSV). If the primary protection (PSH) was unable to detect or initiate shut down, then the excessive pressure would be relieved through the PSV to a relief containment system.

Leak

A leak is the accidental escape of fluids from a process component to the atmosphere. The primary protection from leaks of a significant rate creating an abnormal operating condition within a pressure component is provided by a low-pressure sensor (PSL) and a flow safety valve (FSV). The PSL is set at a pressure no lower than 15 percent below the lowest operating pressure of the pressure component. If a significant leak were to incur and the pressure within this component dropped to the PSL set pressure, it would invoke shut down of the incoming valve. An FSV is basically a valve fitted with a flapper gate, allowing production flow in only one direction thereby minimizing backflow of downstream production to flow to the leak. Secondary protection is provided by the ESS. The gas detection system on a production platform would sense and initiate shut in before a leak became significant.

Liquid Overflow

Liquid overflow is the discharge of liquids from a process component through a gas or vapor outlet. The primary protection for liquid overflow is provided by a level sensor high (LSH). If an abnormal high liquid level occurred within a process vessel, then activation of this sensor would shut off production to the process component.

Secondary protection from liquid overflow to the atmosphere is provided by the ESS, as in the case of a leak occurrence discussed previously. Additionally, secondary protection from liquid overflow to downstream components would be provided by downstream safety devices on those components.

Gas Blowby

Gas blowby is the discharge of gas from a process component through a liquid outlet. The primary protection from gas blowby is provided by a level sensor low (LSL). If an abnormally low liquid level occurred within a process component, then this sensor would effect shut in of incoming production to the vessel. Secondary protection is provided by safety devices on the downstream process component.

Underpressure

"Underpressure" is pressure in a process component that is less than the design collapse pressure. This undesirable event is generally experienced within stock tanks where production is transferred by pumps to departing pipelines. The pumps, in transferring production, impose a vacuum on the tank. The primary protection for underpressure is the installation of an adequate vent system. Secondary protection is provided by an additional vent or a pressure-vacuum safety device. This device serves to protect the component from excessive pressures or a vacuum.

Drilling and Workover Operations

With respect to drilling operations, control of well formation fluids (oil, gas, and water) is of main concern. Primary and secondary levels of protection are implemented to maintain control of the well while drilling. The primary level of control is provided by the hydrostatic pressure of the drilling mud. Control is maintained by the circulation of properly weighted mud. The weight of the mud is adjusted to provide a sufficient hydrostatic margin over the estimated formation pressure. This hydrostatic margin allows for safe drilling without taking a "kick" from drilled formations. Various rig equipment monitors the mud system to ensure that this margin is maintained and that the system is working as designed. Monitoring of the mud system is accomplished through the use of mud pit indicators (gain or loss), flow indicators, and gas detection. When this equipment detects pit gain, flow, or the presence of gas, the secondary level of control can be initiated. This second level of control is comprised of the blowout preventer (BOP), rig mud pumps, and the choke manifold. This equipment allows for control of the well when formation pressure exceeds the hydrostatic pressure of the mud. The BOP is composed of a series or a stack of rams, which are designed to seal the wellbore at the surface to prevent flow. The stack includes at least two rams equipped to close on drill pipe, one blind ram, and one annular type--all of which can be hydraulically operated from remote stations on the rig. Once the well is shut in, the mud can be weighted up and pumped downhole with the rig pumps. While the mud is pumped, the hydrostatic pressure on the formation is maintained utilizing the choke system. Control of the well is reestablished once the weighted mud is circulated throughout the well.

This two-tiered level of control has been well proven through many years of drilling. This is illustrated by the extremely low blowout occurrence record.

Developing Technologies

In the interest of improving safety and oil-spill prevention, several new approaches are being developed to improve current technology. Much of the new technology is in the area of Systems Control and Data Acquisition. These systems are capable of computer monitoring numerous points for abnormal pressure, temperature, or volume conditions. Additionally, these systems can provide offshore operators a means of remote monitoring and shut in of unmanned facilities. Another technology being developed is the remote video monitoring of a facility utilizing remote-control video cameras. This technology could provide an operator with a means of remote-control visual inspection of an unmanned facility. In regard to drilling technology, the measurement while drilling (MWD) systems currently being implemented provide the driller with a nearly instantaneous reading of wellbore pressure and an indication of potential kicks. Systems such as these allow the driller to react quicker to blowout possibilities. New approaches are constantly being analyzed for improving the prevention of accidental hydrocarbon releases.

5. Oil Spill Contingency Planning and Response

The ability to prevent, contain, and clean up oil spills--already an area of concern and focus for MMS, the oil industry, and the general public before the March 24, 1989, *Exxon Valdez* grounding on Bligh Reef in Prince William Sound, Alaska--has been an even greater area of concern and focus after the recent rash of tanker-spill incidents occurring in U.S. waters nationwide. Although tanker spills are not a result of activities conducted in association with OCS oil and gas development, their occurrence has shown that existing government and industry cleanup operations were ineffective in containing large oil spills. A report to the President on the Alaskan spill that was prepared by the National Response Team (NRT) stated, "The lack of necessary preparedness for oil spills in Prince William Sound (Alaska) and the inadequate response actions that resulted mandate improvements in the way the nation plans for and reacts to oil spills. . ." (Skinner and Reilly, 1989). As a means of addressing this issue, the Oil Pollution Act of 1990 (OPA) was enacted in August 1990. On October 18, 1991, the President signed the Executive Order delegating the provisions of OPA to various departments and agencies within the U.S. Government, including the USCG, USEPA, NOAA, and DOI. Pending implementation of the provisions of the Act, the MMS spill-response program as described in this section is expected to undergo further assessment and change.

a. Responsibility and Authority

The President (through the USCG) must ensure the removal of a discharge under the recently enacted Oil Pollution Act of 1990. Never before in the history of oil-spill response has the Federal Government had as much authority over the cleanup of an oil spill. The USCG is responsible for ensuring an "effective and immediate removal of a discharge" into water (OPA, Title IV, Subtitle B, Sec. 4201) This can be accomplished in a number of ways; the USCG can either conduct (and fund) the cleanup itself and request reimbursement from the spills, direct others as to how to cleanup the spill, or monitor the cleanup activities.

Coordination among the USCG, MMS, and industry has historically been required in order for an effective spill response to an OCS-related operation discharge to take place. A Memorandum of Understanding (MOU) dated August 29, 1989, outlines the responsibilities between USCG and MMS. The Minerals Management Service is responsible for spill abatement and mitigation measures on or within 500 m of a platform, drilling rig, or other OCS facility. The USCG has the ultimate responsibility for ensuring that the oil-spill incident is effectively cleaned up. The OCS operators are required to prevent pollution, inspect and maintain oil-spill response equipment, develop oil-spill contingency plans, and conduct drills and training for oil-spill response personnel. Section I.B.3.d.(3) further outlines industry requirements for environmental safeguards.

b. Oil Spill Contingency Planning

Oil spill contingency plans (OSCP's) provide spill response guidelines to responsible parties when a spill occurs. These plans provide for the preplanning, management, and coordination of all of the operations at the scene of a spill, as well as of the communications between involved parties at the time of a spill. The goal of the development of such plans is having the ability to provide an efficient, coordinated, and effective response to oil spills.

The Federal Government's statutory requirements for contingency planning are outlined in the Federal Water Pollution Control Act (commonly called the Clean Water Act), as amended by the Oil Pollution Act of 1990, and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). The National Oil and Hazardous Substance Pollution Contingency Plan (commonly called the National Contingency Plan) calls for the establishment of a system of Federal regional plans (Regional Contingency Plans, or RCP's) that would fulfill the same requirements on a regional level as the National Contingency Plan.

The Oil Pollution Act of 1990 requires that the National Contingency Plan be revised and republished to include the amendments made by this Act. This monumental effort is ongoing. Provisions of this Act require, in part, that the National Contingency Plan contain (1) an assignment of duties among Federal, State, and local agencies; (2) an identification, procurement, maintenance, and storage of equipment and supplies; (3)

designation of USCG strike teams consisting of personnel, equipment, and a detailed oil and hazardous substance pollution and prevention plan; (4) a system of surveillance and notice to safeguard against and ensure the early notification of discharges of oil; (5) establishment of a national center to coordinate and direct operations in carrying out the Plan; (6) procedures and techniques to be employed in identifying, containing, dispersing, and removing discharges; (7) a State coordinated dispersant use plan; (8) a system whereby a State can act to remove a spill or be reimbursed by the Oil Spill Liability Trust Fund; (9) designation of the Federal On-Scene Coordinator for each area for which an Area-Contingency Plan is prepared; and (10) a fish and wildlife response plan, developed in consultation with the FWS, NOAA, and other interested parties for the immediate and effective protection, rescue, and rehabilitation of fish, wildlife, or their habitat that are harmed or may be jeopardized by a discharge.

The OPA also calls for the designation of areas for which Area Committees will be established and for which Area Contingency Plans will be required. The designated coastal areas for which Area Committees will be established are expected to coincide with the USCG Captain of the Port boundaries. Inland areas will be established under joint concurrence between USCG and USEPA. Although existing Captain of the Port Contingency Plans are available, they will require extensive revision as they currently do not contain the level of planning required. Some of the content requirements for Area Contingency Plans require that (1) when implemented in conjunction with the National Contingency Plan provisions an Area Plan would be adequate to remove a worst case discharge; (2) the area covered by the plan including areas of specific economic or environmental importance are discussed; (3) the procedures for obtaining an expedited decision regarding the use of dispersants are described; and (4) details regarding how the Plan is integrated into other Area Plans and the vessel, offshore facility, and onshore facility response plans, also required pursuant to this Act, are provided. Operators of a tank vessel or facility are also required to submit response plans sufficient to respond, to the maximum extent possible, to a worst case discharge. The responsible agencies have a target date of August 1992 to issue regulations for tank vessel and facility response plans.

The following discussion outlines the planning requirements and procedures for responding to a discharge that are currently in effect and that will remain in effect until the implementation of the revised contingency planning provisions enacted by the Oil Pollution Act of 1990. Significant changes to these current contingency planning procedures are not, however, expected.

The two Regional Contingency Plans that operate in the Gulf cover the Regional Response Teams for USEPA Regions IV and VI. When the spill occurs in coastal and offshore navigable waters of the United States, the USCG Captains-of-the-Port are designated as the On-Scene Coordinators (OSC's). Duties of the OSC include notifying the responsible party of the spill, encouraging the party to undertake proper countermeasures to mitigate the effect, directing and monitoring cleanup progress, and providing advice and counsel to the spiller as necessary. To provide support to the OSC, a Regional Response Team, which consists of representatives from Federal agencies as well as representatives from State and local agencies, has been established. The Regional Response Team serves as a regional body for oil spill preparedness planning and can be convened at the request of an OSC for coordination and advice during a spill incident. The DOI is a member of the Regional Response Team. The DOI assists the OSC at the time of a spill by providing special expertise relating to land management, fish and wildlife habitat, and water resources management. A Scientific Support Coordinator is provided by NOAA to coordinate and develop scientific response information as needed. The National Contingency Plan also requires Federal local plans (Local Contingency Plans) for areas in which the Coast Guard provides the predesignated OSC's. Each level of planning is designed to contain more site-specific information to allow the USCG to quickly organize an effective response to a pollution incident, if necessary.

During an OCS operations-related spill event, the U.S. Coast Guard's OSC will make every reasonable effort to have the operator voluntarily and promptly clean up spilled oil. Per regulation requirement, it is the responsibility of all OCS oil industry operators to take immediate corrective action when an oil spill has occurred. Provisions for authority in removing discharges are further discussed in Section IV.C.6.a.

To effectively accomplish oil spill containment and removal actions, the MMS requires that all Exploration Plans (EP), Development and Production Plans (DPP), and Development Operations Coordination Documents (DOCD) be accompanied by an OSCP. In order to facilitate this requirement in the Gulf of Mexico region in a practical manner, it is expedient for each OCS operator to submit for approval a regional OSCP that covers all of their operations in the Gulf of Mexico. The approved regional OSCP is then referenced when EP's and DOCD's are submitted. However, the operator may elect or may be required by MMS to include a site-specific OSCP in a EP or DOCD when the approved regional OSCP does not provide adequate oil spill protection or when lease stipulations for leases in the Eastern Gulf of Mexico require response capabilities beyond those described in the operator's approved regional OSCP.

The OCS operators are required to prepare OSCP's in accordance with the requirements of 30 CFR 250.42. However, since OCS operators in the Gulf of Mexico region prepare regional OSCP's, the MMS has issued a Letter to Lessees (LTL) dated February 1, 1989, which outlines the requirements for regional OSCP's. In addition, LTL's dated October 12, 1988; September 5, 1989; and November 4, 1991, were issued. These LTL's list the oil spill information that must accompany every EP or DOCD when the EP or DOCD references an approved regional OSCP. This information includes (1) an identification of the primary location of containment and removal equipment; (2) an estimation of the individual times for procurement of the equipment, the equipment transportation vessel, and the personnel to load and operate the equipment as well as equipment load-out, travel time to the deployment site, and equipment deployment; and (3) a discussion that identifies the zones that appropriate and available trajectory analysis indicate may be impacted by an oil spill, the environmentally sensitive resources and areas within the impact zones, and the strategies to be used to protect these resources from oil spills. Site-specific OSCP's are prepared in accordance with the requirements of 30 CFR 250.42 and, in addition, address those items that the MMS has identified as necessary or those that are required by lease stipulation.

Besides the Federal Government and private industry, there are contingency plans developed at the State and local authority levels. The States of Florida, Texas, Alabama, and Mississippi have oil and hazardous substances pollution contingency plans for their coastal areas. The State of Louisiana recently passed the Oil Spill Prevention Response Act, which requires the State's appointed oil-spill response coordinators to develop a statewide oil-spill prevention and response plan. This plan shall be fully operational no later than one year after the latest effective date of the area and regional contingency plans designated for Louisiana pursuant to Federal law.

At the time of a spill on the OCS, a network of contingency plans is put into effect. The provisions of the Oil Pollution Act of 1990 will not alter this basic procedure; however, the existing policies may change somewhat with the implementation of the provisions of the Act. Generally, if a spill results from an oil and gas facility, an operator would notify the National Response Center, which was established under the auspices of the National Contingency Plan; the MMS, Gulf of Mexico OCS Region; and his oil spill response coordinator, who may activate the operator's oil spill response operating team. At this time, equipment and manpower would be mobilized, if deemed necessary. The Local Contingency Plan of the closest Captain-of-the-Port (the OSC) would also be activated. At the request of the OSC, or if the spill crosses regional boundaries or poses a substantial threat to the environment, the Regional Response Team would be activated.

Review of Contingency Plans

The Federal Government's current network of contingency plans as outlined above is reviewed through two mechanisms. Draft National and Regional Contingency Plans are published in the *Federal Register* for an appropriate time period to allow review of the plans by all interested parties. All members of the Regional Response Team are given an opportunity to review the draft plans to ensure that the plans recognize and integrate their agency's responsibilities. Through the DOI's Regional Response Team member, MMS can provide comments on Regional and Local Contingency Plans to assure that the plans conform with MMS policies and procedures and that the notification process addresses MMS responsibilities regarding oil-spill response planning.

The OCS oil industry's oil spill contingency plans, as well as the supplemental information submitted with EP's or DOCD's, are reviewed by MMS. This review attempts to ensure that an operator's identified response time is reasonable, accurate, and sufficient to protect the adjacent environmental resources. Response times are further reviewed to determine whether they include sufficient time for the procurement of a vessel, for load-up and mobilization of cleanup equipment, and for transportation and deployment of the equipment.

Based on the results of this review, it is determined whether the primary oil-spill response equipment location identified by the operator is appropriate for the subject plan and whether the projected response time allows sufficient containment/cleanup time prior to a spill potentially hitting the shoreline.

If the analysis indicates that a potential spill could possibly contact the shoreline in an environmentally sensitive area prior to the operator reaching the spill site and/or without allowing sufficient time for cleanup, the operator's response would be required to be reduced if possible; and/or as a condition of plan approval, the operator would be required to be capable of implementing the appropriate shoreline oil-spill protection methodology identified or referenced in their EP or DOCD to protect those resources that potentially would be impacted within a time period designated by this office.

Section VII of the MOU between the MMS and the USCG concerning the regulation of activities and facilities on the Outer Continental Shelf of the U.S., as amended in August 1989, sets up a mechanism by which coordination of an oil spill contingency plan review will be handled between the USCG and the MMS. In response to this MOU, the USCG's Eighth Coast Guard District is provided a copy of all MMS required OSCP's submitted for the Gulf of Mexico in order that a library of these plans is available to the USCG as a guide to the planned action to be taken by these facilities in the event of a spill.

c. Spill Response Training/Drills

Containment and cleanup operations are labor intensive due to the complexity of the environment they are conducted in and the constant monitoring/planning efforts associated with these types of operations. It is therefore essential that personnel be well trained in the use of the equipment and in the methodology of spill containment and cleanup. The MMS addresses this training by requiring through regulation (30 CFR 250.43) that the lessee ensures that the oil-spill response operating team is provided with annual hands-on training classes in the deployment and operation of pollution-control equipment. Those responsible for supervising the oil-spill response operations are required to be trained in directing the deployment and the use of all response equipment.

Drills for familiarization with pollution-control equipment and operational procedures are required to be held when equipment is initially placed and thereafter on an annual basis by the lessee or his contractor. The personnel identified as the oil-spill response operating team in the OSCP are required to participate in these drills. The drills are required to simulate conditions in the area of operations and include the deployment and operation of the equipment. Records of these drills are required to be maintained for 2 years. The MMS, Gulf of Mexico OCS Region, requires that these drills result in the deployment and operation of each piece of oil spill equipment maintained by Clean Gulf Associates (CGA) at least once every 4 years and that each oil-spill response team participate in enough exercises such that they will have deployed every type of pollution-control equipment maintained by CGA at lease once every 4 years. As lessees generally depend on contract employees for their oil-spill response operation team members, the number of drills and training classes required annually to accommodate all of the OCS lessees results in the contract personnel participating in several drills and training classes within the annual timeframe. The MMS may initiate unscheduled drills and may require an increase in the frequency or a change in the locations of the drills, equipment to be deployed, or deployment procedures and strategies.

The MMS, Gulf of Mexico OCS Region, has recently implemented a program to conduct unscheduled drills of five or six randomly selected operators each year. The various drills include different stages of deployment of equipment and personnel. The four types of drills developed by the MMS for use in the Gulf of Mexico include (1) unannounced drills with equipment mobilization only, (2) unannounced drills with equipment mobilization and deployment, (3) spot "Table Top" drills, and (4) announced "Table Top" simulations of a large oil spill. A written report of each unannounced drill will be required to be submitted to MMS within 15 days of the conclusion of the unannounced drill. The MMS evaluates the results of these drills and advises the lessee of any necessary changes in response equipment, procedures, or strategies.

As of November 1991, MMS has conducted 10 unannounced drills in the Gulf of Mexico of randomly selected operators and offshore locations ranging from Florida to Louisiana. In all instances, a team of MMS officials initiated the drills and monitored the timing and actions taken by various company officials at several key locations. Although most of the drills were initiated early in the day, one drill held February 1, 1990, was conducted as a night exercise. Varying scenarios were utilized ranging from a simulated 200-bbl diesel fuel spill from a storage tank in the Destin Dome area that resulted in onsite equipment deployment to a simulated 1,000-bbl storage tank rupture combined with a 600-bbl/hr pipeline spill some 62 mi south of New Orleans that resulted in a combination of equipment mobilization and simulated table-top exercises. After each drill, recommendations for improvement were provided to the participating operator by MMS. While each exercise identified some areas that could be improved, the Gulf of Mexico Regional Director for MMS indicated that each company's response effort was generally well executed.

Oil-spill responders are also required, through the National Contingency Plan (40 CFR 300) effective April 19, 1990, to adhere to the training and safety requirements outlined in the U.S. Department of Labor, Occupational Safety and Health Administration's (OSHA) Hazardous Waste Operations and Emergency Response regulations at 29 CFR 1910.120. Although OSHA has specifically decided that petroleum products and gases are covered by 29 CFR 1910.120, questions have been raised concerning the interpretation and implementation of these regulations for various oil-spill response conditions. Effective April 13, 1990, the OSHA requirements generally provide that spill responders, such as the equipment operators and general laborers, having a potential for minimal exposure to a hazardous substance are required to have 24 hours of initial oil-spill response instruction and 8 hours of actual field experience. Those spill responders having potential exposure to a hazardous substance at levels exceeding the permissible exposure limits (generally, those situations requiring the use of a respirator and protective clothing) are required to have 40 hours of initial training off site and 24 hours of actual field experience. Onsite management and supervisors are required to receive the same amount of training as the equipment operators and general laborers, with the addition of 8 hours of specialized training in hazardous waste management. Eight hours of annual refresher training is required of both general employees and managers. The OSHA regulations include provisions that would relax the training requirements in emergency response situations; however, there is some confusion over the interpretation of the distinction between an emergency response situation and a post-emergency response situation at this time.

d. Equipment Response and Capability

(1) Equipment Locations

In the Gulf of Mexico region, oil-spill response equipment, identified in each operator's regional oil spill contingency plans, is generally maintained at nine strategically located onshore bases by the oil industry cooperative, CGA (Table IV-23). This equipment is currently the primary equipment used to respond to an oil spill associated with OCS operations. However, upon the finalization of CGA's identified vessel concept, equipped and dedicated vessels will be available at four strategic offshore locations in the Gulf for rapid initial response. In addition, when there is drilling activity in the EPA, oil-spill equipment may be strategically located at the rig site or at other staging leases (e.g., Panama City). All MMS approved OSCP's are required to contain an inventory of backup equipment or sources that are available locally, regionally, or through contract to augment the initial response equipment.

Although the CGA equipment is acquired and maintained for use by member companies, it is also available to nonmembers for a scheduled fee. Table IV-23 also identifies the types of equipment stockpiled at the nine onshore bases. All CGA bases have offshore skimmer systems known as Fast Response Systems (FRS). The High-Volume Open Sea Skimmer System (HOSS) barge is maintained at the Grand Isle base in coastal Louisiana because of this base's proximity to a large number of oil-related activities. Further discussion of this spill-response equipment is provided in Section IV.C.6.d.(2). Other types of equipment strategically sited at CGA bases throughout the Gulf of Mexico include boat and helicopter spray systems, communications equipment, and 50-bbl oil storage barges.

The oil industry can also contract for cleanup with an extensive number of independent spill-cleanup contractors and industry cooperatives located throughout the Gulf Coast. The number of companies included in the Marine Industry Group's Oil Spill Response manuals that have various pieces of available equipment are listed by State in Table IV-24. It should be noted that, due to the recent equipment acquisitions made by the local Gulf states, the Marine Spill Response Corporation, and other local cooperatives that are not included in Table IV-24, the information provided in this table under represents the current Gulf equipment inventory. Details of these recent equipment acquisitions will be added when the national inventory of spill-response

Table IV-23

CGA's Oil Response Equipment[1]

	Offshore Booms	Coastal Booms	Offshore Skimmers	Shallow Water Skimmer Vessels	Sorbents	Surface Collecting Agents	Chemical Dispersants	Bird Care Equipment	Identified Vessels[4]
Texas									
Galveston	x		x		x	x	x	x	
Port Aransas	x	x	x		x	x	x	x	
Louisiana									
Cameron	x		x						
Intracoastal City	x		x		x	x		x	
Houma	x		x	x					
Grand Isle[2]	x	x	x	x	x	x	x	x	
Venice	x	x	x	x	x	x	x	x	
Alabama									
Theodore	x		x						
Florida									
Panama City[3]	x		x		x	x	x	x	
Offshore									
West Cameron 71	x		x						x
South Marsh Island 240	x		x						x
South Timbalier 26	x		x						x

[1]As of May 1990.
[2]Main base.
[3]When there is a drilling activity in the EPA, equipment is strategically located at nearby offshore staging bases; for example, Panama City. When there is no EPA drilling, the equipment is stored in Houma, Louisiana.
[4]Identified vessels are Field Utility Boats on the payroll of CGA members. The boats are equipped with skimmers and boom and two extra personnel. They will be released by the operator to respond to CGA member's spill.

Source: CGA, 1991.

Table IV-24

Number of Oil Spill Cleanup Contractors/Operators by State Stocking Various Cleanup Equipment

	Offshore Booms	Inland/Coastal Booms	Offshore Skimmers	Inshore Skimmers	Sorbents	Surface Collecting Agents	Chemical Dispersants	Bird Care Equipment
Texas	5	27	1	13	12	2	4	1
Louisiana	4	16	1	8	9	1	1	4
Mississippi	0	0	0	0	0	0	0	0
Alabama	2	6	0	2	1	0	0	0
Florida	8	25	0	14	9	7	2	0

Source: Marine Industry Group, 1991.

equipment is in place. The task of keeping a national inventory of spill-response equipment has been delegated to the USCG National Response Unit, renamed the National Strike Force Coordination Center (NSFCC), located in Elizabeth City, North Carolina, in response to the mandates of OPA. This inventory will replace the U.S. Coast Guard SKIM inventory initiated in 1978 and ceased in the early 1980's. Besides the equipment operated by numerous contractors, coastal booms and skimmers are housed near refineries and other oil and chemical industry operations to respond to spills that may occur from their own facilities. For example, in 1988 there were 16 onshore oil companies maintaining coastal booms at their facilities. One of the most extensive stockpiles of equipment, particularly open-ocean cleanup equipment, is maintained by the Louisiana Offshore Oil Port (LOOP) located at Port Fourchon, Louisiana. Discussions are ongoing between CGA, through Haliburton Services, and LOOP towards an agreement to potentially share equipment in the event of a spill.

Historically, if the Coast Guard OSC determines that the OCS operator responsible for the spill is not taking appropriate response measures, the OSC may hire a cleanup contractor to conduct the spill cleanup. Under certain situations, the USCG National Strike Force would be called to provide assistance to the OSC. The Gulf Area Strike Team, located in Mobile, Alabama, is part of the National Strike Team and is equipped with specialized containment and removal equipment with rapid deployment capabilities.

In compliance with the revisions made through the Oil Pollution Act of 1990 to the Federal Water Pollution Control Act, the USCG has recently, August 1991, established a National Response Unit in Elizabeth, North Carolina, and USCG District Response Groups throughout the U.S.

Although the recently created (commissioned September 1991) NSFCC located in Elizabeth City, North Carolina, will not warehouse equipment, it will be available to administer the three USCG Strike Teams, to conduct training exercises, to serve as a public information assist team, and to keep a computerized national and international inventory of spill-response equipment. The NSFCC will be fully manned and operational by Summer 1992.

The USCG is also charged with the responsibility (under OPA) to create USCG District Response Groups to provide quick first aid to a spill. The groups are not intended to be the primary cleanup resource; they are only intended to provide a rapid spill-response capability and assistance to the primary cleanup contractor. One of the primary assets available to the USCG District Response Groups will be pollution control and cleanup equipment, which will be prestaged at 19 locations throughout the country. These locations and the selection of the equipment were based on several USCG studies that considered known and proposed stockpiles of industry provided response equipment and the risk of a spill occurring in specific geographical areas. Sites selected in the Gulf Coastal States include Corpus Christi and Galveston, Texas; New Orleans, Louisiana; and Tampa, Miami, and Mayport, Florida. Equipment for each of the 19 sites (at a cost of approximately $1 million to equip each site) includes containment boom (2,000 ft of harbor and 2,500 ft of open ocean boom), two vessel of opportunity skimming systems (VOSS's), and two portable collapsible barges to hold collected oil.

The VOSS's are designed to be used on vessels over 65 ft in length that would be available in the area. It is expected that offshore supply vessels or fishing vessels may be used. The equipment will be stored on flat beds for quick transport; however, a truck would need to be hired to transport the equipment in the event of a spill. The 2,000 ft of harbor boom will be packaged to be easily transported by helicopter. The Gulf Area Strike Team is expected to receive additional equipment similar to that being purchased for these 19 sites.

Approximately 49 Marine Safety Offices nationwide, which are not located in proximity to one of the 19 staging sites, will receive equipment to enhance their response capability. Equipment placed at these sites will include a small skimmer system, 1,000-2,000 ft of harbor boom, a mooring system, and a trailer. All of the USCG equipment is expected to be in place by Fall 1992 at the latest. The USCG is also looking at putting skimming operations on offshore and coastal buoy tenders as they come off-line.

Equipment purchased by the MSRC is discussed in Section IV.C.6.f. Recent equipment acquisitions and future procurement plans to increase CGA's equipment inventory are discussed in Section IV.C.6.d.

(2) Equipment/Response Options and Effectiveness

(a) Mechanical Equipment

A wide variety of mechanical equipment is available to aid in the containment and cleanup of spilled oil. Some general categories of oil spill cleanup and containment devices include booms, skimmers, pumps, and sorbents.

Oil-spill control booms are floating barriers designed to contain spilled oil for recovery, to divert oil to areas where recovery is more easily carried out, and to act as a barrier in pathways to areas containing commercially valuable or environmentally sensitive resources. Boom designs vary considerably, but all of them usually incorporate the following features: freeboard to prevent or reduce splashover; subsurface skirt to prevent or reduce the escape of oil under the boom; flotation by air or some buoyant material; and a longitudinal tension member (chain or wire) to withstand the effects of winds, waves, and currents. The length and size of boom sections are important considerations. The optimum size of a boom is largely related to the sea state under which it is to be used. As a general rule, the minimum height of freeboard to prevent oil splashover should be selected; and the depth of the skirt should be of similar dimensions. Short section lengths of boom are easier to handle and can protect the integrity of the boom as a whole, should one section fail; however, this should be weighed against the difficulty of connecting the sections effectively. A boom is typically constructed of modern lightweight/high-impact materials (high strength-to-weight ratio) and packaged compactly to allow for ease in transportation and deployment. Booms generally cannot contain oil against water velocities much in excess of 1 knot (kn) (0.5 m/s) acting at right angles to it. The escape velocity for most booms is around 0.7 kn (0.35 m/s), irrespective of skirt depth (Oil Spill Intelligence Report, 1984a).

Skimmers are mechanical devices designed to collect spilled oil from the water surface for disposal without chemically or physically altering the oil. Skimmers are classified on the basis of their operating principles into the following major groups: weir skimmers (provide gravity drain off to oil); vacuum skimmers (similar to weir, but use a power source to actively remove the oil); centrifugal skimmers (where a power source is used to create a vortex that drains the oil for collection); submersion skimmers (force the oil below the water level and use its buoyant property in the collection process); and oleophilic skimmers (collect oil on a moving sorbent material and mechanically squeeze it into collection areas) (Oil Spill Intelligence Report, 1984b).

Each of these skimmer types has its advantages and disadvantages, although the efficiency of each model depends on several parameters, including oil thickness, oil viscosity, sea state, and storage capability. Each type of skimmer is best suited for a particular situation; no skimmer is effective in all conditions. In addition, since the skimmer is part of a system involving the containment and recovery of the spilled oil, as well as the separation of the oil/water mixture and the transportation of that mixture to receptacles, the overall efficiency of a skimmer depends on the effectiveness of the individual components of the system (Oil Spill Intelligence Report, 1984b).

Pumps are used in oil spill cleanup operations to transfer collected oil from a collecting device, such as a boom, to a vessel or facility for separation, reprocessing, storage, or transportation to other facilities. Although specifications of the various pumps available are not relevant to this discussion, it should be recognized that pumps are necessary for cleanup operations.

Sorbents are those materials that recover oil by either absorption or adsorption. In absorption, oil penetrates the solid structure of the adsorbents' fibers or particles, which then swell in size to accommodate the oil. In adsorption, oil adheres to the surface of the adsorbent material but does not penetrate the fibers or particles themselves. Sorbent materials are generally classified by their composition: (1) natural organic products, such as hay, peat moss, straw, or wood pulp; (2) mineral compounds, such as ash, perlite, or vermiculite; and (3) synthetic products, such as polyethylene, polypropylene, or polystyrene. Sorbents are usually marketed in particulate form or as booms, pillows, rolls, or sheets. Synthetic products are generally preferred over natural sorbents because they are able to absorb more oil while taking on less water. For this reason, they take up less storage space and pose less of a disposal problem (Oil Spill Intelligence Report, 1984c).

As previously stated, winds and sea state have a significant effect on the performance of the aforementioned oil spill equipment. In general, 15-20 kn are the maximum wind speeds for dynamic upwind recovery, and recovery over sea states of 3-4 ft is essentially undocumented (Tennyson, personal comm., 1988). Of additional importance is the period of the waves. When an increase in winds produces short-period, localized seas, the efficiency of oil spill containment/cleanup devices decreases because the equipment tends to get swamped in the wash of these choppy waves. Large rolling waves (long period) present less problems due to the ability of the equipment to follow the waves' contours (Oil Spill Intelligence Report, 1984b).

Initial response to an oil spill occurring due to OCS oil-development activities is available through equipment owned by CGA. Open-ocean equipment available through CGA includes FRS and the HOSS barge. The FRS is essentially a vessel of opportunity skimming system (VOSS) in that it is designed to be loaded onto a single vessel supplied by the lessee. Vessel length can range from 65 to 100 ft. Fast Response Systems are staged at onshore locations throughout the Gulf as indicated by Table IV-23. Once an FRS unit is loaded onto a vessel, the vessel is generally capable of a 10- to 15-kn response dependent upon the size of the vessel utilized. Clean Gulf Associates' FRS consists of a barrier (two sections of 24-ft lengths of 48-in boom) connected to a weir skimmer and towed alongside a single vessel with an outrigger, an oil-water separator system, and recovered oil-storage capacity.

Due to the problems of equipment and manpower coordination inherent in an oil-spill response, skimming systems deployed from single, independent vessels are an attractive means of recovering spilled oil offshore. Whereas a large sweep system is advantageous on large, unified slicks, a VOSS can be deployed more quickly, is more maneuverable (for skimming windrows of oil, for example), and requires only one vessel (Crocker, 1985). Operations of single-vessel systems are presently limited by the deployment and retrieval of the skimming system in rough conditions rather than by barrier performance in waves (Crocker, 1985). The CGA reports that the FRS weir skimmer will pick up essentially all the slick presented to it at boat speeds of 3/4 to 1 1/4 kn in seas up to 2 ft. As seas pick up and/or boat speed increases, however, effectiveness of the system decreases. This system has been tested at the Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) under varying conditions with both heavy and medium oils. The tests showed that throughput efficiencies ran as high as 100 percent for speeds of 1.25 kn, with an oil recovery rate of 293 bbl of oil per hour in a slick that was 2 mm (0.08 in) thick. The skimmer was tested under severe harbor-chop conditions of 2 ft, resulting in throughput efficiencies of 70 percent (USDOI, MMS, 1987a).

The HOSS barge located in Grand Isle, Louisiana, consists of a skimming system built into a specially designed 174-ft barge. Boom (1,000 ft total) is stored on two sides of the barge and is launched off the stern by means of a trolley running down ramps cut into the hull. Mounted in slots in the barge's stern are four oleophilic belt skimmers, each followed by a weir skimmer. The HOSS barge is designed to be utilized to skim extensive long-duration spills where chasing after slicks is not required and to provide offshore operational support for spill recovery. This system must be towed to an oil spill site. Tow speed is typically 4-7 kn. The HOSS barge is capable of working in up to 6-ft waves with boom and 7-ft waves without boom.

The main objective in any offshore spill response effort is to prevent the oil from damaging resources by containment and recovery of the spill. The CGA currently has 500 ft of 72-in offshore boom stockpiled at Grand Isle, Louisiana, primarily as a replacement boom to the HOSS barge. The CGA has finalized the procurement of 18,000 ft of open-ocean boom that has been strategically sited along the Gulf Coast at existing CGA bases. Approximately 1,500-3,000 ft of the boom are stockpiled at each of the CGA bases. The boom chosen can be easily stored, deployed, and retrieved. The CGA is in the process of finalizing the procurement of 10,000 ft of tricompartment shoreline boom that will also be strategically sited along the Gulf Coast. The shoreline boom will be used to isolate an oiled section of the beach from a clean or biologically sensitive area to protect the adjacent areas from being oiled. Other offshore booms, which may currently be available through Gulf of Mexico oil and gas operators, would include the 750 ft of boom that is required to be located at each rig site or staging area in the Florida panhandle during drilling activity in those areas located in the EPA. Booms procured by CGA for open-ocean use are generally capable of being deployed in less than 1 hour and can generally operate effectively in waves up to 6 ft. Lengths of 36-in nearshore containment booms, self-propelled skimming vessels, hand skimming systems, floating suction oil skimmers for use in shallow water, and sorbents make up a portion of the remaining inventory available through CGA.

Clean Gulf Associates has also initiated the establishment of four identified vessels to be strategically sited at various locations offshore and equipped to provide an initial response effort in the event of an oil spill. These boats are strategically located in areas having a high concentration of oil production. The first three identified vessels are currently staged offshore and will be available to the general CGA membership once contractual problems are resolved. Establishing the identified vessels required procurement of additional equipment, such as skimmers, to outfit the vessels. A skimming system, including a crane, power pack, outrigger and boom, skimmer (designating 200 gpm) and a 2,100-gallon oil separator, are skid mounted on each vessel. Five hundred feet of open-ocean boom, which is to be used for containment in conjunction with skimming operations, is also stored on the vessel. Approximately $400,000 was approved by CGA to outfit the first identified vessel, which is located offshore at South Timbalier Area Block 26. The other vessels are located in West Cameron Area, Block 71 and in South Marsh Island, Block 239. The fourth identified vessel is expected to be in place by mid-1992.

In the event of a spill by a member CGA company, the member would call the Halliburton dispatcher for release of the ID boat. Upon approval by a member of the CGA Executive Committee or the Executive Director, the operator contracting the vessel (Shell, Mobil, or Texaco) would release it to respond to the spill. The identified vessel would be the first responder to the incident and would remain on scene until the backup equipment reaches the scene from the CGA shore base locations. At this time the identified vessel would be returned to service for the operator.

Another planned addition to the CGA stockpile are two additional shallow-water skimmers. These skimmers were selected because of their durability, storage capacity, shallow draft, unmanned operation potential, and ability to handle weathered oil.

(b) Chemicals/Dispersants Usage

Chemical dispersants may potentially be used as an oil-spill mitigation tool. Tables IV-23 and IV-24 delineate the major locations presently stockpiling dispersants in the Gulf of Mexico. The key components of chemical dispersants are surface-active agents (surfactants), which are molecules that have both water-soluble (hydrophilic) and oil-soluble (hydrophobic) ends. These molecules, when applied to an oil spill, orient themselves at the oil/water interface such that the hydrophilic ends of the molecules are in the water and the hydrophobic ends are in the oil. The result is a reduction of interfacial tension between the oil and water. This action reduces the cohesiveness of the oil slick and, with agitation, finely dispersed oil droplets (ranging in size, depending on the effectiveness of the surfactant formulation, from about 10 microns to 0.5 mm in diameter) are formed in the near-surface water. The hydrophilic surfactant groups prevent droplet recoalescence.

Dispersant formulations have changed since the Torrey Canyon spill in attempts to develop more effective and less toxic products. These so-called second-generation dispersants, introduced in the late 1970's, are being manufactured today. Therefore, only the current (late 1970's to the present) literature on effects of dispersed oil is relevant. Some studies have investigated the toxicity of dispersants alone (Wells, 1984). Studies that have considered species indigenous to the Gulf of Mexico, such as mangroves, seagrasses, and corals, include those by Baca and Getter (1984), Getter and Baca (1984), Getter and Ballou (1985), Teas et al. (1986), and Thorhaug et al. (1986).

The LOOP, Inc. has completed static and flow through toxicity tests on five Gulf species--brown and white shrimp, blue crab, eastern oyster, and red fish--in August 1988. The test results showed that when the test species were exposed to chemically dispersed Mayan or Saudi Arabian light crude oil, the observed toxicity occurred rapidly, usually within 6 hours after addition of the dispersed oil. The test animals that survived the first 6-12 hours of exposure usually recovered and survived for the remainder of the test period. In almost all cases, surviving test organisms were swimming normally and were not lethargic 12-24 hours after test material addition. Test results indicated that if the organisms were exposed to dispersed Mayan or Saudi Arabian light crude oil but survived long enough for the material to decrease in concentration, the organisms could recover and survive without any apparent short-term effects (Shuba and Heikamp, 1989). Also, MMS has recently awarded Continental Shelf Associates a contract to conduct an Oil and Oil Dispersant Toxicity Study. The objective of this study is to collect additional data on the toxicity of dispersed oil to selected Gulf species, particularly the eggs and larvae of a few important commerical and recreational fisheries species of the north-central Gulf.

The decision to use dispersants must be made soon after the spill occurs. Weathering of oil will increase the viscosity and decrease the capability of chemically dispersing the oil. Factors to be considered in making this decision are oil type and properties, environmental conditions, the availability of dispersant and application equipment, and the probable fate of the oil without treatment. Highly viscous oils (greater than 5,000 centistokes), oils with pour points near or above ambient temperature, and oils with a high wax or asphaltene content may not be amenable to dispersant treatment (International Tanker Owners Pollution Federation, Ltd., 1982; Canevari, 1985). Dispersants are not recommended for use on spills on very calm waters. Some dispersants are formulated for use on marine (saltwater) spills only.

Dispersants may be applied by boat or aircraft. Boat application is limited to small spills or those within a few miles of shore. Aerial spraying is the preferred method because it offers rapid response, coverage of large areas per unit of time, good control of treatment rates, optimum use of dispersants, and much better evaluation of treatment results than is possible from boats. Regardless of the method used, the application system must deliver the proper dosage of dispersant in a uniform spray of droplets to the slick. Most oil slicks considered for dispersion will be 0.25 mm thick or less (a 0.25 mm thick slick contains over 4,000 bbl per square mile of oil). The dispersant must penetrate the oil to reach the oil/water interface. The proper dosage of dispersant (5 gal/acre is an average amount, depending on the dispersant and the oil types) must be used to attain the maximum reduction of interfacial tension. Finally, some form of energy (e.g., wind, wave, or mechanical) must be applied to the oil/water interface to cause the dispersion of oil into the upper part of the water column. Newer types of dispersants require very little mixing energy.

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) requires that the USCG on-scene coordinator obtain the concurrence of the USEPA representative to the Regional Response Team (RRT) and, as appropriate, the concurrence of the RRT representatives from the states having jurisdiction over the navigable waters threatened by the release or discharge, and, when practicable, consult with the DOC and DOI natural resource trustees prior to authorizing the use of a chemical agent. Approved chemical agents must be listed on the NCP Product Schedule. The OSC is not required to obtain the aforementioned concurrence when, in the judgement of the OSC, the use of a chemical agent is necessary to prevent or substantially reduce a hazard to human life. Consistent with this, a Memorandum of Understanding between the Department of the Interior and the Department of Transportation dated August 16, 1971, allows MMS the authority to grant approval to OCS operators to use chemical agents within a 500-m radius of the source of pollution only when such agents are deemed necessary to abate the source of pollution as a measure for the safety of personnel and operations.

Dispersant use in the Gulf of Mexico is controversial and has not yet been fully accepted by the five Gulf States, which, along with USEPA, have approval authority regarding the use of dispersants in waters off their shores. The States, however, by their participation in the Regional Response Teams (RRT's) and the Dispersant Working Groups (DWG's), are reviewing relevant data with an eye to approving dispersant use under certain specific conditions. Recent Federal and State progress has been made in this area. Recent progress made towards the designation of areas in the Gulf for which dispersant use may be preapproved has been encouraging. The Louisiana Offshore Oil Port recently developed a plan that requests preapproval of the use of dispersants within a designated area near the LOOP facility. In acknowledgment that an effective dispersant response is an immediate one, the USEPA Region VI Regional Response Team granted pre-spill authorization for the use of dispersants within a designated geographic area surrounding the LOOP facility to the Federal OSC in 1991.

The National Research Council (NRC) of the National Academy of Sciences has addressed the effects of dispersants in its review, "Using Oil Dispersants on the Sea." The study addressed two questions about the use of dispersants: (1) Do they do any good? and (2) do they do any harm? (NRC, 1989).

> *Do they do any good?* This is not an easy question to answer. In a few carefully planned, monitored, and documented field tests, as well as in laboratory tests, several dispersants have been shown to be effective---that is, they have removed a major part of the oil from the water surface when properly applied to oils that were dispersible. However, at other field tests and at accidental spills, dispersants have been reported to have low effectiveness. The latter results may have been due to the use of inadequate application techniques, such as poor targeting and distribution of aerial sprays, as well as the possibilities that the oils were not dispersible, that some dispersants were poorly formulated, or that the results were inconclusive. Resolution of these ambiguities will require further studies. Much is known of how dispersants work, but one aspect inadequately understood is the interaction of various physical and chemical processes involved in oil dispersion.
>
> *Do they do any harm?* Concern that chemical dispersants could be toxic to marine life has led to considerable caution in authorizing their use at spill sites. Laboratory studies of dispersants currently in use have shown that their acute lethal toxicities are usually lower than crude oils and their refined products. A wide range of sublethal effects of dispersed oil has been observed in the laboratory. These occur in most cases at concentrations comparable to or higher than those expected in the water column during treatment (1 to 10 ppm), but seldom at concentrations less than those found several hours after treatment of a oil slick (less than 1 ppm). The times of exposure in the laboratory (24 to 96 hours) are much longer than predicted exposures during slick dispersal in the open sea (1 to 3 hours), and the effects would be expected to be correspondingly less in the field. Laboratory bioassays have shown that acute toxicity of dispersed oil generally does not reside in the dispersant, but in the more toxic fractions of the oil. Dispersed and untreated oil show the same acute toxicity. The immediate ecological impact of dispersed oil varies. In open waters, organisms on the surface will be less affected by dispersed oil than by an oil slick, but organisms in the water column, particularly in the upper layers, will experience greater exposure to oil components if the oil is dispersed. In shallow habitats with poor water circulation, benthic organisms will be more immediately affected by dispersed oil. Although some immediate biological effects of dispersed oil may be greater than for untreated oil, long-term effects on most habitats, such as mangroves, are less, and the habitat recovers faster if the oil is dispersed before it reaches that area.

The report went on to make several recommendations regarding future studies; it also recommended that dispersants be considered as a potential, first-response option to oil spills, along with other response options.

An oil-treating agent called "Elastol," which is not a dispersant, aids in the containment and recovery aspects of oil-spill cleanup. Elastol is a nontoxic powder that dissolves rapidly when dispensed on hydrocarbon liquids. It modifies the oil, giving it a viscoelastic property and making recovery more efficient, and is usable on light and heavy crude oils, kerosene, diesel, gasoline, bunker, and many other hydrocarbons. In recent tests, the application of Elastol on offshore oil spills in 500-900-ppm quantities increased the performance of skimming equipment 2-5 times over untreated performance recovery rates. It also minimized oil spreading, streaking, and breakup due to wind and wave conditions of up to 15 kn. When used with booms, it shows successful containment in currents over 1 knot. It should be noted, however, that the effectiveness of Elastol has not yet been proven under field conditions; and, like dispersants, its usefulness is still the subject of some controversy. Additional information on Elastol can be obtained from a technical paper entitled Laboratory and Tank Test Evaluation of Elastol, which was presented at the "Tenth Arctic and Marine Oil Spill Program Technical Seminar" (Bobra et al., 1987).

(3) Response Times

Although regional oil spill contingency plans submitted for the Gulf of Mexico do not specify response times, the supplemental oil-spill information submitted for EP's and DOCD's does provide a response time for operations on a particular lease. Review procedures for an operator's response time submitted as supplemental information to a EP or DOCD are discussed in Section IV.C.6.b.

The USCG has established guidelines for response times for OCS operations in Commandant Instruction 5740.6. The instructions request a target response time of 6-12 hours from the time of the spill, dependent on the location and general operating characteristics of the OCS operations. However, this 6- to 12-hour range for response times is not flexible enough to cover the wide variation in the distance of the leased areas in the Gulf of Mexico to the shoreline or to the nine CGA-designated spill-equipment bases.

Initial response times in the Gulf of Mexico to an oil spill would vary dependent upon the chosen spill-equipment base, the distance of the block to the chosen spill-equipment base, the travel speed of the chosen vessel, the amount of time needed to procure and deliver a vessel to the spill-equipment staging area, the time needed to transport the oil-spill response crew to the spill-equipment loading base, the load-up time, and the deployment time. The utilization of some staging areas would require a longer period of inland water travel at reduced speeds, which could significantly increase a response time. Additionally, although most OCS operators are members of CGA, the few that are not may incur delays at the time of a spill while negotiating an agreement with the co-op for the use of the equipment. However, the establishment of identified vessels at strategic offshore locations by CGA should alleviate many of these variables affecting response times and consequently should effectively reduce initial response times to some areas of the Gulf.

Until the finalization of the identified vessel concept throughout the Gulf Region, first response to an oil- and gas-drilling-related spill in the Gulf of Mexico would generally be made utilizing CGA equipment staged at onshore locations. Each operator would be responsible for supplying their own vessels, cranes, and personnel when utilizing CGA equipment. The majority of the facilities located more than 97 km (60 mi) from an onshore equipment base currently have response times greater than 12 hours. These response times are based on an estimate of 4 hours for the procurement and mobilization of both personnel and a vessel to a subject base, an estimate of 2 hours to load the equipment onto the support vessel, an estimate that the procured vessel would travel at 10 mph in open water, and an estimated channel run time. An internal study of the projected response times submitted to date by Gulf of Mexico OCS operators was made to determine these estimates. Some variance of these estimated times can be expected depending upon the availability of a vessel and the distance of the spill response personnel headquarters from the subject CGA base location, as well as the wind and weather conditions at the time of a spill. It should be noted, however, than an oil spill at these distances from shore would not normally be an immediate threat to coastlines in the Gulf because (a) prevailing currents and winds do not tend to move spills directly toward shorelines, (b) the greater the distance from shore of a facility, the greater the time available before a coastline could be impacted, and (c) Gulf crude oils are generally light and, therefore, easily and naturally dispersed.

The establishment and offshore staging of CGA's identified vessels provide the first stage of a tiered response. The equipped, identified vessels are sufficient to handle smaller size spills and to provide initial response to larger spills until back up equipment could reach the spill site. Back-up equipment is available through CGA bases located throughout the Gulf Coast, the USCG Atlantic Area Strike Team base in Mobile, Alabama, and from numerous contractors and oil companies in the Gulf Coast area.

A large number of operators in the Gulf of Mexico presently propose the use of contract personnel to load and operate the CGA equipment. These operators typically enter into a "no fee" type of contract with one or more of these companies to provide spill response on a 24-hour basis if they are available at the time of a spill. Because these companies are not located in close proximity to all of CGA's spill-equipment bases, the delivery of the contract personnel to a spill base for loadout could increase a projected response time. Trained oil-spill response personnel can generally be transported from locations throughout the Gulf Coast to CGA's nine base locations by helicopter in time periods ranging from 40 minutes to 2 1/2 hours. This timeframe may be longer depending upon the weather conditions at the time of a spill, as it could require up to 6 hours to drive contract personnel to some of the bases.

Vessel procurement has been identified by numerous OCS operators as one of the biggest limiting factors in attempting to reduce response times in the Gulf of Mexico. Vessel procurement times over 12 hours have been projected in some instances. Many operators request using a spill-equipment base nearer their onshore support base rather than a base closer to the subject lease to ensure that a vessel could be procured within a reasonable time. Most companies prefer to rely upon vessels they have already contracted with as opposed to attempting to contract or borrow a vessel from another company at the time of a spill. Other problems encountered regarding vessel procurement are the availability of large vessels (160-180 ft in length) that would be needed to respond to deep-water blocks and the limited number of spill-equipment base locations that could handle these large vessels. These factors could significantly increase an already lengthy response time to a deep-water area.

Hopefully, CGA's effort to locate four identified and equipped vessels at strategic offshore sites in the Gulf of Mexico will be a start in successfully alleviating many of the vessel procurement problems identified in the Gulf.

(4) Offshore Cleanup Capability for Handling Various Size Spills

The MMS-required OSCP's describe response actions for two types of spills--continuous spills and spills of short duration and limited maximum volume. Response to a very large spill, if the spill results from an instantaneous release, is not described; however, the discussion of response actions to continuous spills included in MMS required OSCP's would be equivalent to a "very large spill" that may result from oil and gas drilling or production activity. If the spill were very large, in addition to company-owned and CGA equipment, industry would attempt to access available uncommitted equipment (generally that equipment available regionally that is not part of CGA's stockpile) that could help in containing the spilled oil as identified in their OSCP's. Logistics for transporting and deploying this uncommitted equipment would, however, have to be worked out at the time of a spill. The OPA requires that offshore facility plans identify and ensure by contract the availability of private personnel and equipment necessary to remove, to the maximum extent practicable, a worst case discharge.

An examination of the daily cleanup capacity of CGA's major cleanup equipment described above can be used to estimate the amount of oil that industry could remove from the slick daily. The FRS and the HOSS barge serve the industry in cleaning up spilled oil in open seas. The HOSS barge would only be used for spills of long duration, such as blowouts, because of the amount of time to transport the barge to the spill site. This system can recover a nominal amount of 4,300 bbl of fluid per day. The oil tanks can hold about 4,100 bbl and can be offloaded to other oil storage barges. The FRS's would be used for spills of short duration and to supplement the HOSS barge. The recovery pumping system of the FRS is conservatively estimated to handle 1,000 bbl per 12-hour day (Union Exploration Partners, Ltd., 1988). As previously stated, during OHMSETT testing under varying conditions with both heavy and medium oils, throughput efficiencies for the FRS ran as high as 100 percent for speeds of 1 1/4 kn, with an oil recovery rate of 293 bbl of oil per hour in a slick 2 mm (0.08 in) thick (USDOI, MMS, 1987a). Clean Gulf Associates currently has 13 FRS units, which could be utilized during a spill staged at locations throughout the Gulf of Mexico. Obviously, the response capability in the Gulf of Mexico would vary depending upon the number of FRS units deployed to the spill site. In the event of a 10,000-bbl oil spill, one medium-size skimmer capable of picking up 600 bbl of fluid/hr, which would have similar capacity to one FRS, would be required for a maximum of 7 days working 12 hours/day to recover the total fluid to be recovered (50,000 bbl--20% oil/80% water). A 63,000-bbl oil spill would require six medium-size skimmers to recover the total fluid necessary (315,000 bbl of fluid) over the same timeframe (Exxon, 1979). The recovered oil-storage capacity of an FRS is 100-180 bbl. Recovered oil in excess of the 100- to 180-bbl FRS storage capacity could be temporarily offloaded to the supply-vessel tanks. However, a waiver from the USCG would have to be obtained to utilize the mud tanks in the supply vessel for auxiliary recovered oil storage. Other options for additional recovered oil storage would include the 50-bbl oil storage barges available through CGA or oil barges located throughout the Gulf of Mexico. Contacts for the procurement of these oil barges are provided in the Gulf of Mexico lessees' OSCP's.

It should be noted that offshore cleanup operations to open-water spills have, for the most part, been ineffective, as evident in the Alaskan oil-spill response efforts. Despite the massive effort to clean up the oil in Alaska, cleanup crews were able to recover no more than 15 percent of the spilled oil. According to the U.S. Congressional Office of Technology Assessment (OTA) report entitled *Coping With An Oiled Sea: A Background Paper* some experts feel that the most oil that can be recovered after a major spill is 10-15 percent. Information obtained by OTA from several documented open ocean tanker spills show that the actual oil recovered at sea has usually been much less than 10 percent of the oil discharged (Johnson et al., 1990).

Mechanical containment and recovery remains the primary spill response method utilized in the U.S. The current technology available for mechanical oil spill cleanup has many limitations. The OTA report indicates that while new designs have appeared over the years, the basic technology has not changed much over the past decade. The report also indicates that while improvements in mechanical recovery technologies can be expected from stepped-up research and development efforts, they are unlikely to result in dramatic increases in the amount of oil that can be recovered from a catastrophic spill. In general, the OTA report stated that the improvements made in mechanical oil spill clean up technology that would be more likely to offer greater effectiveness for large offshore spills would involve larger, more costly equipment, strategically located for a quick response (Johnson et al., 1990).

(5) Coastal Cleanup Techniques and Effects

Whenever possible, spill response should be carried out on water, as most equipment and techniques have been designed for such an approach. However, when a spill contacts a coastline, several techniques can be used. The selection of the type of treatment onshore will depend on the type and the amount of oil on the shore, the nature of the coast, the depth of oil penetration into the sediments, the accessibility and trafficability of the shoreline, and the possible ecological damage of the treatment to the shoreline environment (CONCAWE, 1981). The most suitable types of cleanup techniques to be used on a specific shoreline are shown on Tables IV-25 and IV-26.

Direct-Suction: If a beach, rocky area, or marsh has been contaminated with large volumes of oil and if the oil has pooled naturally in low spots or poorly drained areas, the use of direct suction can be a viable cleanup method. However, the effectiveness of this technique requires thick accumulations of oil. Direct suction can be accomplished with a pump, hoses, and a storage container. Recovered oil can be stored in metal storage containers, natural depressions lined with an impervious material, or a truck used for storing liquids. Another option is to use a vacuum truck equipped with a pump. Direct suction also can be applied to spills that have saturated porous soil types, such as sand and silt, by mechanically cutting a trench to act as a collection area for the oil (USDOI, MMS, 1987a).

Manual Removal: Where oil contamination is low or sporadic, or when penetration of the oil into the sediment is low, manual removal of the oil is preferred. Manual removal usually is used to some extent on any shoreline cleanup, in combination with other techniques or alone. Due to logistical constraints or to access constraints placed on heavy equipment in some areas, manual recovery may be the only cleanup technique possible for some shoreline spills. This type of response is very time-consuming, costly, and labor-intensive; however, it might be the only way to deal with a spill. Manual removal is a very selective method of removing contaminated sediment and vegetation, making it an extremely effective response technique. The effectiveness of a manual response is directly related to the amount of time, labor, and money the operator wants to devote to the problem. The more money and time invested in a manual cleanup operation, the greater the amount of oil that may be recovered (USDOI, MMS, 1987a).

Manual recovery involves the use of hand tools--such as rakes, shovels, buckets, pickaxes, brush cutters, scythes, and power brush-cutting tools--to remove contaminated sediment and vegetation. Oil-contaminated sediment or vegetation is collected and put into heavy-duty plastic or burlap bags for disposal. Bags may be removed manually, by vehicle, by boat or barges, or airlifted by helicopters to the disposal site (USDOI, MMS, 1987a).

Method \ Habitats	Open Waters-Offshore/Nearshore	Open Waters-Enclosed Bays & Harbors	Soft Bottom-Subtidal	Seagrass Beds (Intertidal)	Seagrass Beds (Wade Zone Subtidal)	Rky Subtidal-Open Md-Bot. & Rocky Rfs	Exposed Rock Intertidal	Sheltered Rocky Intertidal	Sand Beaches (Exposed)	Sandy Beaches (Sheltered)	Sheltered Tidal Flats	Gravel/Cobble Beach (Exposed)	Sheltered Gravel Beaches	Sheltered Cobble Beaches	Coral Reefs (lagoons)	Coral Reefs (Deep Fore, Flats, Crests)	Mangrove Forests	Salt Marshes
Beach Cleaning Machines									P	P								
Booms/Skimmers	P	P					V	P	A		P				P		P	P
Burial				A					A	A	A	A	A					
Burning	NA	NA					NA	NA		A			A		A	A	A	A
Dispersants	P	V		NA	NA		V	NA	V	A	NA	P	A	V	NA	V	P	V
Earth Barriers																		
Herding	V	V															V	V
High Pressure Flushing				A		NA	NA	NA	A	A	A	NA	A	NA	V		NA	A
Low Pressure Flushing				V	V		V	V		V	P	P	V	R	P	V	P	P
Management (Drainage)																	P	P
Manual Removal			V	NA	NA	NA	V	V	P	P	V	NA	P	NA			V	A
Natural Cleansing	P	P	P	P	P	PV	P	NA	P	V	P	P	NA	P		P	V	P
Sand Blasting							A					NA		A				
Sinking Agents	A	A																
Sorbents	V	V		NA	V	V	V	V	V	V	P	NA	V	V	V	NA	V	V
Steam Cleaning							A	A				A		A				A
Substrate Displacement				A					P	A	A	A		A				
Substrate Removal			NA	A			A	A	P	NA	A	A	NA	A			A	A
Vacuum Pumping	V	V	NA	A	A	V	V	V	P	P	V		P		P	V	V	V
Vegetation Cropping				A	NA		NA	NA										NA

P = Preferred
V = Viable
NA= Not Advisable
A = Avoid

Source: CSA, 1989.

Table IV-25. Summary of Cleanup Methods.

Table IV-26

Shoreline Cleanup Methods

Method	Description	Applicability	Effect
High-pressure Hoses	- high-pressure stream of water washes oil from the substrate	- can be effective on rock, boulder, and manmade surfaces - oil flushed onto water surface for removal or channeled to beach collection site	- can damage flora and fauna - can flush oil into sediments - if beach is backed by unconsolidated cliffs, hosing of cliff can cause slumps, falls, or slope failure
Steam or Hot-Water Cleaning	- steam or hot-water washes oil from the substrate	- very effective on rock, boulder, and manmade surfaces - oil flushed onto water surface for collection or channeled to beach collection site - expensive method	- can be very harmful to flora and fauna - can flush oil into sediments
Sandblasting	- high-velocity sand removes oil from the substrate	- effective but slow method for rock, boulder, and manmade surfaces - can remove oil stains - expensive method	- can be very harmful to flora and fauna - scatters oil and sand - can cause deeper penetration of oil into sediments
Low-pressure Hoses	- low-pressure stream of water washes oil from the substrate	- effective but slow method for rock, boulder, and manmade surfaces - oil flushed onto water surface for collection or channeled to beach collection site	- biologically preferable to high-pressure hoses, steam cleaning, or sandblasting - can flush oil into sediments
Mixing	- A - mechanical equipment such as rakes, discs, or harrows used to break up oil cover and mix surface sediments	- accelerates natural cleaning - useful for light-grade oils or to break up "asphalt pavements" - increases surface area of exposed oil and increases dispersal and degradation rates	- does not remove oil - can cause burial of the oil

Table IV-26. Shoreline Cleanup Methods (continued)

Mixing	- B - mechanical equipment used to push oil/sediment down beach into water	- accelerates natural cleaning - wave action disperses and degrades oil - sediment is returned to the beach - applicable for "asphalt pavements" or coarse-sediment beaches	- does not remove oil - should not be used if storm waves are expected before sediment is returned to the beach; could result in waves overtopping the beach and/or causing backshore erosion
Removal			
Graders, Scrapers	- remove thin layer of oiled sediments - graders form windrows for scraper or front-end loader to remove - scraper removes oil/sediment layer directly	- effective on sand or pebble beaches with low oil penetration depths (less than 3 cm) - scraper can remove up to 25-cm layer of oil/sediment - some spillage which can be removed manually	- removes sediment from the beach, amount of sediment removed usually not sufficient to affect beach stability
Front-end Loaders	- loader removes material directly from beach to collection sites	- used on beaches with poor traction or for high oil penetration depths (25 cm or more) - high spillage - usually large amounts of uncontaminated sediment are recovered - rubber-tired vehicles are preferred to tracked vehicles	- can result in excessive sediment removal that could cause beach or backshore erosion - grinds oil into the beach
Bulldozers	- push material into collection sites for removal	- can remove oil/sediment where penetration is 25 cm or greater - not recommended unless other equipment unavailable or traction is too low for other equipment	- can result in excessive sediment removal that could cause beach or backshore erosion - large spillage and grinds oil into sediments
Dragline, Clamshell	- sediment collected in bucket dragged towards equipment, or by crane-operated bucket	- useful where beach access or trafficability is poor	- can result in excessive sediment removal that could cause beach or backshore erosion

Table IV-26. Shoreline Cleanup Methods (continued)

Sump Collection and Pump Removal	- sump excavated and used to collect oil, which is then removed by pump or vacuum systems	- useful for large spills with oil washed onshore over a period of days	- does not remove all the oil from the beach
Manual	- A - oil scraped from the substrate	- A/B - useful for areas inaccessible to equipment or small spills	- A - selective oil removal, not all oil is removed
	- B - oil collected with buckets, shovels, rakes, forks, etc. (with or without sorbents)	- A/B/C - labor-intensive methods; slow rate of oil removal	
	- C - cutting of oiled vegetation	- C - oil/vegetation collected in containers for removal	- C - labor-intensive method; pedestrian traffic can disturb marsh vegetation and can cause oil/sediment mixing
<u>In Situ Cleaning</u>			
Burning	- oil ignited, usually with ignition agents - continued burning may require wicking agents	- seldom completely successful - useful for oil on surface of ice - can be used in marshes with appropriate biological advice - oil residues remain	- causes heavy air pollution - can increase the penetration of oil into the sediments - can damage root systems of marsh vegetation
Beach Cleaning Machines	- cleaner picks tar lumps from the beach	- useful on beaches with tarballs	- little sediment removal

Source: USDOI, MMS, 1987b.

Sorbents: Sorbent pads, booms, or rolls are often used as part of a manual response, or they can be used in conjunction with other techniques. Small, isolated pools of oil on the sediments or on nearshore waters can be removed by using sorbents. Once the sorbent materials have become soaked with oil, they can be removed by the methods described above, or they can be burned (USDOI, MMS, 1987a).

Heavy Equipment: For certain areas, heavy equipment can be used as an effective cleanup technique. Its use would require either the availability of roads or a means of air-lifting or barging the equipment to the contaminated area. Only certain soil types, such as sand or rocks, could withstand heavy equipment. Graders, scrapers, loaders, bulldozers, and backhoes are equipment that may be used in cleaning up shoreline areas. This equipment can be used in areas where the soil-bearing capacity is adequate and habitats are not harmed by removal of soils (USDOI, MMS, 1987a).

Flushing or Washing:

- *Low Pressure:* For cleaning light oils, such as fuel oil, from lightly contaminated sediments or vegetation, low-pressure flushing or washing can be a viable cleanup technique. In performing this operation, water is pumped from the ocean and is flushed over the lightly contaminated sediment to remove the oil. The removed oil is trapped downstream in a manmade trench or in a boomed-off area of the ocean close to shore. Once the oil is trapped, it can be removed by direct suction, skimming, burning, or sorbent pads. This technique is applicable only to shoreline areas because a nearby water source must be available. Additionally, this technique is easier to carry out if the trench or boom can be located downslope from where the flushing operations are being conducted.

  Low-pressure flushing or washing operations are extremely labor intensive and may damage the sediment by erosion or by driving the oil farther into the sediment. (USDOI, MMS, 1987a).

- *High Pressure:* High-pressure flushing is basically the same technique as low-pressure flushing except that higher water pressures are used for high-pressure flushing. Typical specifications for high-pressure flushing are a 10-gallon-(0.04-m^3) per-minute flow rate at 4,000 pounds per square inch (272 atm). The penetration of oil deeper into the sediment with high-pressure flushing is an even greater danger than for low-pressure flushing (USDOI, MMS, 1987a).

Steam Cleaning and Sandblasting: Steam cleaning and sandblasting are techniques that can be used to remove oil from rocks, boulders, and manmade structures. These techniques use high-pressure jets of steam or sand to physically remove oil from the contaminated surface. Care must be taken in using these techniques because the high-pressure streams can severely erode the sediment or damage any uncontaminated flora or fauna in the area (USDOI, MMS, 1987a).

Natural Dispersion: Another option in dealing with shoreline cleanup that could prove very effective in certain environments is natural dispersion. For contaminated shorelines close to high-energy ocean environments--such as sand, gravel, or cobble beaches--natural dispersion of the oil into the ocean could be very effective. Natural dispersion may be the only possible alternative when logistics or weather problems preclude a response effort (USDOI, MMS, 1987a).

(6) In Situ Burning

In situ burning of spilled oil appears to have merit under certain spill conditions, especially if the oil can be contained and thickened with fireproof booms. In order to ignite oil on water, the oil must be relatively fresh and the slick must be at least three millimeters thick. Some oil residue (about one millimeter thick layer) will remain in the water after burning oil because the flame is always quenched by heat losses to the water surface when the oil layer gets thin (Johnson et al., 1990).

Several techniques have been devised for igniting oil spills. Devices used include floating igniters that can be deployed by air and the helitorch igniter, which is a tank system containing gelled gasoline suspended on cables below a helicopter. One device under design is a laser ignition system using two coupled lasers from a helicopter to ignite oil spills (Johnson et al., 1990).

Although not currently an important oil-spill countermeasure, this technique is currently being investigated further in the U.S. Some experiments have resulted in high burn percentages and thus high removal rates. Burn efficiencies of over 90 percent can be obtained, particularly if the oil is confined with booms or other means to keep the oil layer as thick as possible. Burning is, however limited in its applications. Igniting and keeping a slick burning may be a problem in some instances; in others, burning may jeopardize a vessel or facility; and the resultant visible air pollution may be unacceptable. This visible air pollution must, however, be weighed against the invisible air pollution caused by allowing evaporation of the toxic volatile compounds of an oil (Johnson et al., 1990).

(7) Bioremediation

Bioremediation is the in situ use of microbes to biodegrade and oxidize hydrocarbon molecules. Biodegraders can be marine bacteria occurring naturally in the spill area, nonindigenous naturally occurring bacteria, genetically engineered microbes, and nutrients that can be added to enhance biological oxidation. Tests of this technique on water have shown little or no enhancement over the naturally occurring biodegradation. Use of bioremediation on impacted shorelines, however, has indicated effectiveness in some cases. Exxon, in conjunction with the USEPA, recently conducted a large-scale test of this technique in an attempt to clean up Alaska's oiled beaches as a result of the *Exxon Valdez* incident. Approximately 70 mi of shoreline were coated with two kinds of nitrogen- and phosphorous-bearing fertilizers to boost indigenous bacterial populations. Initial results are inconclusive, but the data are still being evaluated. One difficulty is measuring the effectiveness of the technique. The USEPA is also conducting separate bioremediation projects in this area. One such project will take place on Elrington Beach, a site that was heavily oiled last year. Researchers are particularly interested in determining the effects on subsurface oil and plan to use a sprinkler system to spray inorganic nitrogen, phosphorus, and seawater for three to four hours, once every four days (Johnson et al., 1990).

Bioremediation was also recently used during the clean up of the *Mega Borg* tanker spill that occurred in waters located offshore Texas. Permission was granted by the USEPA to conduct a controlled bioremediation experiment on a 100-m^2 patch of oil. The experiment was modeled after a October 1989 test that was conducted in Port Aransas, Texas. The reportedly successful bioremediation results during the Mega Borg response have been met with a great deal of criticism from the oil spill community. Many bioremediation experts are skeptical about the use of the procedure on open-water spills, mainly because such an undertaking can be difficult to control and because of the long timeframe needed for effective use (Oil Spill Intelligence Report, 1991).

Proponents of bioremediation indicate that it is potentially the least costly of cleanup techniques, particularly for soiled beaches. Its use on water, however, would appear to be limited except as a follow up to other actions. The major disadvantage of bioremediation is the long timeframe needed for effective use. On beaches where it could take 5-7 years for oil to break down under normal conditions, bioremediation with fertilizer could reduce that time to 2-5 years (Johnson et al., 1990).

A May 23, 1991 report, *Bioremediation for Marine Oil Spills*, released by the U.S. Congressional Office of Technology Assessment (OTA) stated that scientists are still evaluating the effectiveness of the use of bioremediation for marine oil spills (U.S. Congress OTA, 1991). The report concluded that recent research and field testing of bioremediation technologies on oiled beaches produced some encouraging if not altogether conclusive results. The report cited nutrient enhancement as the most promising use of bioremediation technology. The report also concluded that bioremediation has not proven to be an effective response to at sea oil spills.

e. Response Options for Handling Oiled Wildlife and Birds

Rehabilitation of oil-contaminated wildlife may be necessary to protect species that are endangered or of high aesthetic value. Successful programs are very labor intensive and have relied mostly on volunteer labor. Some of the studies that have been done regarding the effects of oil on marine mammals indicate that a few mammal species may rid themselves of oil by washing. Animals that groom themselves may ingest oil, which can result in mortality of the animal. Rehabilitation efforts may also stress certain animals, causing increased mortality and behavioral changes. Rehabilitation programs require extensive manpower to locate, capture, treat, and care for oiled wildlife. The success of such a program will be dependent upon the number of animals involved, the extent of oiling, the physiological condition of the animals, and the experience of the people undertaking the rehabilitation program (USDOI, MMS, 1987a).

Wildlife researchers are currently in disagreement about the effectiveness of Exxon's $18 million otter rescue effort following the 1989 *Exxon Valdez* oil spill in Prince William Sound, Alaska. Some researchers question the value of such a research effort, particularly for lightly oiled otters, as prior research had shown that lightly oiled animals could recover without any treatment and that the stresses of capture, transportation, and cleaning itself may have been unnecessarily disruptive.

The current RCP for the Region VI Regional Response Team contains Annex 7, recognizes the importance of responding to contamination of waterfowl, and designates the FWS and names contacts for initiating bird collection and cleaning activities. The current RCP for the Region IV Regional Response Team contains no special Annex but lists the NPS and FWS as contacts for responding to potential impacts to sensitive resources, including bird rookeries, which are used at the time of an oil spill to determine where lines of response should be placed.

The Oil Pollution Act of 1990's revisions to the Federal Water Pollution Control Act require that a fish and wildlife response plan be developed, in consultation with the FWS, NOAA, and other interested parties (including State fish and wildlife conservation officials), for the immediate and effective protection, rescue, and rehabilitation of fish and wildlife resources or their habitats in the event of an accidental discharge. Consequently, some of the planning efforts currently identified in this section may change somewhat dependent upon the findings resulting from the development of this plan.

Because of the less confined nature of coastlines and marshes, aircraft would probably be of most value for the initial dispersal of birds. If the section of coastline that was oiled or about to be oiled was extensive, use of aircraft would probably be the only practical dispersal method, and numerous aircraft would be necessary.

Deterrent methods and devices would need to be deployed along the shore in order to prevent birds from entering the contaminated water. Shell crackers, exploders, lights, reflectors, and mortars, together with continued use of aircraft, would be standard approaches. Distress and alarm calls would be useful if calls of the appropriate species existed and were available. The major limiting factors would be the logistical problems of deploying and operating a sufficient number of devices (Koski and Richardson, 1976).

The most effective dispersal method offshore would probably be the use of aircraft. However, some species of seabirds are more likely to dive than to fly when an aircraft approaches, and some molting waterfowl would be unable to fly. Low-altitude (effective) operations would be impossible at night. Searchlights mounted on boats and mortars, rockets, flares, and shell crackers fired from boats would be useful at night, but their effectiveness in cases of large spills would be limited. Because of their large area of coverage, rockets and mortars would probably be more useful than shell crackers and flares both by day and by night. Clean Gulf Associates currently stockpiles a total of 10 sets of 12 bird scare guns strategically located at their bases in Port Aransas and Galveston, Texas; Intracoastal City, Venice, and Grand Isle, Louisiana; and Panama City, Florida. It is recommended that this equipment be manned continuouslyand that the guns be alternately turned on and off every hour in order that their use would remain effective in scaring birds from oiled areas.

It is possible that creation of lure areas away from the contaminated area might attract birds out of the hazardous zone. The obvious approach would be to feed seabirds by throwing fish and other foods into the sea from a boat. However, it is quite probable that this would attract more birds into the general area of the oil spill and ultimately increase rather than decrease mortality. It is also possible that boats working in or near the spill for cleanup or even deterrent purposes might unintentionally attract seabirds, which commonly fly toward boats (Koski and Richardson, 1976).

The FWS has designated contacts in Clear Lake, Texas; Lafayette, Louisiana; Daphne, Alabama; and Panama City, Florida, who act as field coordinators for any waterfowl-rehabilitation actions. These coordinators can call upon the services of any local FWS office for assistance and equipment. The FWS also maintains a dedicated spill-response trailer in Daphne, Alabama, which contains equipment needed to prevent bird contamination or to care for oiled birds. This center serves the Gulf Coast region and can be relocated to a spill site upon demand. The FWS in Texas has an extensive oiled bird-rehabilitation program. The CGA has a movable waterfowl rehabilitation station located in Grand Isle, Louisiana. Extensive information on the use of this rehabilitation station is provided in Volume I of the CGA Operations Manual (CGA, 1989). This waterfowl rehabilitation station has physical space inside for up to two dozen birds, depending upon the species, degree of recovery, and aggressiveness. If it is decided to expand the station, then up to 200 game-size birds can be accommodated. The expanded, fenced enclosure will accommodate several hundred more. The CGA station is designed to complement a larger and more permanent facility that would be established based upon the siting, personnel, and equipment guidelines recommended by the International Bird Rescue Center of Berkeley, California. Approximately 350 gallons of a recommended cleanser, enough to cleanse 1,000 birds, is stockpiled by CGA.

To care for 50, 100, and 500 birds in need of immediate treatment poses severe logistical and equipment challenges. To care for 100 birds over a single day would require three 8-hour shifts with an absolute minimum of 25 people per shift to provide medical care, wash teams, rinse teams, and facilities management. Cleaning teams would need 8,000 gallons of hot water under pressure, and provision would have to be made for environmentally acceptable disposal of 5,000 gallons of oily, soapy waste water. Compliance with OSHA requirements, human safety protocols, liability insurance, damage assessment protocols, and techniques for preventing animals from becoming contaminated would also need to be considered.

Survival of rehabilitated oiled birds may vary from 30 percent (Sims, 1970) to 90 percent (Mueller and Mendoza, 1983). The success of rehabilitation is primarily due to three factors: advance preparation in stockpiling supplies and training volunteers; the availability of a cleanup station with adequate indoor space, hot running water, and outdoor pens; and, most importantly, the efforts and cooperation of willing volunteers and the government agencies involved (Mueller and Mendoza, 1983). When the rehabilitation effort is managed by an experienced oil-spill response team, oiled bird rehabilitation has been carried out with particular success in *Anatidae* species, averaging over 90 percent release of ducks and geese.

f. Recent Developments in Spill-Response Planning/Capabilities

In light of all the recent tanker spills occurring in the U.S. coastal waters since the *Exxon Valdez* incident in March 1989, much effort has been expended from the national to the local level in assessing the adequacy of the country's spill response planning and capabilities. As discussed throughout Section IV.C.5., the implementation of the recently enacted Oil Pollution Act of 1990 could greatly alter the country's existing oil-spill response planning structure and response capability. This section provides an update on other recent oil-spill response capability related developments, particularly those ongoing by the National Response Team (NRT), MMS, USCG, USEPA, and the Marine Spill Response Corporation.

National Response Team

In May 1989, the National Response Team issued its Report to the President on the *Exxon Valdez* spill (Skinner and Reilly, 1989). Besides summarizing the status of the spill, the NRT identified actions that they felt should be taken to improve the nation's preparedness for spill response. They recommended a better response coordination between Federal, State, and local authorities, especially in regard to the concerns of States; that the National Contingency Plan needs to be changed; that oil spill planning should better incorporate the care of wildlife and should prepare for and mitigate for wildlife impacts; that exercises to test contingency plans should be conducted; and that more research should be conducted into improving cleanup technology. The NRT, under the leadership of the USCG, finalized a nationwide review of contingency plans by the entire Federal Government, including the 14 agencies that makeup the NRT and all of the U.S. Coast Guard's RRT. The review, which included a total of 75 reports from these various agencies, was directed toward examining the use of worst-case scenarios to ensure realistic planning, examining the adequacy of equipment and personnel for an effective response, and the importance of well-defined organizational responsibilities. The final report was published in October 1990.

Minerals Management Service

On April 18, 1989, the Secretary of the Interior directed MMS to review current oil-spill planning, response requirements, and practices for OCS oil and gas operations. As a result of this review, MMS has undertaken a number of measures.

On April 18, 1989, MMS announced that they will be conducting a stepped-up series of surprise visits by inspectors to OCS drilling rigs and production platforms, and on May 30, 1989, the MMS Gulf of Mexico OCS Region informed industry, through a Letter to Lessees, that unannounced drills would occur. The MMS Gulf of Mexico OCS Regional Office finalized procedures for various types of oil-spill response drills and initiated the unannounced drill program in the summer of 1989.

On May 13, 1991, the MMS published in the Federal Register the Notice of Final Rule regarding changes in the methods by which MMS would assess civil penalties. This notice revised rules governing civil penalty assessment under section 24(b) of the OCSLA (43 U.S.C. 1350(b)) to implement revised authority for the Secretary of the Interior to assess civil penalties for failure to comply with regulations governing oil and gas and sulphur operations in the OCS. This action will enable MMS to assess a civil penalty without first providing notice and time for corrective action in cases where the failure constitutes or constituted a threat of serious, irreparable, or immediate harm or damage to life, property, any mineral deposit, or the marine, coastal, or human environment.

The MMS has initiated a $6 million research program on oil-spill technology research. The MMS remains a lead agency in the continuing technology assessment and research to improve oil-spill response capabilities. The MMS has long been involved in oil-spill response research, although the program has been heightened somewhat in light of the recent large oil spills from tankers. Current research projects include the development of an airborne, laser-assisted fluorosensor; the development of improved strategies for gaining an improved understanding of the fate and behavior of spilled oil as it affects response strategies; the development of safe and environmentally acceptable strategies to burn spilled oil *in situ*; an evaluation of the effectiveness of different shoreline cleanup techniques and the environmental damage resulting from each of the techniques; the development of a prototype high-speed, water jet barrier boom; the development of realistic laboratory effectiveness test protocol for dispersants; testing of new oil-spill chemical agents that are nondispersants; the investigation of new chemical dispersant formulas that promise greater effectiveness; and the development of a portable oil analysis kit for responders.

In addition, as of April 27, 1990, the management of the Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT), located in Edison, New Jersey, was transferred to MMS for purposes of research to improve oil-spill response and capability. It was reopened in Fall 1991. The reactivation of this facility will allow the development of standard testing protocol to determine the efficiency and effectiveness of response equipment and products, such as skimmers and dispersants, and the evaluation of subsurface oil detection and collection concepts. The development of standard text procedures will ensure that only the appropriate equipment is approved for use in oil spill contingency plans.

The MMS has also recently developed guidelines for equipment inspections and for reviewing and approving OSCP's. All OSCP's have been reviewed to ensure an appropriate response to the largest possible OCS oil spill. The Gulf Office is currently assessing oil-spill response times on a case-by-case basis for adequacy in the light of potential damage and will continue to assess the effectiveness of measures such as CGA's use of identified and equipped vessels at designated sites offshore to reduce response times in the Gulf of Mexico.

U.S. Coast Guard

The OPA is the largest single legislative tasking that the USCG has ever received. The work required to implement the Act is extensive. The following discussion is limited to just a few of the many tasks assigned to the USCG through implementation of OPA. Required organizational actions include the establishment of two special staff elements to facilitate OPA implementation; a National Pollution Funds Center to develop and administer those parts of OPA dealing with financial responsibility and the Oil Spill Liability Trust Fund; and a separate multidisciplinary Headquarters staff to write implementing regulations and to oversee and coordinate the multiple studies and reports required by the Act.

The USCG has also commissioned a third strike team at Fort Dix, New Jersey, on September 5, 1991. New equipment is being procured for the strike teams and full-response capability is expected in the Fall/Winter of 1992. The National Strike Force Coordination Center was also commissioned on September 3, 1991, in Elizabeth City, North Carolina. In addition, the USCG is establishing District Response Groups that will consist of all USCG personnel, vessels, and equipment assigned to the District as well as prepositioned response equipment that is strategically located within the District. In order to provide a ready supply of equipment necessary to combat a spill, the USCG has selected 19 sites nationwide for locating spill-response equipment. The criteria for this site selection included spill probability and environmental sensitivity. Equipment to be procured for these sites is discussed in Section IV.C.5.d.(1). In addition the USCG is procuring a small amount of additional equipment to be located at numerous other sites not located within proximity of the 19 selected equipment sites.

The USCG and USEPA have been co-chairing monthly meetings to draft a revised National Contingency Plan for oil spills. Work also continues between USEPA and USCG to draft contingency plans for response areas. The USCG is delegated the responsibility of designating areas in the coastal zone for which area committees are to be established. These areas are also designated as those requiring Area Contingency Plans. Similar mandates are given to USEPA for inland areas. The initial designation of these areas would make the areas the same as those already established by Regional Response Team Contingency Plans; however, if required, additional subareas will be established after the Area Committee review. The USCG is also in the process of developing requirements for tank vessel response plans.

Title VII of OPA establishes an Interagency Coordinating Committee on Oil Pollution Research charged with coordinating a comprehensive program of research, technology development, and technology demonstration among Federal agencies in cooperation with industry, universities, research institutions, State governments, and other countries. The Committee is chaired by the Department of Transportation (USCG). In addition to establishing the Interagency Committee, the Act addresses specific Federal activities including development of a Federal Oil Pollution Research and Development (R&D) Plan outlining a comprehensive five-year effort to upgrade technology for oil spill prevention and response, a program to study the effects of specific oil spills to be monitored by the Department of Commerce and USEPA, demonstration projects in specific port areas to be conducted by the USCG in coordination with other agencies (New Orleans has been selected as the site of one of these demonstration projects), and a regional grants program addressing regional aspects of oil pollution such as prevention, removal, mitigation, and the effects of discharged oil on regional environments. Presently, there are 19 member agencies and 4 ex-officio member agencies participating on the Committee and involved in preparing the Interagency Oil Spill R&D Plan. At this time, the Committee has completed the initial draft of the Comprehensive 5-Year Oil Pollution R&D Plan. The Plan is currently being reviewed within the Executive Branch prior to submission to Congress.

Some of the significant research efforts underway include (1) a major joint effort between USCG and NOAA to develop an integrated, prototype Decision Support System for oil-spill response that will provide OSC's and SSC's with detailed maps of specific areas showing attributes relevant to managing spill-response operations, and databases with accurate and accessible technical information for spill response; (2) a study that focuses on the short-term upgrade of its oil-spill surveillance capability; (3) a study that focuses on a longer term upgrade within USCG's multi-mission remote-sensing surveillance system; (4) participation in the project to develop an oil-spill thickness sensor; (5) participation in the reopening of the OHMSETT facility in Leonardo, New Jersey; (6) participation in a joint project with the U.S. Navy to streamline the current oil-spill recovery process by developing technologies to separate oil from water and provide for temporary storage of recovered oil and debris and to test and improve vessel-of-opportunity skimming systems; and (7) participation in the ongoing *in-situ* burn work.

U.S. Environmental Protection Agency

As implementation of OPA continues, the oil-spill response program at USEPA is expected to expand to meet its increased responsibilities. The OPA mandates that the NCP be revised to address a number of new issues, including area contingency planning and response procedures for "worst case discharges" and "substantial threats to health or welfare." The Act also added the requirement that spill mitigating devices and substances be addressed in the NCP Product Schedule where appropriate. The Product Schedule is currently a list of dispersants and other chemicals that may be used in spill mitigation. The USEPA has formed workgroups to address revisions to the NCP in general and to the Product Schedule specifically. In addition, USEPA is reconsidering the current toxicity and effectiveness tests for dispersants under Subpart J of the NCP. The USEPA may develop effectiveness criteria for products on the Product Schedule, which may reduce the number of products on the Schedule.

Activities underway to recognize the environmental significance of preventing oil spills include providing the funding to implement the programs already in place, coordinating with agencies and departments responsible for other aspects of oil pollution, promulgating additional regulations, issuing guidance, and conducting training. Currently, regulations mandated by OPA are being developed. The USEPA intends to develop a set of factors to determine which onshore fixed facilities must submit plans.

In the area of bioremediation, USEPA is undertaking a major R&D program to assess and improve this technology. This includes continuing post *Exxon Valdez* bioremediation research and development of a bioremediation use and monitoring protocol for application of bioremediation agents on subsequent spills. The USEPA has developed interim guidelines to help response officials consider bioremediation in their oil spill contingency plans. The guidelines are offered as a way for spill responders to collect necessary information on bioremediation to use in their contingency plan.

The USEPA is also developing a series of testing protocols to identify safe, effective, and efficient bioremediation techniques to clean up oil spills. The agency is putting together a database of available bioremediation technologies for use by spill responders to match a specific product with a specific spill. To support more extensive test and evaluation of bioremediation products, USEPA is developing a three-tiered protocol including initial vendor tests, more extensive laboratory effectiveness and toxicity tests, and microcosm tests. The establishment of an USEPA bioremediation testing center is also being considered.

Marine Spill Response Corporation

The Petroleum Industry Response Organization, first formulated in June, 1989 by the American Petroleum Institute, has been renamed the Marine Spill Response Corporation (MSRC) because the organization's potential clientele has since expanded beyond the conventional oil industry. The MSRC is an independent, privately financed, nonprofit catastrophic oil-spill response organization in the U.S. Membership in MSRC is now also open to independent tanker operators, public utilities, or any company that handles petroleum or petroleum products in quantity over coastal waters. Implementation of the MSRC organization was on hold pending the outcome of the Oil Pollution Act of 1990. Since the Act limits the liability of responders under Federal law, MSRC is now in the process of activation and expects to be fully operational by March 1993.

Since 1989, the costs and size of the organization have increased tremendously; equipment, maintenance, research, and personnel costs for the first 5 years are now estimated to be more than $800 million, three times the original estimate. The MSRC will be able to respond to large spills in offshore and tidal waters along the Pacific, Atlantic, and Gulf coasts, plus Hawaii, the U.S. Virgin Islands, and Puerto Rico. The MSRC will be available to help with smaller spills whenever the USCG determines that local response capabilities are inadequate. The organization will augment, not replace, existing local spill co-ops and response coordinators. A separate nonaffiliated corporation, the Marine Preservation Association (MPA), will fund the MSRC. The MPA, whose membership will include owners, shippers, and receivers of crude oil and petroleum products, will not have any direction over MSRC operations.

The MSRC is headquartered in Washington D.C. with five regional centers each capable of responding to a 9-million-gallon oil spill. Each regional center will have four to six prestaging areas where responders will warehouse equipment and, in some instances, vessels and response personnel. The five general areas for response centers and their prestaging areas include (1) northeast region, with a response center in the New York/New Jersey metropolitan area; (2) southeast region, with a response center in Port Everglades, Florida; (3) Gulf region, with a response center in Lake Charles, Louisiana; (4) southwest region, with a response center in the Port Hueneme area of Southern California; and (5) northwest region, with a response center in Seattle, Washington. The prestaging areas in the Gulf region include Mobile, Alabama; Venice, Louisiana; Galveston, Texas; and Corpus Christi, Texas. The MSRC will employ a full-time staff of 400 employees and will require more than $315 million worth of initial equipment, including booms, skimmers, vessels, trucks, dispersants, and wildlife rehabilitation and shoreline restoration tools.

The MSRC has recently purchased more than $216 million worth of vessels and equipment. Contracts for the construction of sixteen 210-ft offshore response vessels have been issued. The vessels will be deployed around the U.S. and will be similar in design to standard offshore supply boats with deckspace to deploy a full range of spill-response equipment. The MSRC has purchased 16 over-the-side high capacity skimmers and 16 boom containment systems designed to accumulate large quanities of oil in a V-shaped pocket to facilitate recovery. This equipment will be installed on each of the 16 response vessels. The over-the-side skimmers are reported to have a manufacturer's advertised removal capacity of up to 2,200 bbl per hour. Also to be purchased are 10 wier boom skimming systems and two heavy oil recovery skimmers that are transportable systems which can be deployed on a variety of platforms. A total of 10 viscous oil transfer pumps, 7 high capacity transfer pumps, 30 vacuum skimmers which have particular application in shallow water and for shoreline cleanup, and 20 miles of intertidal boom is also being procured.

The MSRC is developing a computer assisted spill management system, which will make a major improvement in the way large spills are fought in the future. Such system elements as spill tracking, resources at risk, and logistics are some of the kinds of information that will be available, on a real time basis, to regional general managers and the government OSC to facilitate decision making on-scene.

The organization will also provide a program to audit on a continuing basis, the readiness of the response forces to meet their objectives; and an active research and development program. The research and development program objectives are to improve the basic information about spills and the technology of oil-spill response and cleanup. Research programs will be funded to study chemical and biological effects of spilled oil on the environment, techniques for on-water recovery and treatment, and the prevention and mitigation of shoreline impacts. Patents or royalties will be donated to the public domain.

The MSRC successfully carried out field tests evaluating various remote airborne sensing devices. This is part of a larger project the MSRC is aggresively pursuing to develop an integrated remote sensing and imaging processing system. The goal is to provide the oil spill responder the ability to see oil on the sea under adverse conditions not currently possible.