Gulf of Mexico Sales 147 and 150:

Central and Western Planning Areas

Final Environmental Impact Statement

Volume I: Sections I through IV.C.

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REGIONAL DIRECTOR'S NOTE

The Gulf of Mexico Outer Continental Shelf (OCS) Region of the Minerals Management Service has been conducting environmental analyses of the effects of OCS oil and gas development since the inception of the National Environmental Policy Act of 1969. Since that time we have published 38 draft and final environmental impact statements (EIS). Our goal has always been to provide factual, reliable, and clear analytical statements in order to inform decisionmakers about the environmental effects of proposed OCS activities and their alternatives. We view the EIS process as providing a balanced forum for early identification, avoidance, and resolution of potential conflicts. It is in this spirit that we welcome comments on this document from all concerned parties.

A handwritten signature in black ink that reads "Chris C. Oynes". The signature is written in a cursive, flowing style.

Chris C. Oynes
Acting Regional Director
Minerals Management Service
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COVER SHEET

Environmental Impact Statement for Proposed Central Gulf of
Mexico OCS Lease Sale 147 (March 1994) and Proposed
Western Gulf of Mexico OCS Lease Sale 150 (August 1994)

Draft ()

Final (x)

Type of Action:

Administrative (x)

Legislative ()

Area of Potential Impact:

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

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ABSTRACT

This Final Environmental Impact Statement (EIS) covers the proposed 1994 Gulf of Mexico OCS oil and gas lease sales [Central Gulf of Mexico Sale 147 (March 1994) and Western Gulf of Mexico Sale 150 (August 1994)]. 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. Proposed mitigating measures and their effects are analyzed, in addition to potential cumulative impacts resulting from proposed activities.

Additional copies of this 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.

SUMMARY

This environmental impact statement (EIS) addresses two proposed Federal actions that offer for lease areas in the Gulf of Mexico Outer Continental Shelf (OCS). These areas may contain economically recoverable oil and gas resources. Lease Sales 147 and 150 are proposed for 1994 and include lease blocks in the Central Gulf of Mexico Planning Area (CPA) and Western Gulf of Mexico Planning Area (WPA), respectively. Up to 10,383 blocks will be available for lease under the two proposed actions; only a small percentage is expected to be actually leased. Of the blocks that will be leased, 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 actions 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 147 and the Alternatives

Alternative A (Proposed Central Gulf Sale 147) is scheduled to be held in March 1994 and offers for lease approximately 5,701 unleased blocks (as of August 1993) in the CPA. This area includes about 30.6 million acres (ac) located from 4.8 to 354 km (3 to 220 mi) offshore in water depths ranging from 4 to 3,425 m (13 to more than 11,000 ft). No areas are excluded 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 0.12 billion barrels of oil (BBO) and 1.21 trillion cubic feet (tcf) of gas.

Alternative B (The Proposed Action Excluding the Blocks Near Biologically Sensitive Topographic Features) would offer for lease all unleased blocks offered under the proposed action, with the exception of approximately 71 blocks of the 167 total blocks on or near biologically sensitive areas of the topographic features. A total of 5,630 unleased blocks (approximately 30.3 million ac) would be available for lease under this alternative.

Alternative C (No Action) equates to cancellation of the sale. Neither potential environmental effects nor possible oil and gas production resulting from the proposed action would occur. Potential alternative energy resources needed to replace those lost by cancellation of this sale are discussed in Appendix D.

Proposed Western Gulf Sale 150 and the Alternatives

Alternative A (Proposed Western Gulf Sale 150) is scheduled to be held in August 1994 and offers for lease approximately 4,682 unleased blocks (as of June 1993) in the WPA. This area includes about 25.7 million ac located from 14 to 357 km (9 to 220 mi) offshore in water depths ranging from 8 to more than 3,000 m (26 to more than 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, East Addition, South Extension; 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. In addition, 337 blocks (about 1.8 million ac) contained in the Western Naval Operations Area near Corpus Christi, Texas, were

excluded from proposed Western Gulf of Mexico Sale 150 based on negotiations between MMS, Department of Defense (Department of the Navy), and industry. 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 0.04 BBO and 0.65 tcf of gas.

Alternative B (The Proposed Action Excluding the Blocks Near Biologically Sensitive Topographic Features) would offer for lease all unleased blocks offered under the proposed action, with the exception of approximately 109 blocks of the 200 blocks on or near biologically sensitive areas of the topographic features. A total of 4,573 unleased blocks (approximately 25.2 million ac) would be available for lease under this alternative.

Alternative C (No Action) equates to cancellation of the sale. Neither potential environmental effects nor possible oil and gas production resulting 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 stipulations are being analyzed as part of the proposed actions. These stipulations include 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. 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. The estimated resources are based on many factors such as geologic structure, economic assumptions, and proximity to existing development. The primary scenario analyzed is called the Base Case, which assumes the mean or expected amounts of undiscovered, unleased hydrocarbon resources, and resultant development activities. The second scenario analyzed 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.

A cumulative analysis is presented and considers environmental impacts that result from the incremental impact of the lease sales when added to all past, present, and reasonably foreseeable future human activities, such as those resulting from other OCS lease sales as well as non-OCS activities, such as import tankering and commercial fishing. The environmental analyses are based on levels of assumed development activities correlated with the amount of resources estimated to be leased. 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

Those resources and activities determined through the scoping process to warrant an environmental analysis included the following: sensitive coastal environments, sensitive offshore resources, water and air quality, coastal and marine mammals, marine turtles, coastal and marine birds, the Gulf sturgeon, commercial fisheries, recreational resources and activities, archaeological resources, and socioeconomic conditions.

The scoping process is an ongoing effort whereby contacts are made with other Federal and State agencies, the public, academia, and environmental groups to identify those resources about which there is concern. Through this process the significant resources and activities analyzed in the EIS are determined.

Impact Conclusions

Tables II-2 and II-3 provide a summary of the impacts of proposed Sales 147 and 150 and their alternatives under the Base Case, High Case, and cumulative analyses. A general summary of impacts resulting from the proposed actions is as follows:

Coastal Resources

Coastal barrier beach configurations are not expected to encounter substantial alteration, except in localized areas downdrift from support channel maintenance dredging activities. Approximately 80 ha and 5 ha (198 ac and 12 ac) of wetlands are projected to be lost in the Central and Western Gulf, respectively. The productivity of some 25-35 ha (62-87 ac) of wetlands will be suppressed for up to 10 years in the Central Gulf Region; whereas, the productivity of 0.4-0.6 ha (1.0-1.4 ac) will be suppressed for that same period in the Western Gulf. Minor, long-term changes in coastal water quality will occur in proximity to navigation channels and support complexes; however, these changes will not preclude the current use of the affected waters. Impacts from dredging operations and from hydrocarbon spills will result in short-term changes to coastal water quality, with water use being affected for up to 5 years in a few instances. Air pollutant emissions are not expected to have concentrations (about $1 \mu\text{gm}^{-3}$) that would change or exceed existing onshore air classifications. At this concentration, the greatest impacts will occur during the summer months, due to the prevailing onshore winds blowing for a greater percent of the time. Impacts to the Alabama, Choctawhatchee, and Perdido Key beach mice (Central Gulf only) would result in temporary disturbance in their behavior and habitat use. Coastal and marine birds will experience no discernible decline in regional population or species, although some temporary changes in local distributions and abundances are expected. The loss of individual nests could take up to several years to recover to predisturbance conditions. Minor pollution events (oil spills, solid waste) resulting from proposed OCS activities may diminish the enjoyment of recreational beach users.

Offshore Resources

Impacts to live-bottom areas (pinnacle trend--Central Gulf only), deep-water benthic communities, and topographic feature areas are expected to be such that any changes to the physical integrity, species diversity, or biological productivity would recover to pre-impact conditions in less than 2 years. Marine waters will be degraded from discharges, oil spills, and bottom disturbances. Drilling muds and cuttings are expected to contaminate a localized area around platforms out to 3,000 m for up to 1 year after drilling ceases. Production wastes will change some water quality and sediment parameters within several hundred meters downcurrent from the discharge point for up to 20 years. These discharges will contribute to a very slight extent to long-term, regional contamination. Impacts to marine mammals would result in physiological stress, would alter normal behavior, and would bring about avoidance of affected areas. Marine turtles and their habitats would be temporarily disturbed by various support activities; however, deaths are expected to be rare. Should the Gulf sturgeon (Central Gulf only) be contacted by hydrocarbon spills, several adults could experience nonfatal irritation to gill epithelium and a possible increase in liver function for less than a month. Less than a 1 percent decrease in commercial fish populations or in commercial fishing is expected to occur, with recovery to predisturbance conditions expected in less than 6 months for fishing activity and one generation for fishery resources.

Other Resources

There is a slight possibility that unique or significant archaeological information could be lost if proposed OCS activities impact an archaeological resource (historic shipwrecks or prehistoric sites). Employment demands will be met by the available labor force and existing population. Peak annual changes in population, labor, and employment will be less than 1 percent of those levels anticipated in the absence of the proposed actions. Population and employment impacts would not result in disruption of community infrastructure and public services beyond what is anticipated by planning and development agencies. 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.

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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
AEDP	Area Evaluation and Decision Process
Ala.	Alabama
ANWR	Aransas National Wildlife Refuge
APD	Application for Permit to Drill
API	American Petroleum Institute
ARTC	Armament Research and Test Center
ARZ1	Archeological Resource Zone 1
atm	atmosphere
AUM	Action Update Memorandum
B.P.	before present
Ba	barium
BAST	best available and safest technology
BAT	best available technology
bbl	barrels
BBO	billion barrels of oil
Bcf	billion cubic feet
BLM	Bureau of Land Management
BMR	Bureau of Marine Resources (Mississippi)
BOD	biological oxygen demand
BOP	blowout preventer
BPD	barrels per day
C-14	carbon 14
ca.	circa, about
CAA	Clean Air Act
CAB	Coastal Area Board
Call	Call for Information and Nominations
CB	citizens band
CBRA	Coastal Barrier Resources Act of 1982
CBRS	Coastal Barrier Resource System
CEI	Coastal Environments, Inc.
CEQ	Council on Environmental Quality
CER	categorical exclusion review
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
cf	compare, see
CFR	Code of Federal Regulations
CGA	Clean Gulf Associates
CH ₄	methane
cm	centimeter
cms ⁻¹	centimeters per second
CO	carbon monoxide
COE	Corps of Engineers (U.S. Army)
COST	continental offshore stratigraphic test (well)
CPA	Central Planning Area
Cr	chromium

CSA	Continental Shelf Associates
CWA	Clean Water Act
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
dB	decibel
DDE	dichloro diphenyl dichloroethane
DDT	dichloro diphenyl trichloroethane
DM	Departmental Manual
DNR	Department of Natural Resources (Louisiana)
DOCD	Development Operations Coordination Document
DOD	Department of Defense (U.S.)
DOI	Department of the Interior (U.S.) (also: USDOl)
DOT	Department of Transportation (U.S.) (also: USDOT)
DPP	Development and Production Plan
dwt	deadweight tonnage
E.O.	Executive Order
EA	environmental assessment
EEZ	Exclusive Economic Zone
EIS	environmental impact statement
EP	Exploration Plan
EPA	Eastern Planning Area
ESP	Environmental Studies Program
et al.	and others
et seq.	and the following
FAA	Federal Aviation Administration
FCF	Fishermen's Contingency Fund
FERC	Federal Energy Regulatory Commission
FMC	Fisheries Management Council
FMP	Fishery Management Plan
FPS	floating production system
FPSO	floating production, storage, and offloading system
FR	Federal Register
FRM	Federal Reference Methods
FRS	Fast Response System
ft	foot
FWPCA	Federal Water Pollution Control Act of 1972
FWS	Fish and Wildlife Service
FY	fiscal year
G&G	geological and geophysical
gal	gallon
GIWW	Gulf Intracoastal Waterway
GMFMC	Gulf of Mexico Fishery Management Council
gpm	gallons per minute
GULFCET	Distribution and Abundance of Marine Mammals in the North-Central and Western Gulf of Mexico (MMS-funded study)
H.R.	House Resolution (U.S. Congress)
H ₂ S	hydrogen sulfide
ha	hectare
HAPC	Habitat Area of Particular Concern
HOSS	High-Volume Open Sea Skimmer System
hphr	horsepower hour
hr	hour

Hz	hertz (cycles per second)
IBR	Information Base Review
ID	identification
in	inch
IPF	impact-producing factor
ITL	Information to Lessees and Operators
ITM	Information Transfer Meeting
kHz	kilohertz (kilocycles per second)
km	kilometer
kn	knots
l/m ²	liters per square meter
La.	Louisiana
LATEX	Texas-Louisiana Shelf Circulation and Transport Process Program (MMS-funded study)
lb	pounds
LCZMP	Louisiana Coastal Zone Management Program
LLD	lower limit of detection
LNG	liquefied natural gas
LOOP	Louisiana Offshore Oil Port
LSU	Louisiana State University
LTL	Letter to Lessees and Operators
m	meter
m ²	square meter
m ³	cubic meter
M/V	motor vessel
MAFLA	Mississippi, Alabama, and Florida
MAMES	Mississippi-Alabama Marine Ecosystems Study
MARPOL	International Convention for the Prevention of Pollution from Ships
mb	millibar
MCP	Mississippi Coastal Program
MFCMA	Magnuson Fishery Conservation and Management Act of 1976
mg/l	milligrams per liter
mi	mile
micro-REMS	microroentgens
Miss.	Mississippi
ml/l	milliliters per liter
mm	millimeter
MMbbl	million barrels
MMcf/d	million cubic feet per day
MMPA	Marine Mammal Protection Act of 1972
MMS	Minerals Management Service
MOU	Memorandum of Understanding
MPA	Marine Preservation Association
mph	miles per hour
MPPRCA	Marine Plastic Pollution Research and Control Act of 1987
ms ⁻¹	meters per second
MSRC	Marine Spill Response Corporation
Mta	million metric tons annually
N	north
NA	not available
NAAQS	National Ambient Air Quality Standards
NAS	National Academy of Sciences
NCP	National Oil and Hazardous Substances Pollution Contingency Plan

NEPA	National Environmental Policy Act
NERBC	New England River Basins Commission
NGVD	National Geodetic Variable Datum
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
nmi	nautical mile
NO	nitric oxide
NO ₂	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NODC	National Oceanographic Data Center
NOI	Notice of Intent to Prepare an EIS
NORM	naturally occurring radioactive materials
NOW	nonhazardous oil-field waste
NO _x	nitrogen oxides
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
NSFCC	National Strike Force Coordination Center
NSPS	new source performance standards
NTL	Notice to Lessees and Operators
O ₃	ozone
OCD	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
OOO	Offshore Operators Committee
OPA	Oil Pollution Act
OSC	On-Scene Coordinator
OSCP	Oil Spill Contingency Plan
OSHA	Occupational Safety and Health Administration
OSRA	Oil Spill Risk Analysis
OTA	Office of Technology Assessment (U.S. Congress)
P.L.	Public Law
PCB	polychlorinated biphenyl
pCi/l	picoCuries per liter
pCi/g	picoCuries per gram
pCi	picoCuries
PINC	Potential Incident of Noncompliance
PM ₁₀	particulate matter smaller than 10 microns
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
PSD	Prevention of Significant Deterioration
R&D	research and development
Ra-226, Ra-228	radium isotopes
RCP	Regional Contingency Plan
RCRA	Resource Conservation and Recovery Act
RD	Regional Director
ROM	Regional Oxidant Model

ROTAC	Regional Operations Technology Assessment Committee
RRT	Regional Response Team
RTWG	Regional Technical Working Group
SAIC	Science Applications International Corporation
SARA	Superfund Amendments and Reauthorizations Act of 1986
SEL	Site Evaluation List
SIC	Standard Industrial Classification
SMSA	Standard Metropolitan Statistical Area
SO ₂	sulphur dioxide
SO _x	sulphur oxides
sp.	species
SPCC	Spill Prevention Control and Countermeasure
spp.	multiple species
Stat.	Statutes
t/45-d	45-day total
t/p/y	total per platform per year
T.S.	tropical storm
tcf	trillion cubic feet
TCMP	Texas Coastal Management Plan
TED	turtle excluder device
Tex.	Texas
THC	total hydrocarbon content
TLP	tension leg platform
TSP	total suspended particulates
TSS	traffic separation schemes
U.S.	United States
U.S.C.	United States Code
USCG	U.S. Coast Guard
USDOC	U.S. Department of Commerce
USDOI	U.S. Department of the Interior (also: DOI)
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compounds
VOSS	Vessel of Opportunity Skimming System
WPA	Western Planning Area
yr	year
°C	degrees Celsius
μm	micro meters
μgm ⁻³	micrograms per cubic meter

CONVERSION CHART

Measurements in this EIS are given in SI metric units (International System of Units) except where U.S. units are the accepted standard (for example, altitudes for aircraft). For the reader's convenience, both SI metric and U.S. customary units are included in the Summary. Factors for converting SI metric to U.S. customary units are provided in the following table.

To convert from	To	Multiply by
millimeter (mm)	inch (in)	0.03937
centimeter (cm)	inch (in)	0.3937
meter (m)	foot (ft)	3.281
kilometer (km)	mile (mi)	0.6214
meter ² (m ²)	foot ² (ft ²)	10.76
	yard ² (yd ²)	1.196
	acre (ac)	0.0002471
hectare (ha)	acre (ac)	2.47
kilometer ² (km ²)	mile ² (mi ²)	0.3861
meter ³ (m ³)	foot ³ (ft ³)	35.31
	yard ³ (yd ³)	1.308
liter (l)	gallons (gal)	0.2642
degree Celsius (°C)	degree Fahrenheit (°F)	°F = (1.8 x °C) + 32

1 bbl = 42 gal = 158.9 l

1 nautical mile (nmi) = 6,076 ft or 1.15 mi

THE PROPOSED ACTIONS

I

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THE PROPOSED ACTIONS**

II

**DESCRIPTION OF THE
AFFECTED ENVIRONMENT**

III

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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. Under the Outer Continental Shelf Lands Act (OCSLA), as amended, the Department of the Interior (DOI) is required to manage the leasing, exploration, development, and production of oil and gas resources on the Federal 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.

Scheduled to be held in 1994, the proposed sales are part of the DOI's *Outer Continental Shelf Natural Gas and Oil Resource Management Comprehensive Program (1992-1997)*. The sale areas are depicted in Figure 1-1 and lease blocks and lease status are shown on Visual No. 1. The East and West Flower Garden Banks (Blocks A-375 and A-398 in High Island Area, East Addition, South Extension) were excluded from the Call for Information and Nominations (Call) as a result of action taken during the development of the Comprehensive Program. The East and West Flower Garden Banks have been designated as marine sanctuaries. In addition, 337 blocks (about 1.8 million acres) contained in the Western Naval Operations Area near Corpus Christi, Texas, were excluded from proposed Western Gulf of Mexico Sale 150. This exclusion was jointly agreed upon by the MMS and the U.S. Navy, following extensive consultation with the Navy and industry. A number of proposals were analyzed in relationship to the area's overall potential to produce oil and gas, economic evaluation under the market price of gas, and U.S. Navy requirements. Up to 10,383 blocks will be available for lease under the two proposed actions, but only a small percentage are expected to actually be leased and an ever smaller percent will actually produce oil and gas.

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 descriptions, Section IV.D.).

Proposed Central Gulf Sale 147 is scheduled to be held in March 1994 and will offer for lease approximately 5,701 unleased blocks (as of August 1993) in the Central Planning Area (CPA). This area includes about 30.6 million acres located from 4.8 to 354 kilometers (km) offshore in water depths ranging from 4 to 3,425 meters (m). The proposed alternatives are to exclude approximately 71 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 147 (Base Case):

- 35-year project life.
- During the exploration phase, 1995-2004, 130 wells will be drilled.
- During the development phase, 1996-2018, 110 oil wells and 110 gas wells will be drilled and 20 platform complexes will be installed.
- During the production phase, 1996-2027, 0.12 billion barrels of oil (BBO) and 1.21 trillion cubic feet (tcf) of gas will be produced.

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

- By the end of 2028, all platforms associated with the proposed action will be removed, with eight structures being removed explosively, and the remaining being removed by nonexplosive methods.
- The transportation of this oil and gas will require the following:
 - the construction of 275 km of oil and gas pipelines;
 - 197 barge trips carrying oil to eight existing shore terminals along the Texas and Louisiana coasts; and
 - no shuttle tanker trips will occur from proposed activities.
- No new onshore support or processing facility construction is expected; existing OCS-related facilities will be utilized.
- Offshore transport of personnel and supplies will involve 267,000 helicopter trips and 8,400 service-vessel trips.
- Potential accidents include the following:
 - one Size 3 spill (greater than or equal to 1,000 bbl), one Size 2 spill (greater than 50 bbl and less than 1,000 bbl), and 18 Size 1 spills (greater than 1 bbl and less than or equal to 50 bbl) occurring from offshore operations; and
 - two Size 2 spills (greater than 50 bbl and less than 1,000 bbl) and 11 Size 1 spills (greater than 1 bbl and less than or equal to 50 bbl) occurring from onshore operations.

Sections IV.A. and B. fully describe activities and impact-producing factors assumed to occur from proposed Sale 147.

Proposed Western Gulf Sale 150 is scheduled to be held in August 1994 and will offer for lease approximately 4,682 unleased blocks (as of June 1993) in the Western Planning Area (WPA). This area includes about 25.7 million ac 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 excluded from this proposed action because of the environmentally sensitive nature of the biological communities located thereon. Another 337 blocks (about 1.8 million ac) comprising the Western Naval Operations Area near Corpus Christi, Texas, were excluded through negotiations between MMS, the U.S. Navy, and the offshore industry. The proposed alternatives are to exclude approximately 109 blocks of the 200 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 the amounts and timing of activities that will result from proposed Sale 150 (Base Case):

- 35-year project life.
- During the exploration phase, 1995-2004, 120 wells will be drilled.
- During the development phase, 1996-2015, 40 oil wells and 60 gas wells will be drilled and 10 platform complexes will be installed.

- During the production phase, 1996-2027, 0.04 BBO and 0.55 tcf of gas will be produced.
- By the end of 2028, all platforms associated with the proposed action will be removed, with four 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 220 km of oil and gas pipelines;
 - eight barge trips carrying oil to three existing shore terminals along the Texas and Louisiana coasts; and
 - 53 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 151,000 helicopter trips and 5,000 service-vessel trips.
- Potential accidents include the following:
 - six Size 1 spills (greater than 1 bbl and less than or equal to 50 bbl) occurring from offshore operations; and
 - two Size 1 spills (greater than 1 bbl and less than or equal to 50 bbl) occurring from onshore operations.

Sections IV.A. and B. fully describe activities and impact-producing factors assumed to occur from proposed Sale 150.

In addition to the alternatives, 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. These measures are discussed in Section I.B.3. under Regulatory and Administrative Framework.

B. BACKGROUND

1. Administrative Events Leading to the Proposed Actions

On April 30, 1992, the Call and the Notice of Intent to Prepare an EIS (NOI) for the proposed 1994 Gulf of Mexico 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.

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

The OCSLA requires that the 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 OCS Natural Gas and Oil Resource Management Comprehensive Program for 1992-1997, was approved July 1, 1992. Contained within that Program was an Area Evaluation and Decision Process (AEDP), which heightens attention to the adequacy of information for decisionmaking involved for lease sales under that program. Under the AEDP, the area proposed for leasing and the stipulations that are included in the analysis of the proposed action were included in the Notice of Sale that was made available concurrently with the Draft EIS.

The first step of the AEDP is called the Information Base Review (IBR). The IBR provides a broad overview of available information relevant to the issues identified for leasing, exploration, and development. It further provides an indication of potential information needs for future decisions and an indication of interest from industry.

The IBR for proposed Sales 147 and 150 was completed in March 1992 and identified several areas for potential information enhancement. The review process for this IBR was designed to incorporate both public and internal assessments of the information base available for decisionmaking on the OCS. Public involvement in the process was solicited during the Gulf of Mexico Region's Information Transfer Meeting (ITM) held in November 1991. Pertinent comments and study suggestions submitted by outside parties in response to recently published EIS's and Consistency Determinations were also considered. In addition, an interdisciplinary and comprehensive assessment of the status of the information base was conducted by the MMS.

Additional research needs were also identified during the IBR for Sales 142 and 143 completed last year and the Environmental Studies Program planning process for Fiscal Years 1991, 1992, and 1993. These informational enhancements concern the analysis and modelling of water circulation patterns, information gathering on coral reef and shelf slope ecosystems, further research on marine turtles, continued monitoring of the Flower Gardens Banks, and research on oil spill recovery and the use and toxicity of oil dispersants.

The IBR conducted prior to the issuance of a Call/NOI for proposed Sales 147 and 150, and the responses to the Call/NOI and subsequent scoping activities did not identify any new short- or long-term information gathering efforts that would have made it necessary to delay or cancel the publication of the Call/NOI, the Area ID, or the preparation of the Draft EIS. Those data gaps that were recognized have been identified in the past, and studies are currently underway to obtain the information, or proposals for studies have been entered into the regional studies planning process.

Pursuant to the 1984 Memorandum of Understanding (MOU) between the U.S. Environmental Protection Agency (USEPA) and the DOI concerning the coordination of National Pollution Discharge Elimination System (NPDES) permit issuance with the OCS oil and gas lease program, the MMS, Gulf of Mexico OCS Region and the USEPA Regions 4 and 6, have entered into a Cooperating Agency Agreement to prepare an EIS for oil and gas exploration, development, production, and well treatment activities on the Gulf of Mexico OCS. Section 402 of the Clean Water Act (CWA) authorizes the USEPA to issue NPDES permits to regulate discharges to waters of the United States, including the territorial seas, contiguous zone, and oceans. The NPDES permits for OCS oil and gas facilities may contain effluent limitations developed pursuant to sections of the CWA, including Sections 301, 302, 306, 307, and 403. With the offshore subcategory under the CWA, the USEPA may have National Environmental Policy Act (NEPA) responsibilities for permits issued to new sources (Section 306 of the CWA) which overlap with those of MMS. The USEPA's primary role in the Cooperating Agency Agreement is to provide expertise in those fields specifically under its mandate.

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 147

Alternative A (The Proposed Action): The proposed action for Sale 147 offers for lease all unleased blocks, approximately 30.6 million acres or approximately 5,701 blocks (as of August 1993), 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 offer for lease all unleased blocks offered under the proposed action, with the exception of approximately 71 blocks of the 167 blocks potentially affected by the Topographic Features Stipulation. A total of 5,630 unleased blocks (approximately 30.3 million ac) would be available for lease under this alternative.

Alternative C (No Action): This alternative is equivalent to cancellation of a sale scheduled for a specific timeframe in the approved Comprehensive Program. The opportunity for development of the estimated oil and gas resources that could have resulted from proposed Sale 147 would be precluded 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 150

Alternative A (The Proposed Action): The proposed action for Sale 150 is to offer for lease all unleased blocks, except for 339 blocks within the WPA for oil and gas operations. This totals approximately 25.7 million acres or 4,682 blocks as of June 1993. The exceptions are Blocks A-375 and A-398 in High Island Area, East Addition, South Extension (East and West Flower Garden Banks, respectively) and 337 blocks contained within the Western Naval Operations Area near Corpus Christi, Texas. The exclusion 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 offer for lease all unleased blocks offered under the proposed action, with the exception of approximately 109 blocks of the 200 blocks potentially affected by the Topographic Features Stipulation. A total of 4,573 unleased blocks (approximately 25.2 million ac) would be available for lease under this alternative.

Alternative C (No Action): This alternative is equivalent to cancellation of a sale scheduled for a specific timeframe in the approved Comprehensive Program. The opportunity for development of the estimated oil and gas resources that could have resulted from proposed Sale 150 would be precluded or postponed, and 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 Offshore Mississippi/Alabama (Pinnacle Trend): This alternative was originally proposed by the National Oceanic and Atmospheric Administration (NOAA) several years ago and such an alternative has also been considered and discussed by MMS staff on several occasions. This alternative would offer all available unleased blocks except for those of the pinnacle trend area, an extensive area located in the northeastern corner of the CPA. The pinnacle trend is a region of widely-scattered topographic features and patch reefs, ranging in relief from less than 1 to approximately 15 m. The impetus for consideration of this proposed alternative is based in part on the fact that the MMS has traditionally analyzed in the EIS the impacts of a somewhat similar alternative (Alternative B) that excludes blocks near certain biologically sensitive topographic features in both the CPA and WPA. However, the geological and biological characteristics of the topographic features proposed for deferral by Alternative B and the topographic features of the pinnacle trend area are quite different. The topographic features covered by Alternative B are distinct, relatively large features of substantial relief and support a high biomass and diversity of plant and animal species, including hermatypic (reef building) corals. These features are generally surrounded by vast areas of much lower

diversity. The biota associated with these features is of such value that the protective stipulations routinely applied to leases in blocks where these features are located contain strict provisions to avoid adverse impacts to the biota on these features, including "no activity" zones, buffer zones, and provisions to regulate discharges. In contrast, the topographic features of the pinnacle trend area vary considerably in size, relief, and in terms of the quality and value of their biological assemblages. They do not support significant areas of hermatypic corals as do some of the other topographic features in other areas. Nonetheless, many of the features in the pinnacle trend area do warrant protection, and the protective stipulation routinely applied to leases in blocks containing these features require the operator to provide to MMS a live-bottom survey of the area where disturbing activities such as drilling and anchoring may occur. If the data indicate that such activities would disturb a pinnacle trend feature of biological importance, the operator would be required to relocate the operations or to monitor the impacts of the activity on live bottoms. The addition of a pinnacle trend deletion alternative would not add significant additional protection to the areas.

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. Alternative C (No Action) for both Sales 147 and 150 equates to the cancellation of the proposed sales. If selected by the Secretary, the development of oil and gas resources associated with these sales would be precluded, as would any potential adverse effects resulting from support activities. The oil and gas not produced as a result of selecting Alternative C would be replaced, at least in part, by energy from other sources. Appendix C of the Comprehensive Program for 1992-1997 includes a comparative environmental analysis of energy alternatives to OCS oil and gas (USDOL, MMS, 1992a), and this analysis is also included in Appendix D of this EIS.

Exclude Shelf or Deep-water Areas within the Central Gulf of Mexico: The DOI's Comprehensive Program for 1992-1997 included a provision stating "... MMS will pursue further consultation on the pace of offering deep-water tracts." This provision resulted from the State of Louisiana's concern over areawide (accelerated) leasing and the need to focus leasing by limiting the number of tracts offered. The State went on to recommend the offering of biennial sales or alternating sales between deep-water and shelf areas. In our continued consultation with the State, these issues were discussed at the July 22, 1992, Regional Technical Working Group (RTWG) meeting in Mobile, Alabama, with the State of Louisiana's RTWG representative, and again several days later in a conversation with the Executive Director of the Louisiana Center for Coastal, Energy, and Environmental Resources. In both instances the State's concern for slower leasing during the current period of low prices was emphasized, but it was generally acknowledged that a geographically based alternative to the proposed action was not essential to accommodate the State's concerns. Since the State proposed this alternative several years ago, it has yet to provide MMS with specifics as to how this alternative should be structured and has stressed that its only purpose was that of slowing the pace of leasing. At present, industry analysts contend that the future of oil and gas leasing in the Central Gulf lies in its deep-water provinces. The MMS estimates that a major portion of the remaining oil and gas resources lie in the deep-water areas (400+ m) of the Central and Western Gulf. Removing these tracts would restrict industry's opportunity to explore these areas and limit their efforts to areas having a lower resource potential. Current technology and dwindling budgets are presently limiting industry's ability to explore and produce in the deep-water areas. Likewise, current leasing trends are, to a large extent, being controlled by market forces and the lower cost of a barrel of oil. Therefore, industry is, in essence, slowing the pace of leasing or regulating itself with regard to leasing.

b. Mitigating Measures

(1) Potential Mitigating Measures Analyzed

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. These measures are being considered for adoption by the Secretary and are analyzed as part of the proposed action.

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 147 and 150. 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 stipulations is discussed in Section II. The analysis of these stipulations as part of the proposed action 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 (Pinnacle Trend) Stipulation

The Live Bottom Stipulation covers the pinnacle trend area of the CPA. Through detection and avoidance, this stipulation precludes mechanical damage (from OCS activities--associated with rig and anchor emplacement) to the sessile and pelagic communities associated with the crest and flanks of such features. This stipulation does not address the discharge of effluents near the pinnacles due to the area being subjected to heavy natural sedimentation. The northeastern portion of the Central Gulf contains a band of pinnacles between 67 and 109 m in depth, which extends into the northwestern portion of the Eastern Gulf. The pinnacles are a series of topographic irregularities with variable biotal coverage, which provides 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 stipulation is provided in Section II.

Topographic Features Stipulation

The Topographic Features Stipulation precludes damage to the biota of the banks from routine OCS oil and gas activities. Coral and associated communities at the crest and on the flanks of these features would be adversely affected by OCS activities should unrestricted activities be allowed to occur on or near these features. Through avoidance, by establishing "No Activity Zones," many such activities and their associated impacts are precluded. 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 147 and 150. A discussion of the effectiveness of this stipulation is provided in Section II.

Archaeological Resource Stipulation

The archaeological stipulation may reduce the potential impacts to proposed archaeological sites from oil and gas development by allowing detection of sites prior to development, thereby making avoidance possible. This 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 147 and 150. The 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) 91-02 (Appendix F). A discussion of the effectiveness of this stipulation is in Section II.

Military Areas Stipulation

A standard Military Areas Stipulation has been applied to all blocks leased in military areas in the Gulf of Mexico since 1977. The stipulation reduces potential impacts, primarily those associated with safety, by curtailing OCS operations and support activities in areas where military operations are being conducted. One of the requirements of the 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 147 and 150. A discussion of the effectiveness of this stipulation is in Section II.

(2) Mitigating Measures Considered But Not Analyzed

Four 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 and considered for Sales 147 and 150. 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. In an effort to improve the overall response efforts of OCS oil and gas operators within the Gulf, MMS began an unannounced oil spill program in 1989. The MMS conducts surprise drills to test the effectiveness of an operator to contain or mitigate and clean up a mock oil spill. In all instances, a team of MMS officials initiated the drills and monitored the timing and type of actions taken for each spill scenario. After each of these drills, MMS holds meetings with the operators to discuss its findings and recommendations.

Add Seabee, Big Adam, Little Adam, and Phleger Banks to the List of Banks Covered by the Topographic Features Stipulation or the Live Bottom Stipulation: The NOAA has recommended for several years that Seabee, Big Adam, Little Adam, and Phleger Banks be afforded the protection of either the Topographic Features Stipulation or the Live Bottom Stipulation. These recommendations stem from the fact that the banks contain, in some cases, sparse populations of ahermatypic (non-reef-building) corals and/or serve as attracting features for aggregations of fish. It is known that sparse occurrences of *Oculina diffusa* occur on Seabee Bank. The MMS's position has been that these banks should not be covered by either of these biological stipulations because they do not contain biological assemblages that warrant protection. They are

low-relief, biologically depauperate banks located in muddy environments subject to frequent events of high turbidity. Additional information regarding these banks is found in Section III B.2.c. On April 8, 1993, MMS representatives met with Mr. Don Moore of NOAA's National Marine Fisheries Service (NMFS) to discuss their concerns over the four banks in question. With regard to Big Adam, Little Adam, and Phleger Banks, the MMS discussed why these banks lacked the features of the other banks currently protected by the Topographic Features Stipulation. The NMFS personnel accepted the MMS position on Phleger and Big and Little Adam Banks, i.e., no protection is warranted for these banks. It was agreed that the three banks would continue to be addressed in future EIS discussions. However, with regard to Sebree Bank it was agreed that a cooperative dive effort between MMS and NMFS would take place on Sebree Bank. During the week of August 23, 1993, divers from the MMS, the State of Texas, and academia embarked on this cooperative venture. The NOAA representatives were unable to participate in these dives due to manpower and scheduling difficulties. Future discussions will be held to determine if the new information collected during the dive indicates that the protection of the Topographic Features Stipulation should be extended to Sebree Bank. It is hoped that this cooperative effort will enable us to resolve our long held disagreements with respect to these four banks.

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 copy of the NTL is found in Appendix F. See paragraph two of the NTL for a discussion of the regulatory requirements for this notice. 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.

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 1991, approximately 20 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. Consistent and reliable techniques for nonexplosive structure removals are needed before a universal requirement is imposed by MMS.

c. Issues

(1) Issues Analyzed

Issues are defined by the Council of Environmental Quality (CEQ) to represent those principal "effects" that the EIS should evaluate in-depth. Scoping identifies specific environmental resources or activities, rather than "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 evaluate 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.

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

(2) Issues Considered But Not Analyzed

The following issues were raised during the scoping process but were 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 that 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.

Impacts to recreational fishing were considered for analysis, but it has been determined that they do not constitute an environmental issue that requires a continuing analysis in the EIS. These impacts have been analyzed in many previous EIS's for both the Central and Western Planning Areas. Prior EIS analyses have consistently determined the potential for adverse impacts to marine recreational fishing from OCS lease sales to be negligible. These analyses, supported by MMS study reports and information gathered through our Information Transfer Meetings, have determined that OCS leasing has a major positive impact on offshore fishing and no detectable impact on nearshore or inshore fishing. This is not considered an "issue" by Federal and State agencies responsible for fishery conservation and management within the affected area.

Two endangered species have been omitted from the analyses of the EIS. The endangered West Indian manatee is common in the Gulf of Mexico, but occurs with regularity only along the western coast and contiguous waters of Florida. Its presence along the coasts of Alabama, Mississippi, Louisiana, and Texas is rare enough to consider sightings as accidental occurrences within these areas. The U.S. Fish and Wildlife Service (FWS) and the MMS consider that there is little risk to manatees from the proposed actions, as impacts

from the proposed actions occur outside the manatee's accepted range. The eskimo curlew once existed in enormous numbers and annually migrated across the coastal plains of the Gulf of Mexico states. Today, its existence is questionable, and surveys are underway to determine whether the species is extinct. Therefore, the presence of this species within the proposed planning areas would be extremely rare, and the risk to the species from the proposed actions very slight, if at all. Prior FWS biological opinions for OCS activities in the Central and Western Planning Areas have indicated that these activities would not jeopardize the continued existence of the manatee or the eskimo curlew.

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 OCS 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 OCS 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 OCS; 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.

Under Section 20 of the Act, the Secretary shall ". . . conduct such additional studies to establish environmental information as he deems necessary and shall monitor the human, marine, and coastal environments of such area or region in a manner designed to provide time-series and data trend information which can be used for comparison with any previously collected data for the purpose of identifying any significant changes in the quality and productivity of such environments, for establishing trends in the area studied and monitored, and for designing experiments to identify the causes of such changes."

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 discussion 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 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 to the maximum extent practicable with each affected State's Coastal Zone Management (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 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 Department has developed a new comprehensive program for OCS Natural Gas and Oil Resource Management (1992-1997). In keeping with President Bush's June 26, 1990, statement, a new direction for the management of OCS natural gas and oil activities has been taken. The hallmarks of the 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 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. Section I.B.1. provides additional discussion of the AEDP.

The comprehensive program considered 11 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), were excluded from leasing consideration.

(2) Geological and Geophysical Exploration Regulations/Coordination

Geological and geophysical (G&G) surveys and activities provide most of the information and data used by government and industry to analyze and evaluate the resource potential and hazards of offshore areas. The G&G data collection begins prior to leasing and continues throughout the term of the lease.

Pursuant to 30 CFR 251.4, a permit must be obtained in order to conduct either geological or geophysical exploration for mineral resources, except by a lessee on a lease. A permit is required also for geological or geophysical scientific research; a notice is required for scientific research that involves shallow test drilling. A permit gives the permittee the right to conduct specified G&G exploration in accordance with appropriate statutes, regulations, and stipulations, and limits the permittee's activities to specified areas for a specified period of time of not more than one year. A notice is a statement of intent to conduct geological scientific research that involves shallow test drilling activities.

"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, in support of possible exploration and development activities, 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 seismic survey methods to produce information and data in support of possible exploration and development activities. "Geological or geophysical scientific research" means any investigation conducted on the OCS for scientific research purposes involving the gathering and analysis of G&G information and data, which will be made available to the public. Scientific research includes all operations involving the use of solid or liquid explosives and any drilling activities for scholarly or academic purposes.

Permit applications for G&G activities 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 applicable Letters to Permittees. The Letter to Permittees dated January 20, 1989, specifies forms and maps, stipulations, and special provisions applicable to most permit activity.

The 30 CFR 251 regulations do not apply to G&G activities conducted by, or on behalf of, a lessee on a leased block on the Gulf OCS. Such G&G activities on a lease are governed by 30 CFR 250 regulations and by applicable Letters to Lessees and Operators.

When required under a coastal zone management program approved under the Coastal Zone Management Act, proposed G&G permit activities must receive State concurrence prior to MMS permit approval and issuance (30 CFR 251.6-2(c)(1)). The Gulf Coast States are not involved in the review process for specific G&G permit applications, except for continental offshore stratigraphic tests (COST). A COST, or deep stratigraphic test well, by definition of 30 CFR 251.2, is penetration into the sea bottom of more than 15 m of consolidated rock or a total penetration of more than 91 m on unleased lands. Test drilling to depths less than these is considered shallow test drilling. In accordance with 30 CFR 251.6-2, a Drilling Plan and an Environmental Report must be submitted with a permit application to drill a COST well. Both the Drilling Plan and the Environmental Report are made available to appropriate Federal agencies and the public. Both deep and shallow test drilling must use the best and safest technology.

Upon receiving a complete G&G permit application, MMS prepares a Categorical Exclusion Review (CER), an Environmental Assessment (EA), or an EIS in accordance with NEPA and other applicable MMS policies and guidelines as described in Section I.B.3.d.(1)(a). Most G&G permits require a CER. An EA is automatically required for COST wells, for operations involving the use of solid or liquid explosives, or for other activities that have the potential to significantly affect the quality of the human environment. Additional environmental information may be required to be submitted for G&G applications proposing the use of explosives. The use of explosives may also require MMS to initiate consultation with the National Marine Fisheries Service under Section 7 of the Endangered Species Act.

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 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. A letter dated June 21, 1991, revises the requirements for certain seismic submittals and changes the geographic reference system to North American Datum (1983).

(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), National Marine Fisheries Service (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.(i)(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. An LTL dated November 4, 1991, advises that lessees may use the trajectory analysis

found in the most recent final EIS for the identification of spill impact zones for oil-spill information accompanying plans. Effective December 1, 1992, an OSCP will be required for all right-of-way pipelines (NTL 92-04 dated July 1, 1992). 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 Appendix E 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 for plans. A State CZM agency is required to ensure timely public notice of their receipt of each OCS plan that has been submitted to them for their CZM consistency determination [15 CFR 930.78(h) and 15 CFR 930.84(a)]. 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. The LTL dated January 31, 1989, is used by lessees and operators for blocks requiring photo-documentation surveys of live-bottom areas. Specific information is required for structure-removal applications as outlined in LTL's dated August 19 and December 9, 1986. Archaeological resource protection requirements are outlined in NTL 91-02 dated December 20, 1991, and in an additional letter dated

November 30, 1990). 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 (43 U.S.C. 1334(a)(8)) requires the Secretary of the Interior to promulgate and administer regulations that comply with the National Ambient Air Quality Standards (NAAQS) pursuant to the Clean Air Act (42 U.S.C. 7401 et seq.) and to the extent that authorized activities significantly affect the air quality of any State. Under provisions of the Clean Air Act Amendments of 1990, U.S. Environmental Protection Agency's (USEPA) 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 OCS areas of the Pacific, Atlantic, Arctic, and eastward of 87°30'W. longitude in the Gulf of Mexico. For OCS sources located within 25 mi of the States' seaward boundaries, the requirements are the same as the requirements that would be applicable if the source were located in the corresponding onshore area. For sources located beyond the 25 mi of the States' boundaries, the sources are subject to Federal requirements for Prevention of Significant Deterioration (PSD) promulgated pursuant to Part C of Title 1 of the Act. The new regulations also establish procedures to allow the USEPA's Administrator to exempt any OCS source from a control technology requirement if it is technically infeasible or poses unreasonable threat to health or safety. For sources located in areas under MMS jurisdiction regulations are promulgated by 30 CFR 250.44, 250.45, and 250.46 and are applicable to post-sale activities. The regulated pollutants include carbon monoxide, suspended particulates, sulphur dioxide, nitrogen oxides, total hydrocarbons, and volatile organic compounds. In areas where hydrogen sulfide may be present, operations are regulated by 30 CFR 250.67, as 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 Letter to Lessees dated October 12, 1988, outlines air emissions data that must be submitted by operators to MMS. 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 three years after the passage of the amendments in OCS areas not under USEPA jurisdiction. Based on the results of this study the Secretary must consult with the USEPA Administrator and determine if any further actions are necessary.

On August 17, 1992, the MMS issued NTL 92-06, with the purpose of establishing and clarifying 30 CFR 250.175 (relates to burning and flaring activities in the Gulf of Mexico). The NTL requires prior approval from the Regional Supervisor for unloading, cleaning, and testing operations that may exceed 48 cumulative hours in a single zone. It further minimizes the burning of liquid hydrocarbons and requires the recovery of as much crude oil and condensate as possible during testing operations in areas with no oil handling facilities and pipelines containing volumes of crude exceeding 50 bbl/day. A minimum volume of oil may be burned only during adverse weather conditions as to avoid the interruption of production during testing operations, not to exceed 48 cumulative hours. Prior approval may be obtained from the Regional Director for high volume/rate gas flaring (exceeding 0.28 million m³/day).

(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 shrimp 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 92-02 by the MMS, Gulf of Mexico Region on May 28, 1992. 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.(4).

(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 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 if the operator has agreed to certain requirements requested by the State.

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-Parte process applies to appeals to the Department of Commerce. The merits of an appeal cannot be discussed unless all parties are present (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 91, the Gulf of Mexico Region conducted 1,761 drilling inspections, 3,864 production inspections, 3,602 measurement inspections, and 147 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 (USDOL, 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 the event a no compliance is detected the inspector makes the appropriate enforcement action as dictated by the National PINC List.

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 after 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 muds and cuttings are being properly treated and/or disposed. Occasionally, the inspecting technician may require the operator to perform a "bucket test" by dumping a small amount of cuttings into a bucket of seawater as a test for residual oil to ensure that cuttings from water-based muds have been properly treated and will not cause a visible sheen when discharged offshore. This sheen is different than the "visible sheen" test required under the USEPA's National Pollution Discharge Elimination System (NPDES) general permit for the Gulf of Mexico.

District personnel inspect H₂S 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 H₂S 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. of the Final EIS for Sales 142 and 143 (USDOl, MMS, 1992b).

(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 24,000:1, 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; and the right of eminent domain exercised by pipeline companies. 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, since 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 4.6 m of water as measured 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 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 H₂S 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, as amended; 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. 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. Responsibility for implementing Section 311 is divided between USEPA and DOT by Executive Order 11735. In general, DOT is responsible for regulating 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.

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; and (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.

Operational Wastes Disposal and Storage Regulations

The disposal of oil and gas industry operational wastes are managed by USEPA through regulations established under three Federal Acts: the Resource Conservation and Recovery Act (RCRA), the Clean Water Act (also known as the FWPCA), and the Safe Drinking Water Act.

The RCRA, as amended (42 U.S.C. 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.

When injected underground, oil and gas operational wastes are generally regulated by USEPA's 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).

The FWPCA requires USEPA to establish national effluent limitation standards for wastewater discharges (Title III) and to develop requirements for Federal permits, called the National Pollutant Discharge Elimination System (NPDES) (Title IV). The USEPA Region 6 issued a new NPDES general permit for existing oil and gas operations in the Western Gulf of Mexico on November 19, 1992. Significant new requirements found in this permit include monitoring for toxicity, bioaccumulation, and naturally occurring radioactive material levels in produced water effluents and fish tissue, and restrictions on the levels of mercury and cadmium in the barite used in drilling fluids. On March 4, 1993, USEPA published the final effluent limitation guidelines and new source performance standards for the offshore oil industry subcategory (58 FR 41, pages 12453-12512). These regulations set new limits for contaminants in offshore oil and gas industry discharges. These new standards include decreases in the allowable limits of oil and grease in produced water and well treatment and completion fluids, the use of the static sheen test to determine free oil rather than by visual observation in most cases, and a prohibition on the discharge of produced sands. However, although implemented, these new standards have not gone into effect for Gulf of Mexico operations. Standards imposed on existing sources will not go in effect until the existing NPDES general permit, described above, is modified to incorporate these standards. This modification to the general NPDES permit, along with several other minor changes, was proposed in the *Federal Register* on August 4, 1993 (58 FR 41475). It is expected that a final NPDES permit for existing sources that incorporates the more stringent effluent limitation guidelines will be published in November 1993. In October 1993, USEPA's Region 6 published a proposed new source general permit for the Western Gulf of Mexico OCSA. The permit will provide the same requirements as the general permit for existing sources with very minor changes.

This permit does not cover the OCS area east of the Mississippi River nor does it cover any new sources. At this time, it is unknown what specific restrictions will be in the general permits covering new sources or the Eastern Gulf because these permits have not been proposed as of September 1993.

Section 404

Section 404 of the Federal Water Pollution Control Act (16 U.S.C. 1344) has had a substantial effect on development in areas adjacent to navigable waters. This section requires a Corps of Engineers permit for the discharge or deposition of dredged 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 dredging 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 of the effects of offshore air emissions on onshore air quality in nonattainment areas for O₃ 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 O₃-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 OCSLA, 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 Plastic Pollution Research and Control Act of 1987 (MPPRCA) implements Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL). 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 (33 CFR 151, 155, and 158), calling for adequate trash reception facilities at all ports, docks, marinas, and boat launching facilities. The Gulf of Mexico has received "Special Area" status under Annex V of MARPOL, thereby eliminating the disposal of all solid waste into the marine environment (the exception being ground up food wastes). This additional restrictive disposal protection will not come into full force until adequate reception facilities are available at foreign ports in the Gulf and Caribbean.

Final rules published under MPPRCA explicitly state 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 12 m or 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 8 m or more in length. Furthermore, the Shore Protection Act of 1988 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 (OPA), 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 OCSLA 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.

An Interagency Coordinating Committee on Oil Pollution Research was established by the provisions of the Act and tasked with submitting a plan for the implementation of an oil-pollution research, development, and demonstration program to Congress. This program addresses, 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 OCSLA 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.

Natural 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)(c)) 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 DOI 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 SARA. Finally, on September 22, 1989, the DOI announced that it intends to revise the type "A" natural resource damage assessment procedures in response to recent court rulings (54 FR 39013).

Section 1006(c) of the Oil Pollution Act of 1990 required NOAA to develop rulemakings concerning damage assessment and restoration for oil spills. The NOAA published five *Federal Register* Notices--55 FR 53478 (December 28, 1990), 56 FR 8307 (February 28, 1991), 57 FR 8964 (March 13, 1992), 57 FR 14524 (April 21, 1992), and 57 FR 23067 (June 1, 1992)--requesting information and comments on approaches to developing damage assessment procedures. On September 7, 1993, these rulemakings were passed.

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 to ensure that activities in the OCS under MMS jurisdiction do not 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 and NMFS make recommendations on the modification of oil and gas operations to minimize adverse impacts, although it remains the responsibility of MMS to ensure that proposed actions do not impact threatened and endangered species. The MMS has enacted the following recommendations:

- (1) require adequate oil spill contingency plans for all activities; and
- (2) solicit 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.) established a moratorium on the taking of marine mammals in waters under U.S. jurisdiction. The Act defines "take" to mean "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal."

Under the MMPA, the Secretary of Commerce is responsible for all cetaceans and pinnipeds, except walruses. The Secretary of the Interior is responsible for walruses, polar bears, sea otters, manatees, and dugongs. The Secretary of Commerce has delegated authority for implementing the Act to the National Marine Fisheries Service; the Secretary of the Interior has delegated authority to the Fish and Wildlife Service.

The Act established the Marine Mammal Commission and its Committee of Scientific Advisors on Marine Mammals. The Commission, in consultation with its Committee of Scientific Advisors, is responsible for overseeing and providing advice to the responsible regulatory agencies, including the Minerals Management Service, on all Federal actions bearing upon the conservation and protection of marine mammals.

The Marine Mammal Protection Act provides that the moratorium on taking may be waived when the affected species or population stock is within its optimum sustainable population range and will not be disadvantaged by the authorized taking--e.g., be reduced below its maximum net productivity level, the lower limit of the optimum sustainable population range. Section 101(a)(5) of the Act, as amended, directs that the Secretary, upon request by citizens of the United States, authorize the unintentional taking of small numbers of marine mammals incidental to activities (other than commercial fishing)--e.g., offshore oil and gas exploration and development--when, after notice and opportunity for public comment, the Secretary finds that the total of such taking during the 5-year (or less) period will have a negligible impact on the affected species or stock and prescribes regulations setting forth (1) permissible methods of taking and (2) requirements pertaining to the monitoring and reporting of such taking.

Section 101(a)(5) also specifies that the Secretary shall withdraw, or suspend for a time certain, permission to take marine mammals incidental to oil and gas and other activities if, after notice and opportunity for public comment, the Secretary finds (1) that the applicable regulations regarding methods of taking, monitoring, or reporting are not being complied with or (2) the taking is, or may be, having more than a negligible impact on the affected species or stock.

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 OCSLA (Section 20) states that the Secretary shall conduct studies subsequent to the leasing and development of any area or region in order 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 ongoing studies through Texas A&M University and NMFS on the distribution and abundance of marine mammals along the continental slope of 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.

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 waters and on the OCS in

the Gulf of Mexico 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 these wells and platforms are expected to be removed using explosives. Since 1986, MMS, the U.S. Army Corp of Engineers, and removal operators have been following strict NMFS recommendations in order to prevent adverse impacts to endangered marine turtles. These recommendations have also been followed to avoid the incidental taking of marine mammals. In their request for rulemaking, API stated that the most likely form of incidental take of dolphins 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 dolphins 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 dolphins 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 placing explosive charges below the level of the seafloor. In addition, a slow velocity explosive such as nitromethane 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; DeMarsh, written communication, 1993).

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 nautical miles. 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 1992 (Justen, 1992). 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 (Anon., 1992a). Responsibility for their management and conservation has been given to the appropriate FMC's through the NMFS.

As issues and potential problems from OCS development arise, MMS, NMFS, and the Gulf of Mexico Fishery Management Council (GMFMC) coordinate on all aspects of fishery management and conservation. For example, the GMFMC is concerned over declining stocks of reef fish in the Gulf and in 1991, expressed a need to critically examine sources of mortality on reef fish species. In June 1992, MMS and NMFS have formally entered into an Interagency Agreement (IA 17912) to study the comparative severity of the effect of explosive platform removals on targeted fish stocks in the Gulf of Mexico. During 1993 several test cruises were performed and one explosive platform removal was studied to acquire data toward completion of this study. This work was accomplished through coordinated efforts of both MMS and 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.

The Florida Keys 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 Flower Garden Banks National Marine Sanctuary was designated in December 1991 and became 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 aesthetic 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 Sanctuary was established 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 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. Sombbrero 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: The Flower Garden Banks were designated a marine sanctuary in December 1991 (56 FR 63634-63648). This site, located 177 km offshore, represents the northernmost coral reef community in the Western Gulf of Mexico. The borders of the sanctuary encompass a total of 114 km². 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 seems to 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, 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 Nature 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, 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 within the boundaries of the reserve.

Weeks Bay National Estuarine Research Reserve constitutes a small estuary of approximately 1,225 ha, comprising open shallow waters with an average depth of less than 1.5 m 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.

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 km² of very shallow water, averaging less than 3 m in depth. On the average, precipitation in the bay area watershed equals or exceeds what is lost through evaporation, and nearly 1.2 billion m³ 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 km² of estuarine marsh, 36 km² of forested wetlands, and 158 km² 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.). Title I of the 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. 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 (33 U.S.C. 401-687) 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 dredged material or refuse 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 OCSLA of 1953, as amended.

k. Coastal Barrier Resources Act of 1982

The Coastal Barrier Resources Act (CBRA) (16 U.S.C. 3501-3510) was the culmination of several years of study by the Congress and the DOI of the effects of Federal programs on coastal barriers. The Act established that undeveloped coastal barriers, as per the Act's definition, may be 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. This purpose was approached 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 administered 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 of Commerce is directed to pay for Federal administrative costs of the program and to fund special projects, emergency State assistance, and other discretionary coastal zone management activities. 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. The process for determining a State's priority needs are addressed in NOAA guidance

entitled "Section 309 Assessments and Strategies" issued on May 10, 1991. 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 Secretary now provides technical assistance and management-oriented research to support development and implementation of State CZM programs. Modifications to the National Estuarine Research Reserve System under Section 315 were made to increase Federal financial assistance.

The provisions also authorize the Secretary to make annual achievement awards to recognize individuals, local governments, and graduate students for outstanding accomplishments in the field of coastal zone management.

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. 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, 1991a). On July 14, 1992, the first phase of final rulemaking was published in the *Federal Register* (57 FR 31105) 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 \$112 million, have been awarded to support leasing and regulatory functions of the MMS within the Gulf of Mexico OCS Region.

The MMS Environmental Studies Program (ESP) is authorized by the OCSLA 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. Appendix I of this EIS provides a status of all Gulf of Mexico studies for fiscal years 1992, 1993, and 1994.

SECTION II

ALTERNATIVES INCLUDING THE PROPOSED ACTIONS

II. ALTERNATIVES INCLUDING THE PROPOSED ACTIONS

A. PROPOSED CENTRAL GULF SALE 147

1. Alternative A - The Proposed Action

a. Description

Proposed Central Gulf Sale 147 is scheduled to be held in March 1994 and will offer all unleased blocks (approximately 5,701 blocks) within the CPA. It is estimated that the proposal could result in the discovery and production of 0.12 BBO and 1.21 tcf of gas during the time period 1994-2028. No areas are excluded from the CPA. The alternatives to the proposed action 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 Sections IV.A. and B. The following are the estimates of major activities and associated impact-producing factors assumed for proposed Sale 147 (Base Case). These estimates and factors were used in the impact analyses.

- (1) During the exploration phase, 1995-2004, there will be 130 wells drilled, resulting in the following:
 - the discharge of 1.02 MMbbl of drilling mud and 0.35 MMbbl of drill cutting wastes offshore; an additional 0.26 MMbbl of drilling mud and drill cutting wastes from offshore operations will be disposed of onshore;
 - offshore air emissions from well drilling operations of 36 tons of total suspended particulate matter, 126 tons of total hydrocarbons, 147 tons of sulphur oxides, 335 tons of carbon monoxide, and 1,257 tons of nitric oxides;
 - 2,200 service-vessel trips and 6,700 helicopter trips;
 - disturbance from rig emplacements of 16 ha of ocean bottom; and
 - the likelihood of 1 blowout (Section IV.A.3.h.(1)).
- (2) During the development phase, 1996-2018, there will be 110 oil wells and 110 gas wells drilled, resulting in the following:
 - the discharge of 1.28 MMbbl of drilling mud and 0.358 MMbbl of drilling cutting wastes offshore; an additional 0.12 MMbbl of drilling mud and drill cutting wastes from offshore operations will be disposed of onshore;
 - offshore air emissions from well drilling operations of 144 tons of total suspended particulate matter, 151 tons of total hydrocarbons, 176 tons of sulphur oxides, 401 tons of carbon monoxide, and 1,504 tons of nitric oxides;

- 3,300 service-vessel trips and 15,000 helicopter trips; and
 - the disturbance from fixed structure emplacements of 61 ha of ocean bottom.
- (3) During the production phase, 1996-2027, 0.12 BBO of oil and 1.21 tcf of gas will be produced from 20 platform complexes, resulting in the following:
- the open-water discharge of 243 MMbbl of produced water;
 - the onshore disposal of 26 MMbbl of produced waters and 60,000 bbl of produced sands that were generated offshore;
 - air emissions of 84 tons of total suspended particulate matter, 12,968 tons of total hydrocarbons, 60 tons of sulphur oxides, 4,457 tons of carbon monoxide, and 34,214 tons of nitric oxides;
 - 2,800 service-vessel trips and 242,000 helicopter trips;
 - the removal of 42 ha of commercial fishing area (peak year estimate); and
 - the likelihood of 1 blowout (Section IV.A.3.h.(1)).
- (4) Eight platforms will be removed using explosives. The remaining platforms will be removed by nonexplosive methods.
- (5) The transportation of gas and oil will require the following:
- the construction of 275 km of trunk and gathering pipelines that will connect with existing trunklines prior to landfall, resulting in the disturbance of 88 ha of bottom and the displacement of 523,000 m³ of sediment; and
 - 197 barge trips carrying oil to 8 existing shore terminals along the Texas and Louisiana coasts.
- (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 using 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 1 deepened to support vessel traffic;
 - 5.9 million liters of bilge water will be discharged in coastal waters from service vessels traveling to 28 existing bases;
 - 149,600 helicopter coastal crossings to reach 27 helicopter hubs; and
 - air emissions from service vessels, helicopters, tugboats and shuttle tankers and oil offloading from vessels of 355 tons of total suspended particulate matter, 557 tons of total hydrocarbons, 99 tons of sulphur oxides, 831 tons of carbon monoxide, and 4,819 tons of nitric oxides.

- (7) Eighteen Size 1 crude oil spills, one Size 2 spill, and one size 3 spill are assumed to occur from offshore support activities. The Size 3 spill is projected to be 6,500 bbl and has a 2 percent chance of land contact.
- (8) Eleven Size 1 crude oil and oil-product spills and two Size 2 spills 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 147 is 28,737 person-years, 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 II-2 compares the impacts of Alternatives A-C and the cumulative impacts on each resource category estimated as a result of the various scenarios.

The impact analysis for the proposed action assumes compliance with the Topographic Features Stipulation, the Live Bottom (Pinnacle Trend) Stipulation, the Archaeological Resources Stipulation, and the Military Areas Stipulation. However, because no Secretarial decision to require these stipulations has been made, the impacts of the Base Case without these stipulations is discussed in the mitigating measures section which follows. For a more detailed discussion of the impacts of the Base Case without the Topographic Features Stipulation and the Live Bottom (Pinnacle Trend) Stipulation, see Sections IV.D.1.a.(2)(a) and (c).

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 (LA-1, LA-2, LA-3, and MA-1). These subareas are delineated on Figure IV-1.

Sensitive Coastal Environments

Coastal Barrier Beaches and Associated Dunes (Section IV.D.1.a.(1)(a))

No oil spills are expected to contact a barrier beach. Should an unforeseen contact occur, it is expected that resulting oiling will be very light.

Onshore and nearshore construction of new infrastructure as a result of the proposed action are not expected to occur; hence, no impacts are expected.

Some maintenance dredging is expected to occur, but it has not been shown to have an appreciable negative impact on barrier beaches. The need for dredging cannot be attributed to the small percentage of vessel traffic in OCS-related channels.

Deepening of the channel to Port Fourchon is yet undescribed but is not expected to cause any additional or accelerated adverse impact on nearby barrier features. Strategic placement of dredged material from this project and subsequent maintenance dredging is expected to benefit barrier beaches of the CPA.

Conclusion

The proposed action is expected to result in alteration of barrier beach configurations in localized areas downdrift from navigation channels that are jettied and maintained or deepened. Strategic placement of dredged material resulting from these actions can mitigate adverse impacts upon those localized areas.

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

Only spills from pipeline and navigational accidents are expected to result in high-enough concentrations of oil contacting wetlands to result in impacts. Several onshore barge and pipeline accidents are assumed to occur, impacting approximately 68 ha of wetlands over the course of 35 years. For 4 and 10 years after each spill, 25 and 35 ha will cumulatively recover, respectively. Cumulatively, 8 ha of wetlands will be converted to open water. Few seagrass beds, if any, will be contacted by low concentrations of oil from these spills. No significant impacts to seagrass beds are expected.

As a secondary impact of OCS-related pipeline canals attributable to the proposed action, 61 ha of wetlands are estimated to be lost over 35 years.

Deepening the Port Fourchon channel to accommodate deeper draft vessels is expected to occur within a saline marsh environment and affords the opportunity for the creation of 6 ha of wetlands.

No appreciable adverse impacts from maintenance dredging are expected. Alternative dredged material disposal methods can be used to enhance coastal wetlands.

Erosion of wetlands from OCS vessel wakes is expected to result in up to 18 ha of wetlands loss during the 35-year life of the proposed action.

Conclusion

The proposed action is expected to result in loss of up to 87 ha of wetlands, suppressed productivity of up to 25 ha of wetlands for 4 years and 35 ha of wetlands for 10 years, and a gain of up to 6 ha due to beneficial use of dredged material.

Sensitive Offshore Resources

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

Activities resulting from the proposed action are expected to have only minor adverse impacts on the pinnacle trend environment, since these activities would be constrained by the implementation of the Live Bottom (Pinnacle Trend) Stipulation. See Section IV.D.1.a.(2)(a) for a discussion of the impacts of the proposed action without the Live Bottom (Pinnacle Trend) Stipulation. The impact to the pinnacle trend area as a whole is expected to be negligible because no community-wide impacts are expected. The inclusion of the Live Bottom (Pinnacle Trend) Stipulation would preclude the occurrence of the most potentially damaging of these activities. Any interactions are judged to be infrequent because of the limited operations in the vicinity of the pinnacles, the wide-spread nature of the pinnacle features, and the small size of many of the features. Potential impact from blowouts, pipeline emplacement, muds and cuttings discharges, discharges of produced waters and domestic and sanitary wastes, and structure removals would be negligible because of the effectiveness of the proposed Live Bottom (Pinnacle Trend) Stipulation. Potential impacts from oil spills would be unlikely due to the depth of the features, currents in the area, and the low levels of pipeline activities in the area. 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 proposed action on the pinnacle trend region is expected to be such that any changes in the regional physical integrity, species diversity, or biological productivity of the pinnacle features 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. Seafloor disturbance is considered to be a threat only to the high-density (Bush Hill-type) communities; the widely distributed low-density communities would be at a lower 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 as a result of physical disturbances is expected to take less than 2 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 impacts related to operational discharges would be on the order of 2-4 weeks. See Section IV.D.1.a.(2)(c) for a discussion of the impacts of the proposed action without the Topographic Features Stipulation.

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 on the order of 2-4 weeks.

Oil spills (there is an estimated 6% chance a Size 3 oil spill 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. Small localized areas would be impacted by operational discharges (i.e., muds and cuttings), and recovery 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

Expected future water quality degradation associated with discharges and chronic spills from the use of onshore infrastructure supporting Sale 147 operations will be very minor, but will be widespread and continuous, especially in the Mississippi Deltaic area of Louisiana where support facilities are concentrated. Onshore disposal and storage of offshore operational wastes will only result in some minor localized degradation around a few temporary storage sites in Louisiana. There will be minor, localized, long-term changes in water quality characteristics from current levels in the confined portions of 18 channels due to vessel traffic. These vessel operations will cause bank erosion and contribute to bilge and sanitary wastes discharges. Thirty-seven maintenance and deepening dredging operations will result in localized impacts (primarily elevated water-column turbidities) during the duration (up to several months). Low-level, petroleum hydrocarbon contamination of coastal waters will occur from onshore spills associated with Sale 147 operations and will affect localized, confined areas for up to 6 months in 11 locations along the Louisiana coast, up to 6 weeks in

26 locations along the Louisiana coast, and will persist up to 5 years in 2 locations along the coast affecting 54 ha of marsh waters.

Conclusion

The proposed action will result in minor, long-term changes in water quality within, or in the vicinity of, navigation channels and support complexes. These changes will not preclude current uses of the waters affected. The proposed action will also result in localized, short-term changes in water quality during dredging operations and from the majority of spill occurrences, which will alter uses of the affected waters for up to 6 months. Two spills could affect water quality for up to 5 years for 45 ha of Louisiana marsh.

Marine Waters

Sediment disturbance from the emplacement of 20 platforms and 515 km of pipeline and from the drilling of 350 wells over a 35-year period will result in minor, localized, temporary impacts on water quality. The drilling of the wells, construction of the platforms, and laying of the pipe will result in increased water-column turbidities in offshore waters. Such bottom disturbance of sediments will result in resuspension of any settled pollutants, such as trace metals, chlorinated hydrocarbons, and excess nutrients, that may have accumulated in the sediments. The resuspension of significant quantities of contaminants from bottom-disturbance operations is not expected to occur due to a lack of contaminants in deep-water sediments and the infrequency of the operations. Given the low frequency of platform removals (maximum is three in the peak year), minimum impacts on water quality due to resuspension of sediments, especially resulting from explosive removals, are expected from these operations.

One 6,500-bbl oil spill, one Size 2 oil spill, and 18 Size 1 spills are projected. Given the infrequent nature of these spills, especially the larger sizes, impacts on offshore water quality from oil-spill events related to Sale 147 are projected to be negligible, to be of short-duration (2-3 months), and to only affect a small area of offshore waters at any one time.

The area around each of the 20 projected platforms can be contaminated from the discharge of 36,000 bbl of drilling muds and cuttings at each site. These discharges may be released continuously for about a year and a half (assuming 3 exploratory wells and 9 development wells were drilled at one site), and then other quantities discharged intermittently when old wells become depleted and new wells are drilled. These discharges of drilling wastes will affect an area several thousand meters downcurrent from the discharge point. Sediment contamination can be expected up to 3 km from the discharge point in the primary direction of the current and will last up to 1 year after drilling ceases. Benthic marine organisms will be affected out to 1,000 m. Water quality criteria are expected to be exceeded within 100 m from the discharge. Moderate petroleum and metal contamination of sediments and water column from the discharge of 243 MMbbl of produced water at 10 platforms will occur out to several hundred meters from the discharge point and will have small-scale, localized effects on benthic organisms out to 200 or 500 m. If, for analytical purposes, an assumption is made that the regional, long-term contamination of Gulf waters and sediments by the OCS industry makes up 50 percent of the total water quality degradation that occurs, then discharges from Sale 147 operations would contribute a little more than 1 percent of the Gulf water quality cumulative contamination (Section IV.D.1.d.).

Conclusion

As a result of the proposed action, marine waters will be degraded from discharges, oil spills, and bottom disturbances. Bottom disturbances (platform and pipeline emplacements and removals) and oil spills are expected to result in minor, localized, temporary impacts to water quality. Changes in water quality parameters will return to background within months from the disturbance. Operational discharges are primarily muds and cuttings and produced waters. Drilling muds and cuttings, which are discharged intermittently throughout the life of a platform, are expected to contaminate a localized area around platforms out to 3,000 m for up to 1 year after drilling ceases. Production wastes, which are discharged continuously throughout the life of most of the platforms, will change some water quality and sediment parameters within several hundred meters

downcurrent from the discharge point for an average of 20 years. These discharges will also contribute, to a very small extent, to the long-term, regional contamination of Gulf waters and sediments.

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

Onshore impact on air quality from emissions from the OCS activities are estimated to be negligible 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 that could increase impacts. 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 frequency of onshore winds decreases and the removal of pollutants by rain increases.

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 $1 \mu\text{gm}^{-3}$ (box model steady concentrations). The impacts decrease during winter because onshore winds occur only about 37 percent of the time and increase in summer because onshore winds occur 61 percent of the time.

Marine Mammals

Nonendangered and Nonthreatened Species (Section IV.D.1.a.(5)(a))

Activities resulting from the proposed action have a potential to affect nonendangered and nonthreatened marine mammals detrimentally. These marine mammals could be impacted by degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, and discarded trash and debris from service vessels and OCS structures. The effects of the majority of these activities are expected to be sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris). Lethal effects are estimated from the chance collisions with OCS service vessels, ingestion of plastic materials, and Size 3 oil spills. Sale-related oil spills of any size are expected to seldom contact nonendangered and nonthreatened marine mammals.

Conclusion

The impact of the proposed action on nonendangered and nonthreatened marine mammals is expected to result in sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that are both chronic and sporadic. These impacts could cause acute or chronic physiological stress, alter normal behavior, and result in some degree of avoidance, either temporary or permanent, of the impacted area(s).

Endangered and Threatened Species (Section IV.D.1.a.(5)(b))

Activities resulting from the proposed action have a potential to affect endangered and threatened marine mammals detrimentally. These marine mammals could be impacted by degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, and discarded trash and debris from service vessels and OCS structures. The effects of the majority of these activities are expected to be sublethal. Lethal effects are estimated from the chance collisions with OCS service vessels, ingestion of plastic materials,

and Size 3 oil spills. Sale-related oil spills of any size are expected to seldom contact endangered and threatened marine mammals.

Conclusion

The impact of the proposed action on endangered and threatened marine mammals is expected to result in primarily sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that are both chronic and sporadic. These impacts could cause acute or chronic physiological stress, alter normal behavior, and result in some degree of avoidance, either temporary or permanent, of the impacted area(s). Lethal impacts are expected to be rare for all marine mammals, with the most likely impacts resulting from vessel collisions to lethargic surfaced individual animals. The unexpected and unintentional removal of individuals of any species is considered an incidental take. Such removals have not been documented in the Gulf. Recovery times will vary with species size, gestation period, and rates of reproductive activity. These will vary from two to several (less than ten) years.

Alabama, Choctawhatchee, and Perdido Key Beach Mice (Section IV.D.1.a.(6))

While activities resulting from the proposed action have a potential to cause detrimental effects on Alabama, Choctawhatchee, and Perdido Key beach mice, the likelihood of impacts is low. Beach mice could be impacted by beach debris, coastal habitat degradation, 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.

Conclusion

The proposed action is not expected to harm the Alabama, Choctawhatchee, and Perdido Key beach mice or their habitats unless a Size 3 spill would occur in conjunction with a strong storm surge. Since this probability is estimated to be less than 0.5 percent, no contact of beach mice or their habitats by oil is expected.

Marine Turtles (Section IV.D.1.a.(7))

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, blowouts, water quality and habitat degradation, 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. Sale-related oil spills are expected to rarely contact marine turtles.

Conclusion

The proposed action is expected to temporarily disturb some marine turtles and their habitats, but deaths are expected to be rare. All disturbances are expected to be temporary, and marine turtles are expected to recover within a period of weeks to months.

Coastal and Marine Birds

Nonendangered and Nonthreatened Species (Section IV.D.1.a.(8)(a))

Activities resulting from the proposed action will affect coastal and marine birds within the CPA. These species may be impacted by oil spills and oil-spill response activities, degradation of water quality in coastal areas, helicopter and service-vessel traffic and noise, habitat loss and degradation resulting from pipeline landfalls and coastal facility construction, and discarded offshore oil- and gas-related plastic debris. It is estimated that the majority of effects from major impact-producing factors on coastal and marine birds are sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded

debris), causing periodic disturbances with some displacement of localized groups and/or individuals. Lethal effects stem primarily from uncontained onshore oil spills and oil-spill response activities, with an associated loss of adults and/or nests within affected areas. These events are expected to be rare and will cause no discernible decline in local or regional populations or species.

Conclusion

Nonendangered and nonthreatened coastal and marine birds may encounter periodic disturbance and temporary displacement of localized groups and individuals from proposed activities. Decreases in numbers of adults and/or nests could occur as a result of oil spills and spill-related coastal habitat loss or degradation. Groups experiencing the loss of individuals would require up to several years to recover to a pre-disturbance condition, depending on the species and existing conditions.

Endangered and Threatened Species (Section IV.D.1.a.(8)(b))

The brown pelican, Arctic peregrine falcon, bald eagle, piping plover, and least tern may be impacted by oil spills and oil-spill response activities, degradation of water quality in coastal areas, helicopter and service-vessel traffic and noise, habitat loss and degradation resulting from pipeline landfalls and coastal facility construction, and discarded offshore oil- and gas-related plastic debris. It is estimated that the majority of effects from major impact-producing factors on coastal and marine birds are sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris), causing periodic disturbances with some displacement of localized groups and/or individuals. Lethal effects stem primarily from uncontained onshore oil spills and oil-spill response activities, with an associated loss of adults and/or nests (for some species) within affected areas. These events are expected to be rare and will cause no discernable decline in local or regional populations or species.

Conclusion

Endangered and threatened birds may encounter periodic displacement of individuals and/or localized groups from proposed activities. Decreases in numbers of adults and/or nests could occur as a result of OCS-related oil spills and spill-related coastal habitat loss. The loss of individuals represents a serious loss to the regional population(s) restoration of numbers to a pre-disturbance state would require up to several years, depending on the species and existing conditions.

Gulf Sturgeon (Section IV.D.1.a.(9))

The Gulf sturgeon can be impacted by oil spills resulting from the proposed action. However, spill-related oil spills of any size will rarely contact Gulf sturgeon.

Conclusion

The impact of the proposed action on the Gulf sturgeon could cause nonfatal irritation of gill epithelium and an increase of liver function in a few adults for less than a month.

Commercial Fisheries (Section IV.D.1.a.(10))

Activities resulting from the proposed action have the potential to cause detrimental effects to Central Gulf commercial fisheries. Effects come from coastal environmental degradation, emplacement of production platforms, underwater OCS obstructions, production platform removals, seismic surveys, oil spills, subsurface blowouts, pipeline trenching, and offshore discharges of drilling muds, produced waters, and naturally occurring radioactive material (NORM). It is expected that the effects from the major impact-producing factors on commercial fisheries in the CPA will be inconsequential and rare. At the expected level of effect, the resultant

influence on Central Gulf fisheries is negligible and will be indistinguishable from natural population variations. As a result, there will be little discernible disturbance to Gulf commercial fisheries.

Conclusion

The proposed action is expected to result in less than a 1 percent decrease in commercial fishery populations, in essential habitat, or in commercial fishing. It will require less than 6 months for fishing activity and one generation for fishery resources to recover from 99 percent of the impacts.

Recreational Resources and Beach Use (Section IV.D.1.a.(11))

A few Size 1 oil spills are likely to affect portions of coastal beaches, with little disruption of recreational activities. Marine debris will be lost from time to time from OCS operations associated with drilling 350 new wells and producing oil and gas from 20 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 or Mississippi could impact the natural seascape viewed from some wilderness beaches in coastal Subarea LA-3. Helicopter and vessel traffic will add periodic offsite noise pollution affecting wilderness beach users.

Conclusion

The proposed action is expected to result in pollution events and nearshore operations that may adversely affect the enjoyment of some beach users on Louisiana and Mississippi beaches. However, there will be little to no effect on the number of beach users.

Archaeological Resources

Historic (Section IV.D.1.a.(12)(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 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 not expected to impact 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. There is a small chance of contact from an oil spill associated with the proposed action. 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. Maintenance dredging of navigation channels may result in impact to an historic shipwreck; however, the percentage of OCS use of these channels under the proposed action is less than 2.2 percent.

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 low probability of an interaction between OCS oil and gas activities and an historic shipwreck or site. Should such an impact occur, unique or significant historic archaeological information could be lost.

Prehistoric (Section IV.D.1.a.(12)(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 would 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 proposed action.

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 Size 3 spill (one 6,500-bbl spill is assumed) occurring and contacting a coastal prehistoric site within 10 days is 2 percent. It is assumed that no contact would occur. Onshore oil spills that occur during the proposed life of the lease sale have a very small probability of contacting a prehistoric site. Should such contact occur, C-14 dating of organic materials could be affected.

Conclusion

There is a very low probability of an OCS activity contacting a prehistoric site. Should such an impact occur, there would be damage or loss of significant or unique prehistoric archaeological information.

Socioeconomic Conditions

Population, Labor, and Employment (Section IV.D.1.a.(13)(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 impact of the proposed action 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.(13)(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. Population impacts are not expected to exceed the peak-year impact of 0.14 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 will not result in disruptions to community infrastructure and public services beyond what is anticipated by in-place planning and development agencies.

Sociocultural Issues (Section IV.D.1.a.(13)(c))

The employment projected to occur in association with the proposed action is expected to be filled by persons already engaged in OCS oil- and gas-related employment, unemployed persons living in the area, and underemployed persons living in the area. Inasmuch as jobs will be provided for persons living in the coastal subareas, some positive impact is expected. Given the present amount of OCS-related jobs in the coastal subareas, the proposed action is not expected to result in workforce fluctuations. None of the coastal subareas are projected to experience population impacts greater than 0.14 percent as a result of the proposed action. It is assumed that employment as a result of the proposed action will decrease the amount of out-migration compared to that which would occur without the proposed action. Social and cultural problems typically associated with in-migration and out-migration are not expected to occur as a result of the proposed action. The relatively small amount of employment associated with the proposed action, in comparison with the total employment in the affected Western and Central Gulf coastal subareas, is not expected to result in deleterious impacts to small businesses. The projected amount of wetlands loss is not sufficient to effect the practice of traditional occupations in the CPA, given the total amount of coastal marsh available for exploitation. Based on the low probability of an offshore spill occurring and contacting land, the assumption is that no significant employment requirements will result from the clean-up of offshore spills. Employment requirements for cleanup of onshore spills is expected to be minimal. It is expected that in a small number of cases, successful adaptation of the family to the extended work schedule will not occur. In these cases, some deleterious impacts to family are expected.

Conclusion

Sociocultural impacts associated with the proposed action are expected to be minimal, with some deleterious impacts to family life in a small number of cases resulting from the extended work schedule.

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. The stipulations are being analyzed as part of the proposed action and considered for adoption

by the Secretary. The Secretary will make a decision prior to Sale 147 on whether or not to apply these measures to appropriate leases resulting from the sale. The analysis 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:

<u>Bank Name</u>	<u>Isobath (meters)</u>	<u>Bank Name</u>	<u>Isobath (meters)</u>
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
Aldrice Bank	80	MacNeil Bank ³	82

¹Only paragraph (a) of the stipulation applies.

²Only paragraphs (a) and (b) apply.

³Western 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 10 m, 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 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 DOI 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 (USDOl, 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 and destruction of the benthic environment and are the most likely activities to cause permanent or long-lasting impacts to sensitive offshore habitats. Operational discharges (drilling muds and cuttings, produced waters) may impact the biota of the banks due to turbidity, sedimentation, and toxicity of the discharges, resulting in death to benthic organisms in large areas. Blowouts may similarly cause damage to benthic biota by resuspending sediments, causing turbidity and sedimentation, and discharging oil, resulting in death to benthic organisms. Fortunately, blowouts seldom occur in the Gulf. 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. The above activities resulting from this proposal, especially bottom-disturbing activities, have a potential for causing severe impacts to the biota of the topographic features. Recovery from impacts depends upon the particular biological community and the extent of area damaged. Some impacts would take many years for restoration to predisturbed conditions. 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 severe 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 have demonstrated that the shunting requirements of the stipulation 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 (portions of 70 lease blocks) 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 (Pinnacle Trend) 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 rock 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 using 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 by oil and gas activities resulting from the proposed action if such activities took place on or near these communities without the Live Bottom (Pinnacle Trend) Stipulation. The USDOJ 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.

Activities resulting from the proposed action, particularly anchor damage to localized pinnacle areas, are expected to have caused substantial damage to 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 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. Minor impact is expected from large oil spills, blowouts, pipeline emplacement, muds and cuttings discharges, and structure removals. 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 (Pinnacle Trend) Stipulation, is expected to have an adverse impact on the pinnacle region, but such impact is expected to be of a localized nature. Impact from mechanical damage including anchors could potentially be long term if the physical integrity of the pinnacles themselves became altered.

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 require 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.

Archaeological Resource Stipulation

- (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 could 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 could 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 OSLA, 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 (USDOl, 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 an 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. Figure 11-1 shows the military warning areas located in the Central and Western Gulf of Mexico. The military has recommended using the stipulation on all leasing operations within their warning areas. The stipulation reads as follows:

Military Areas Stipulation

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 11-1.

Figure II-1. Military Warning Areas Within the Central and Western Gulf of Mexico Planning Areas.

Table 11-1

Military Contacts
(updated 6/23/93)

Central Gulf of Mexico

Warning Areas

W-155A and W-155B
(for operational control)

W-155A and W-155B
(for agreement)

W-92

W-453

Eglin Water Test Areas 1-5

Command Headquarters

Fleet Area Control & Surveillance
Facility (FACSFAC)
Naval Air Station
Pensacola, Florida 32508
Telephone: (904) 452-2735/4671

Chief, Naval Air Training
Naval Air Station
Corpus Christi, Texas 78419-5100
Telephone: (512) 939-3862/3902

Naval Air Station
Air Operations Department
Air Traffic Division/Code 52
New Orleans, Louisiana 70146-5000
Telephone: (504) 393-3100/3101

Air National Guard
CRTC
Gulfport ACMI
Gulfport, Mississippi 39507
Telephone: (601) 867-2433

Air Force Development Test Center
XRI
Eglin AFB, Florida 32542
Telephone: (904) 882-3899/9757

Western Gulf of Mexico

Warning Areas

W-228

W-602

Command Headquarters

Chief, Naval Air Training
Naval Air Station
Corpus Christi, Texas 78419-5100
Telephone: (512) 939-3862/3902

Headquarters ACC/DOSR
Detachment 1
Operations Headquarters
U.S. Strategic Air Command
Offutt AFB, Nebraska 68113-5550
Telephone: (402) 294-2334

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.

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 using 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 and save 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.

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

Alternative B 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)).

a. Description

This alternative would offer 5,630 unleased blocks in the Central Gulf Planning Area. This alternative is equivalent to offering the proposal, except for 71 unleased blocks (Figures II-2 and II-3) 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 1.3 percent of the 5,630 blocks to be offered in the Central Gulf. It is estimated that the proposal could result in the discovery and production of 0.12 BBO and 1.21 tcf of gas during the time period 1994-2028. There are no areas excluded 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 Sections IV.A. and B. Estimates of the major activities and associated impact-producing factors assumed for proposed Sale 147 (Base Case) are shown in Section II.A.1.a. It is assumed that activity levels estimated for Alternative B will be the same as those estimated for the proposed action.

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 II-2 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 adjacent coastal region is divided into four coastal subareas (LA-1, LA-2, LA-3, and MA-1). 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.

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

Given the size of the area available for lease under Alternative A, it is reasonable to assume that the removal of 1.3 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 the proposed action indicates that the impacts expected to result will be very similar to those described under the proposed action (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 the proposed action. 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 that would be deleted, with one exception, are located over 115 km from shore (Sackett Bank with a 2 1/4 block deletion area is located about 30 km from the mouth of the Mississippi River). Considering the assumption that the estimated level of activity will not change from that projected for the proposed action 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 the proposed action.

Conclusion

The impacts on the following coastal resources are estimated to be the same as those estimated under the proposed action: coastal barriers; wetlands; coastal and nearshore water quality; air quality; Gulf sturgeon; Alabama, Choctawhatchee, and Perdido Key beach mice; coastal and marine birds and marine turtles (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 71 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 the proposed action. Commercial fisheries and recreational marine fishing would also remain as under the proposed action.

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 96 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 the proposed action (Section II.A.1.c.(1)), the impact to the topographic features will be essentially the same for both the proposed action 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 would be impacted by operational discharges (i.e., muds and cuttings), and recovery 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 (71 of 167) affected by the proposed Topographic Features Stipulation.

Marine Mammals and Marine Turtles

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 85 m, which is near the lower limit of the benthic feeding habitat for these species. However, the pelagic stages of all marine 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 the proposed action. The impact on marine mammals is expected to result in primarily sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that are both chronic and sporadic. These impacts could cause acute or chronic physiological stress, alter normal behavior, and result in some degree of avoidance, either temporary or permanent, of the impacted area(s). Marine turtles and their habitats are expected to experience some temporary disturbance, but deaths are expected to be rare.

3. Alternative C - No Action

a. Description

Alternative C 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 0.12 BBO and 1.21 tcf of gas that could have resulted from proposed Sale 147 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.

Strategies that could provide replacement resources for lost domestic OCS oil and gas production include a combination of energy conservation; onshore domestic oil and gas supplies; alternative energy sources; 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.

Market forces are assumed to be the predominant factor in determining substitutes for OCS oil and gas. Based on this, increased imports of foreign oil are assumed to be the largest replacement source. Much of this imported oil would enter the United States through the Gulf of Mexico, thus increasing the risks due to tanker spills. This is thoroughly analyzed in the Final EIS for the OCS Comprehensive Program (1992-1997).

4. Comparison of Alternatives

The following table (Table II-2) provides an impact comparison and summary for the Base and High Cases 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 147.

Table II-2

Comparison and Summary of Impacts for Alternatives A-C
and Cumulative in the Central Planning Area (Sale 147)

Alternatives	Resource Categories		
	Coastal Barrier Beaches and Associated Dunes	Wetlands	Live Bottom (Pinnacle Trend)
Alternative A (Base Case)	The proposed action is expected to result in alteration of barrier beach configurations in localized areas down-drift from navigation channels that are jettied and maintained or deepened. Strategic placement of dredged material resulting from these actions can mitigate adverse impacts upon those localized areas.	The proposed action is expected to result in the loss of up to 87 ha, suppressed productivity of up to 25 ha for 4 years and 35 ha for 10 years, and a gain of up to 6 ha due to the beneficial use of dredged material.	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 features 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 High Case is expected to result in the loss of up to 175 ha, suppressed productivity of up to 62 ha for 4 years and 87 ha for 10 years, and a gain of up to 12 ha due to the beneficial use of dredged material.	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	Alternative C would preclude all adverse impacts from OCS activities associated with the proposal. However, it would not preclude OCS impacts discussed under the Cumulative Scenario, which are not attributable to the proposal. In addition, increased foreign oil imports could increase the risks of tanker spills and associated impacts to the marine and coastal waters of the Gulf of Mexico.	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes.	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes.
Cumulative Impacts	Coastal barrier beaches have received severe cumulative adverse impacts from both natural processes and human activities. Although natural processes are considered to be the major contributor to these impacts, human activities significantly accelerate coastal barrier deterioration. Human activities that have caused the greatest adverse impacts are pipelines and channel jetties. Deterioration of barrier beaches is expected to continue in the future.	Cumulative impacts to wetlands are primarily due to subsidence, channelization, and levees. Cumulative impacts are expected to result in the loss of up to 35,300 ha, suppressed productivity for 2 to 10 years of up to 21,000 ha, and a gain of up to 192 ha due to beneficial use of dredged material.	The cumulative impacts are expected to be such that 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 II-2. Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Central Planning Area (Sale 147) (continued)

Alternatives	Resource Categories			
	Deep-water Benthic Communities	Topographic Features	Water Quality	
			Coastal and Estuarine Waters	Marine Waters
Alternative A (Base Case)	<p>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 as a result of physical disturbances is expected to take less than 2 years.</p>	<p>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 localized areas would be impacted by operational discharges (i.e., muds and cuttings), 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.</p>	<p>The proposed action will result in minor, localized, long-term changes in water quality within, or in the vicinity of navigation channels and support complexes. These changes will not preclude current uses of the waters affected. The proposed action will also result in localized short-term changes in water quality during dredging operations or from spill occurrences, which will alter uses of the affected waters for up to 6 months, or up to 5 years in two locations in Louisiana.</p>	<p>As a result of the proposed action (Base Case), marine waters of the Gulf of Mexico will be degraded from discharges, oil spills, and bottom disturbances. Bottom disturbances (platform and pipeline emplacements and removals) and oil spills are expected to result in minor, localized, temporary impacts to water quality. Changes in water quality parameters will return to background within 6 months from the disturbance. Operational discharges are primarily muds and cuttings and produced waters. Drilling muds and cuttings, discharged intermittently throughout the life of a platform, are expected to contaminate a localized area around platforms (out to 3,000 m). Production wastes, discharged continuously throughout the life of most of the platforms, will change some water quality and sediment parameters within several hundred meters downcurrent from the discharge point for an average of 20 years. These discharges will also contribute, to a very small extent, to the long-term, regional contamination of Gulf waters and sediments.</p>

Table II-2. Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Central Planning Area (Sale 147) (continued)

Alternatives	Resource Categories			Water Quality
	Deep-water Benthic Communities	Topographic Features	Coastal and Estuarine Waters	
Alternative A (High Case)	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	<p>As a result of the High Case, marine waters of the Gulf of Mexico will be degraded from discharges, oil spills, and bottom disturbances. Bottom disturbances (platform and pipeline emplacements and removals) and oil spills are expected to result in minor, localized, temporary impacts to water quality. Changes in water quality parameters will return to background within 6 months from the disturbance. Operational discharges are primarily muds and cuttings and produced waters. Drilling muds and cuttings, discharged intermittently throughout the life of a platform, are expected to contaminate a localized area around platforms out to 3,000 m for 1 year after drilling ceases. Production wastes, discharged continuously throughout the life of most of the platforms, will change some water quality and sediment parameters within several hundred meters downcurrent from the discharge point for an average of 20 years. These discharges will also contribute, to a very small extent, to the long-term, regional contamination of Gulf waters and sediments.</p>

Table II-2. Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Central Planning Area (Sale 147) (continued)

Alternatives		Resource Categories		
	Deep-water Benthic Communities	Topographic Features	Water Quality	
			Coastal and Estuarine Waters	Marine Waters
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 localized areas would be impacted by operational discharges (i.e., muds and cuttings), 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.	Same as Alternative A - Base Case.
Alternative C ²	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes.	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes.	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes.	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes.

Table II-2. Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Central Planning Area (Sale 147) (continued)

Alternatives	Resource Categories			
	Deep-water Benthic Communities	Topographic Features	Water Quality	
			Coastal and Estuarine Waters	Marine Waters
Cumulative Impacts	<p>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 rarer, widely scattered, high-density Bush Hill-type chemosynthetic communities. Recovery from any damage is expected to take less than 2 years.</p>	<p>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. It is expected that any damage inflicted on these areas would be small, 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.</p>	<p>Chronic discharges and runoff into Louisiana, Mississippi, and Alabama coastal waters, resulting primarily from urban growth, will maintain the water quality problems currently facing these States. There will continue to be low-level, regionally distributed degradation of a substantial percentage of coastal waters. The extensive oil and gas industry operating in the Gulf area has caused low-level, chronic, petroleum contamination of coastal waters. In Mississippi and Alabama, there will be an increase in the onshore support infrastructure which will cause increased contamination, localized around the new sites.</p>	<p>Land-based municipal and industrial low-level discharges and runoff will contribute to the greatest extent to the long-term degradation of marine waters in the Gulf. The Mississippi River, draining two-thirds of the United States, is the major source of pollution in the northern Gulf. Bottom disturbances resulting from platform and pipeline emplacements, dredging, and dredged material disposal operations are expected to result in minor, localized, temporary impacts to water quality. Operational discharges are primarily muds and cuttings and produced waters. Drilling muds and cuttings, discharged intermittently throughout the life of a platform, are expected to contaminate a localized area around platforms, out to 3,000 m for 1 year after drilling ceases. Production wastes, discharged continuously throughout the life of most of the platforms, will change some water quality and sediment parameters within several hundred meters downcurrent from the discharge point for an average of 20 years. Operational discharges and spills from future oil and gas development and transportation offshore will also contribute, to a minor extent, to the regional petroleum contamination of Gulf waters.</p>

Table II-2. Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Central Planning Area (Sale 147) (continued)

Alternatives	Resource Categories			
	Air Quality	Nonendangered and Nonthreatened	Marine Mammals	Endangered and Threatened
Alternative A (Base Case)	Emissions of pollutants into the atmosphere are expected to have concentrations that would not change onshore air quality classifications. Increases in onshore concentrations of air pollutants are estimated to be about 1 $\mu\text{g}/\text{m}^3$. The impacts decrease during winter because onshore winds occur only about 37 percent of the time and impacts increase in summer because onshore winds occur 61 percent of the time.	The impact of the proposed action on nonendangered and nonthreatened marine mammals is expected to result in primarily sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that are both chronic and sporadic. These impacts could cause acute or chronic physiological stress, alter normal behavior, and result in some degree of avoidance, either temporary or permanent, of the impacted area(s).	The impact of the proposed action on endangered and threatened marine mammals is expected to result in primarily sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that are both chronic and sporadic. These impacts could cause acute or chronic physiological stress, alter normal behavior, and result in some degree of avoidance, either temporary or permanent, of the impacted area(s). Lethal impacts are expected to be rare for all marine mammals, with the most likely impacts resulting from vessel collisions to lethargic, surfaced individual animals. The unexpected and unintentional removal of individuals of any species is considered an incidental take. Such removals have not been documented in the Gulf. Recovery times will vary with species size, gestation period, and rates of reproductive activity. These will vary from two to several (less than ten) years.	The proposed action is not expected to harm the Alabama, Choctawhatchee, and Perdido Key beach mice or their habitats unless a size 3 oil spill would occur in conjunction with a strong storm surge. Since this probability is estimated to be less than 0.5 percent, no contact of beach mice or their habitats by oil is expected.
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	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	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes

Table II-2. Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Central Planning Area (Sale 147) (continued)

Alternatives		Resource Categories		
Cumulative Impacts	Air Quality	Marine Mammals		Alabama, Choctawhatchee, and Perdido Key Beach Mice
		Nonendangered and Nonthreatened	Endangered and Threatened	
	Emissions 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). The impacts decrease during winter because onshore winds occur only 37 percent of the time and impacts increase in summer because onshore winds occur 61 percent of the time.	The impact on nonendangered and nonthreatened marine mammals is expected to result in a number of chronic and sporadic sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that may serve to weaken individuals of a local group or population and make them more susceptible to infection from natural or anthropogenic sources. Some displacement of individuals or groups, either temporary or permanent is expected. Projected lethal effects will remove individuals from local populations; restoration of which may take several years, depending upon both species and location.	The impact on endangered and threatened marine mammals is expected to result in a number of chronic and sporadic sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that may serve to weaken individuals of a local group (e.g., sperm whales) or solitary individuals and make them more susceptible to infection from natural or anthropogenic sources. Activities may displace individuals from specific preferred habitat or disrupt mating behavior. Lethal impacts are expected to be rare for all marine mammals, with the most likely impacts resulting from vessel collisions to lethargic surfaced individual animals. The unexpected and unintentional removal of individuals of any species is considered an incidental take. Such removals have not been documented in the Gulf. Recovery times will vary with species size, gestation period, and rates of reproductive activity. These will vary from two to several (less than ten) years.	The Cumulative Scenario is not expected to harm Alabama, Choctawhatchee, and Perdido Key beach mice or their habitats. Non-OCS activities or tropical storms may deplete isolated populations of beach mice.

Table II-2. Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Central Planning Area (Sale 147) (continued)

Alternatives	Resource Categories			
	Marine Turtles	Coastal and Marine Birds Nonendangered and Nonthreatened	Endangered and Threatened	Gulf Sturgeon
Alternative A (Base Case)	The proposed action is expected to temporarily disturb some marine turtles and their habitats, but deaths are expected to be rare. All disturbances are expected to be temporary, and marine turtles are expected to recover within a period of weeks to months.	Nonendangered and nonthreatened coastal and marine birds may encounter periodic disturbance and temporary displacement of localized groups and individuals from proposed activities. Decreases in numbers of adults and/or nests could occur as a result of oil spills and spill-related coastal habitat loss or degradation. Groups experiencing the loss of individuals would require up to several years to recover to a pre-disturbance condition, depending on the species and existing conditions.	Endangered and threatened birds may encounter periodic displacement of individuals and/or localized groups from proposed activities. Decreases in numbers of adults and/or nests could occur as a result of OCS-related oil spills and spill-related coastal habitat loss. The loss of individuals represents a serious loss to the regional population(s); restoration of numbers to a pre-disturbance state could require up to several years, depending on the species and existing conditions.	The impact of the proposed action on the Gulf sturgeon could cause nonfatal irritation of gill epithelium and an increase of liver function in a few adults for less than a month.
Alternative A (High Case)	The High Case is expected to temporarily disturb some marine turtles and their habitats, but the number of deaths are expected to be low. All disturbances are expected to be temporary, and marine turtles are expected to recover within a period of weeks to months.	Same as Alternative A - Base Case.	Endangered and threatened birds may encounter periodic displacement of individuals and/or localized groups from proposed activities. Decreases in numbers of adults and/or nests could occur as a result of OCS-related oil spills and spill-related coastal habitat loss. The loss of individuals represents a serious loss to the regional population(s); restoration of numbers to a pre-disturbance state could require up to several years, depending on the species and existing conditions. Onshore spills are expected to contact some individuals, with associated sublethal and lethal effects.	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 C - Coastal Barrier Beaches and Associated Dunes.	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes.	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes.	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes.

Table II-2. Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Central Planning Area (Sale 147) (continued)

Alternatives	Resource Categories			
	Marine Turtles	Coastal and Marine Birds		Gulf Sturgeon
		Nonendangered and Nonthreatened	Endangered and Threatened	
Cumulative Impacts	The impact of the Cumulative Scenario on marine turtles within the CPA is expected to remove some animals from marine turtle populations and to displace temporarily marine turtles from feeding, reproduction, and resting habitats.	The cumulative effect on coastal and marine birds is expected to result in a discernible decline in the numbers of birds that form localized groups or populations, with associated change in species composition and distribution. Some of these changes are expected to be permanent, as exemplified in historic census data, and to stem from a net decrease in preferred and/or critical habitat.	The cumulative effect on endangered and threatened birds is expected to result in a discernible decline in the number of individuals, or localized groups or populations of these species, with associated change in species composition and distribution. The decline will represent displacement of these species from their natural habitats, as well as some expected death. Some of these changes are expected to be permanent, as exemplified in historic census data, and to stem from a net decrease in preferred and/or critical habitat loss.	The impact of the Cumulative Scenario on the Gulf sturgeon is expected to result in a decline in species number and a displacement from their current distribution that will last more than one generation.

Table II-2. Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Central Planning Area (Sale 147) (continued)

Alternatives		Resource Categories		
	Commercial Fisheries	Recreational Resources and Beach Use	Archaeological Resources	
			Historic	Prehistoric
Alternative A (Base Case)	The proposed action is expected to result in less than a 1 percent decrease in commercial fishery populations, in essential habitat, or in commercial fishing. It will require less than six months for fishing activity and one generation for fishery resources to recover from 99 percent of the impacts.	The proposed action is expected to result in pollution events and nearshore operations that may adversely affect the enjoyment of some beach users on Mississippi and Louisiana beaches. However, these will have little effect on the number of beach users.	There is a very low probability 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 low probability 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.	The High Case is expected to result in pollution events and nearshore operations that may adversely affect the enjoyment of beach users on Mississippi and Louisiana beaches, although the number of pollution incidences adversely affecting the ambience of recreational beaches is likely to increase throughout the 35-year life of the proposed action. Despite this, these will have little effect on the number of beach users.	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 C - Coastal Barrier Beaches and Associated Dunes.	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes.	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes.	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes.
Cumulative Impacts	The impact of the Cumulative Scenario is expected to result in less than a 10 percent decrease in commercial fishery populations, in essential habitat, or in commercial fishing. It will require 3-5 years for fishing activity and 2-3 generations for fishery resources to recover from 99 percent of the impacts.	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 beaches or parks directly impacted by one or two Size 3 oil spills is likely during cleanup operations.	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 II-2. Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Central Planning Area (Sale 147) (continued)

Alternatives	Resource Categories		
	Population, Labor, and Employment	Socioeconomic Conditions	Sociocultural Issues
Alternative A (Base Case)	The impact 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.	Sociocultural impacts are expected to be minimal, with some deleterious impacts to family life in a small number of cases resulting from the extended work schedule.
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 C - Coastal Barrier Beaches and Associated Dunes.	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes.	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes.
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 1.77 million person-years of employment over the life of the proposed action plus at least an additional 1,050 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 LA-1 and LA-2 along the western and central Louisiana coastline, lower for coastal Subarea LA-3 in southeast Louisiana, and lowest for coastal Subarea MA-1 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.	The cumulative impact on sociocultural issues is expected to be substantial in the coastal subareas of the CPA, particularly as a result of an expected decline in OCS activity over the life of the proposed action.

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

Alternative C - No Action.

B. PROPOSED WESTERN GULF SALE 150

1. Alternative A - The Proposed Action

a. Description

Proposed Western Gulf Sale 150 is scheduled to be held in August 1994 and will offer all unleased blocks (approximately 4,682 blocks) within the WPA, except for a 337-block Naval operations area off Corpus Christi, Texas, and two biologically sensitive blocks of the biological communities located on these blocks. The Western Naval Operations Area was excluded following extensive negotiations between the MMS, the Department of the Navy, and industry. The two biologically sensitive blocks were excluded from the proposed action because of their environmentally sensitive nature (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 0.04 BBO and 0.65 tcf of gas during the time period 1994-2028. There are two 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.

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 Sections IV.A. and B. The following are the major estimates of activities and associated impact-producing factors assumed for proposed Sale 150 (Base Case). These estimates and factors were used in the impact analyses.

- (1) During the exploration phase, 1995-2004, there will be 120 wells drilled, resulting in the following:
 - the discharge of 0.94 MMbbl of drilling mud and 0.32 MMbbl of drill cutting wastes offshore; an additional 0.24 MMbbl of drilling mud and drill cutting wastes from offshore operations will be disposed of onshore;
 - offshore air emissions from well drilling operations of 34 tons of total suspended particulate matter, 116 tons of total hydrocarbons, 136 tons of sulphur oxides, 310 tons of carbon monoxide, and 1,160 tons of nitric oxides;
 - 2,100 service-vessel trips and 9,000 helicopter trips; and
 - disturbance from rig emplacements of 19 ha of ocean bottom.
- (2) During the development phase, 1996-2015, there will be 40 oil wells and 60 gas wells drilled, resulting in the following:
 - the discharge of 0.58 MMbbl of drilling mud and 0.16 MMbbl of drill cutting wastes offshore; an additional 0.14 MMbbl of drilling mud and drill cutting wastes from offshore operations will be disposed of onshore;
 - offshore air emissions from well drilling operations of 19 tons of total suspended particulate matter, 65 tons of total hydrocarbons, 76 tons of sulphur oxides, 172 tons of carbon monoxide, and 644 tons of nitric oxides;

- 1,500 service-vessel trips and 7,000 helicopter trips; and
 - the disturbance from fixed structure emplacements of 30 ha of ocean bottom.
- (3) During the production phase, 1996-2027, 0.04 BBO of oil and 0.65 tcf of gas will be produced from eight platform complexes and two floating production systems, resulting in the following:
- the open-water discharge of 93 MMbbl of produced water;
 - 20,000 bbl of produced sands disposed of onshore;
 - offshore air emissions from platforms of 43 tons of total suspended particulate matter, 6,600 tons of total hydrocarbons, 31 tons of sulphur oxides, 2,278 tons of carbon monoxide, and 17,493 tons of nitric oxides;
 - 6,400 service-vessel trips and 127,000 helicopter trips;
 - the removal of 6 ha of commercial fishing area (peak year estimate); and
 - the likelihood of 1 blowout (Section IV.A.3.h.(1)).
- (4) During platform removal operations, which will occur the year after production ceases, four platforms will be removed using explosives.
- (5) The transportation of gas and oil will require the following:
- the construction of 220 km of gathering and trunk pipelines that will connect with existing trunklines prior to landfall, resulting in the disturbance of 70 ha of bottom and the displacement of 113,000 m³ of sediment;
 - 8 barge trips carrying oil to three existing shore terminals; and
 - 52 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 using about 3 percent, on the average, of the capacities of the onshore infrastructure.
 - the use of 15 navigation channels (less than 1 percent), which will be maintenance dredged periodically, with 1 deepened to support vessel traffic;
 - 0.44 million liters of bilge water discharged in coastal waters from service vessel traffic to 27 existing bases;
 - 71,000 helicopter coastal crossings to reach 20 helicopter hubs; and
 - air emissions from service vessels, helicopters, tugboats and shuttle tankers and oil offloading from vessels of 178 tons of total suspended particulate matter, 403 tons of total hydrocarbons, 188 tons of sulphur oxides, 407 tons of carbon monoxide, and 1,888 tons of nitric oxides.

- (7) Six Size 1 crude oil spills are projected to occur, but none will reach land.
- (8) Two Size 1 crude oil and oil-product spills 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 150 is 18,828 person-years, 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 II-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 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 adjacent coastal region is divided into two coastal subareas (TX-1, and TX-2). These subareas are delineated on Figure IV-1.

Sensitive Coastal Environments

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

There is less than a 0.5 percent probability of oil spills contacting a barrier beach. Should an unforeseen contact occur, it is expected that resulting oiling will be very light.

Onshore and nearshore construction of new infrastructure (pipeline landfalls, navigation channels, service bases, platform yards, etc.) as a result of the proposed action are not expected to occur.

Some maintenance dredging is expected to occur, but it has not been shown to have an appreciable negative impact on barrier beaches. The need for maintenance dredging cannot be attributed to the small percentage of vessel traffic in these channels accounted for by proposed action activities.

Detailed plans for deepening of the channel to Corpus Christi, Texas, are not yet available, but it is not expected to cause any additional or accelerated adverse impact on nearby barrier features. Strategic placement of dredged material from this project and subsequent maintenance dredging is expected to benefit barrier beaches downdrift of the channel jetties.

Conclusion

The proposed action is expected to result in alteration of barrier beach configurations in localized areas downdrift from navigation channels that are jettied and maintained or deepened. Strategic placement of dredged material resulting from these actions can mitigate their adverse impacts upon those localized areas.

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

Only spills from pipeline and navigational accidents are expected to result in high-enough concentrations of oil contacting wetlands to result in impacts. Several inshore barge and pipeline accidents are assumed to occur, impacting approximately 3 ha of wetlands over the course of 35 years. For 4 and 10 years after each spill, 1 and 2 ha will cumulatively recover, respectively. Cumulatively, 1 ha of wetlands will be converted to open water.

Seagrass beds are not expected to be contacted by oil from this spill. No impacts to seagrass beds are expected.

As a secondary impact of OCS-related pipeline canals attributable to the proposed action, 7 ha of wetlands are estimated to be lost over 35 years.

Deepening one channel to accommodate larger service vessels is expected to occur within a saline marsh environment and affords the opportunity for the creation of 6 ha of wetlands.

No appreciable adverse impacts from maintenance dredging are expected. Alternative dredged material disposal methods can be used to enhance coastal wetlands.

Erosion of wetlands from OCS vessel wakes is not expected to result in more than 3 ha of wetlands loss during the 35-year life of the proposed action.

Conclusion

The proposed action is expected to result in the loss of up to 11 ha, suppressed productivity of up to 1 ha for 4 years and 2 ha for 10 years, and a gain of up to 6 ha due to beneficial use of dredged material.

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. Seafloor disturbance is considered to be a threat only to the high-density (Bush Hill-type) communities; the widely distributed low-density communities would be at a lower 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 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 as a result of physical disturbance 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 include 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 impacts related to operational discharges would be on the order of 2-4 weeks.

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% chance of a Size 3 oil spill occurring in the Western Gulf as a result of this proposed action and no oil 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. Small areas 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

Expected future water quality degradation associated with discharges and chronic spills from the use of onshore infrastructure supporting Sale 150 operations will be very minor but will be widespread and continuous, especially in the Houston/Galveston area of Texas and the Chenier Plain area of Louisiana where support facilities are concentrated. There will be minor, localized, long-term changes in water quality characteristics from current levels in the confined portions of 15 channels due to vessel traffic. These vessel operations will cause bank erosion and contribute to chronic bilge and sanitary wastes discharges. Thirty-one maintenance and deepening dredging operations will result in localized impacts (primarily elevated water-column turbidities) during the duration (up to several months). Low-level, petroleum hydrocarbon contamination of coastal waters will occur from onshore spills associated with Sale 150 operations and will affect localized, confined areas for up to 6 months in 11 locations along the Louisiana coast and 2 along the Texas coast, and will persist up to 5 years in 2 locations in Louisiana, affecting 54 ha of marsh waters.

Conclusion

The proposed action will result in minor, long-term changes in water quality within, or in the vicinity of, navigation channels and support complexes. These changes will not preclude current uses of the waters affected. The proposed action will also result in localized, short-term changes in water quality during dredging operations or from spill occurrences, which will alter uses of the affected waters for up to 6 months, or up to 5 years in two locations in Louisiana.

Marine Waters

Sediment disturbance from the emplacement of 10 platforms and 220 km of pipeline and from the drilling of 220 wells over a 35-year period will result in minor, localized, temporary impacts on water quality. The drilling of the wells, construction of the platforms, and laying of the pipe will result in increased water-column turbidities in offshore waters. Such bottom disturbance of sediments will result in resuspension of any settled pollutants, such as trace metals, chlorinated hydrocarbons, and excess nutrients, that may have accumulated in the sediments. The resuspension of significant quantities of contaminants from bottom-disturbance operations is not expected to occur due to a lack of contaminants in deep-water sediments and the infrequency of the operations. Given the low frequency of platform removals (maximum is three in the peak year), minimum impacts on water quality due to resuspension of sediments, especially resulting from explosive removals, are expected from these operations.

Only 6 Size 1 spills are projected. Given the infrequent nature of these spills, especially the fact that no spills larger than 50 bbl are projected, impacts on offshore water quality from oil-spill events related to Sale 150 are projected to be negligible, to be of short-duration (2-3 months), and to only affect a small area of offshore waters at any one time.

The area around each of the 10 projected platforms can be contaminated from the discharge of 36,000 bbl of drilling muds and cuttings at each site. These discharges may be released continuously for about a year and a half (assuming 3 exploratory wells and 9 development wells were drilled at one site) and then other quantities discharged intermittently when old wells become depleted and new wells are drilled. These discharges of drilling wastes will affect an area several thousand meters downcurrent of the discharge point. Sediment contamination can be expected up to 3 km from the discharge point in the primary direction of the current and will last up to 1 year after drilling ceases. Benthic marine organisms will be affected out to 1,000 m. Water quality criteria are expected to be exceeded within 100 m from the discharge. Moderate petroleum and metal contamination of sediments and water column from the discharge of 115 MMbbl of produced water at five platforms will occur out to several hundred meters from the discharge point and will have small-scale, localized effects on benthic organisms out from 200 to 500 m. If, for analytical purposes, an assumption is made that

the regional, long-term contamination of Gulf waters and sediments by the OCS industry makes up 50 percent of the total water quality degradation that occurs, then discharges from Sale 150 operations would contribute a little more than 1 percent of the Gulf water quality cumulative contamination (Section IV.D.2.d.).

Conclusion

As a result of the proposed action, marine waters will be degraded from discharges, oil spills, and bottom disturbances. Bottom disturbances (platform and pipeline emplacements and removals) and oil spills are expected to result in minor, localized, temporary impacts to water quality. Changes in water quality parameters will return to background within months from the disturbance. Operational discharges are primarily muds and cuttings and produced waters. Drilling muds and cuttings, which are discharged intermittently throughout the life of a platform, are expected to contaminate a localized area around platforms out to 3,000 m for up to 1 year after drilling ceases. Production wastes, which are discharged continuously throughout the life of most of the platforms, will change some water quality and sediment parameters within several hundred meters downcurrent of the discharge point for an average of 20 years. These discharges will also contribute, to a very small extent, to the long-term, regional contamination of Gulf waters and sediments.

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

Onshore impact on air quality from emissions from the OCS activities are estimated to be negligible 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 that could increase impacts. 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 frequency of onshore winds decreases and the removal of pollutants by rain increases.

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 $1 \mu\text{gm}^{-3}$ (box model steady concentrations). The impacts decrease during the winter because onshore winds occur only about 34 percent of the time and increase in summer because 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 affect nonendangered and nonthreatened marine mammals detrimentally. These marine mammals could be impacted by degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, and discarded trash and debris from service vessels and OCS structures. The effects of the majority of these activities are expected to be sublethal. Lethal effects are estimated from the chance collisions with OCS service vessels and ingestion of plastic materials. Sale-related oil spills of any size are estimated to be extraordinary events that will rarely contact nonendangered and nonthreatened marine mammals.

Conclusion

The proposed action on nonendangered and nonthreatened marine mammals is expected to result in primarily sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that are both chronic and sporadic. These impacts could cause acute or chronic

physiological stress, alter normal behavior, and result in some degree of avoidance, temporary or permanent, 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 affect endangered and threatened marine mammals detrimentally. These marine mammals could be impacted by the degradation of water quality resulting from operational discharges, helicopter and vessel traffic and noise, platform and drillship noise, explosive platform removals, seismic surveys, oil spills, oil-spill response activities, and discarded trash and debris from service vessels and OCS structures. The effects of the majority of these activities are estimated to be sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris). Lethal effects are estimated from the chance collisions with OCS service vessels and ingestion of plastic materials. Sale-related oil spills of any size are estimated to be extraordinary events that will rarely contact endangered and threatened marine mammals.

Conclusion

The impact of the proposed action on endangered and threatened marine mammals within the potentially affected area is estimated to result in primarily sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that are both chronic and sporadic. These impacts could cause acute or chronic physiological stress, alter normal behavior, and result in some degree of avoidance, temporary or permanent, of the impacted area(s). Lethal impacts are expected to be rare for all marine mammals, with the most likely impacts resulting from vessel collisions to lethargic surfaced individual animals. The unexpected and unintentional removal of individuals of any species is considered an incidental take. Such removals have not been documented in the Gulf. Recovery times will vary with species size, gestation period, and rates of reproductive activity. These will vary from two to several (less than ten) years.

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, blowouts, water quality and habitat degradation, 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. Sale-related oil spills are expected to rarely contact marine turtles.

Conclusion

The impact of the proposed action is expected to temporarily disturb some marine turtles and their habitats, but deaths are expected to be rare. All disturbances are expected to be temporary, and marine turtles are expected to recover within a period of weeks to months.

Coastal and Marine Birds

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

Activities resulting from the proposed action will affect coastal and marine birds within the WPA. These species may be impacted by oil spills and oil-spill response activities, degradation of water quality in coastal areas, helicopter and service-vessel traffic and noise, habitat loss and degradation resulting from pipeline landfalls and coastal facility construction, and discarded offshore oil- and gas-related plastic debris. It is estimated that the majority of effects from major impact-producing factors on coastal and marine birds are sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris), causing periodic disturbances with some displacement of localized groups and/or individuals. Lethal effects stem primarily from uncontained onshore oil spills and oil-spill response activities, with an associated

loss of adults and/or nests within affected areas. These events are expected to be rare and will cause no discernible decline in local or regional populations or species.

Conclusion

Nonendangered and nonthreatened coastal and marine birds may encounter periodic disturbance and temporary displacement of localized groups and individuals from proposed activities. Decreases in numbers of adults and/or nests could occur as a result of OCS-related oil spills and spill-related to coastal habitat loss or degradation. Groups experiencing the loss of individuals would require up to several years to recover to a pre-disturbance condition, depending on the species and existing conditions.

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

The brown pelican, Arctic peregrine falcon, bald eagle, piping plover, least tern, and whooping crane may be impacted by oil spills and oil-spill response activities, degradation of water quality in coastal areas, helicopter and service-vessel traffic and noise, habitat loss and degradation resulting from pipeline landfalls and coastal facility construction, and discarded offshore oil- and gas-related plastic debris. It is estimated that the majority of effects from major impact-producing factors on coastal and marine birds are sublethal (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris), causing periodic disturbances with some displacement of localized groups and/or individuals. Lethal effects stem primarily from uncontained onshore oil spills and oil-spill response activities, with an associated loss of adults and/or nests (for some species) within affected areas. These events are expected to be rare and will cause no discernible decline in local or regional populations or species.

Conclusion

Endangered and threatened birds may encounter periodic disturbance and temporary displacement of localized groups and individuals from proposed activities. Decreases in numbers of adults and/or nests could occur as a result of OCS-related oil spills and spill-related coastal habitat loss or degradation. The loss of individuals represents a serious loss to the regional population(s); restoration of numbers to a pre-disturbance state could require up to several years, depending on the species and existing conditions.

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 expected that the effects from the major impact-producing factors on commercial fisheries in the WPA are inconsequential and of nominal occurrence. At the expected level of effect, the resultant influence on Western Gulf fisheries is negligible and will be indistinguishable from natural population variations. As a result there will be no perceivable disturbance to Gulf commercial fisheries.

Conclusion

The proposed action is expected to result in less than a 1 percent decrease in commercial fishery populations, in essential habitat, or in commercial fishing. It will require less than 6 months for fishing activity and one generation for fishery resources to recover from 99 percent of the impacts.

Recreational Resources and Beach Use (Section IV.D.2.a.(9))

A few small onshore oil spills and marine debris lost from OCS operations associated with drilling 240 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, together with one or two small oil spills, 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.

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. An 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 negligible 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 negligible. 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 low probability of an interaction between OCS oil and gas activities and an 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 would 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 negligible.

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 less than 0.5 percent. It is assumed that no contact will occur. Onshore oil spills that occur during the life of the lease sale

have a very small possibility of contacting a prehistoric site. Should such contact occur, C-14 dating of organic materials could be affected.

Conclusion

There is a very low probability of an OCS activity contacting a prehistoric site. Should such an impact occur, there would 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 64 percent of the total employment generated by the Western Gulf sale. The WPA contributes the remaining 36 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.

Conclusion

The impact of the proposed action 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.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 0.10 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 will not result in disruptions to community infrastructure beyond what is anticipated by in-place planning and development agencies.

Sociocultural Issues

The employment projected to occur in association with the proposed action is expected to be filled by persons already engaged in OCS oil- and gas-related employment, unemployed persons living in the area, and underemployed persons living in the area. Inasmuch as jobs will be provided for persons living in the coastal subareas, some positive impact is expected. Given the present amount of OCS-related jobs in the coastal subareas, the proposed action is not expected to result in workforce fluctuations. None of the coastal subareas are projected to experience population impacts greater than 0.10 percent as a result of the proposed action.

It is assumed that employment as a result of the proposed action will decrease the amount of out-migration compared to that which would occur without the proposed action. Social and cultural problems typically associated with in-migration and out-migration are not expected to occur as a result of the proposed action. The relatively small amount of employment associated with the proposed action, in comparison with the total employment in the affected Western and Central Gulf coastal subareas, is not expected to result in deleterious impacts to small businesses. The projected amount of wetlands loss is not sufficient to effect the practice of traditional occupations in the WPA, given the total amount of coastal marsh available for exploitation. Based on the low probability of an offshore spill occurring and contacting land, the assumption is that no significant employment requirements will result from the cleanup of offshore spills. Employment requirements for cleanup of onshore spills is expected to be minimal. It is expected that in a small number of cases, successful adaptation of the family to the extended work schedule will not occur. In these cases, some deleterious impacts to family are expected.

Conclusion

Sociocultural impacts associated with the proposed action are expected to be minimal, with some deleterious impacts to family life in a small number of cases resulting from the extended work schedule.

c. Mitigating Measures

Measures have been developed to mitigate possible impacts of OCS activities on environmental resources and non-OCS activities. The three stipulations presented below have been applied to appropriate OCS leases for many years. The stipulations are being analyzed as part of the proposed action and are being considered for adoption by the Secretary. The Secretary will make a decision prior to Sale 150 on whether or not to apply these measures to appropriate leases resulting from the sale. The analysis 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 (USDOL, MMS, 1990a), these communities would be severely and adversely impacted 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 if such activities were not mitigated. The DOI 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 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; 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, require 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 Garden Banks and the low-relief banks. The Flower Garden Banks, because they contain the northernmost example of living coral reefs in the Gulf and have received National Marine Sanctuary status (Section I.B.4.h.), and are protected to a greater degree than the other banks. The added provisions of the stipulation at the Flower Garden Banks 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 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 and corresponding blocks to which this stipulation may be applied in the Western Gulf are as follows:

<u>Bank Name</u>	<u>Isobath (meters)</u>	<u>Bank Name</u>	<u>Isobath (meters)</u>
<u>Shelf Edge Banks</u>		<u>Low Relief Banks²</u>	
West Flower Garden Bank ¹	100	Mysterious Bank	74, 76, 78, 80, 84
(defined by 1/4 1/4 1/4 system)		(see leasing map)	
East Flower Garden Bank ¹	100	Blackfish Ridge	70
(defined by 1/4 1/4 1/4 system)			
MacNeil Bank	82	Big Dunn Bar	65
29 Fathom Bank	64	Small Dunn Bar	65
Rankin Bank	85	32 Fathom Bank	52
Geyer Bank	85	Coffee Lump	Various
Elvers Bank	85	(see leasing map)	
Bright Bank ⁵	85	Claypile Bank ¹	50
McGrail Bank ⁵	85		
Rezak Bank ⁵	85		

<u>Bank Name</u>	<u>Isobath (meters)</u>	<u>Bank Name</u>	<u>Isobath (meters)</u>
<u>Shelf Edge Banks</u>		<u>South Texas Banks⁴</u>	
Sidner Bank ¹	85	Dream Bank	78, 82
Parker Bank ¹	85	Southern Bank	80
Stetson Bank	62	Hospital Bank	70
Appelbaum Bank	85	North Hospital Bank	68
		Aransas Bank	70
		South Baker Bank	70
		Baker Bank	70

¹Flower Garden Banks - In paragraph (c), a 4-Mile Zone rather than a 1-Mile Zone applies.

²Low Relief Banks - Only paragraph (a) applies.

³Claypile 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.

⁴South Texas Banks - Only paragraphs (a) and (b) apply.

⁵Central 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 10 m, 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 have demonstrated that the shunting requirements of the stipulations 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 (USDOL, MMS, 1990a) were done without the stipulations in the proposed action. 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 severe 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 severe 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. 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 increase 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. (Appelbaum 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 Garden Banks out to 4 mi. 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.

Archaeological Resource Stipulation

- (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 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)(1)(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 (USDOL, MMS, 1980a) 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 an 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 stipulation has been applied to blocks in military warning and water test 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 stipulation reads as follows:

Military Areas Stipulation

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 11-1.

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.

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 11-1 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 on shore 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 11-1, upon using 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 and save 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.

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

Alternative B 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 11 B 1 c (1)).

a. Description

This alternative would offer 4,573 unleased blocks in the Western Gulf Planning Area. This alternative is equivalent to offering the proposal except for the 109 unleased blocks (Figures 11-4 and 11-5) 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 2.4 percent of the 4,573 blocks to be offered in the Western Gulf. It is estimated that the proposal could result in the discovery and production of 0.04 BBO and 0.65 bcf of gas during the time period 1994-2028. For more information describing the proposed action and alternatives, see Section 1.

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

Figure II-5. Location and Lease Status of Blocks Affected by Alternative B (North Texas).

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 Sections IV.A. and B. Estimates of the major activities and associated impact-producing factors assumed for proposed Sale 150 (Base Case) are shown in Section II.B.1.a. It is assumed that activity levels estimated for Alternative B will be the same as those estimated for Alternative A.

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 II-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 WPA is comprised of three subareas (W-1, W-2, and W-3), and the adjacent coastal region is divided into two coastal subareas (TX-1 and TX-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 the proposed action, it is reasonable to assume that the removal of 2.4 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-4)) 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 the proposed action indicates that the impacts expected to result will be very similar to those described under the proposed action (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 the proposed action. 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 offshore. The majority of the acreage that may be deleted is over 160 km offshore. Considering the assumption that the estimated level of activity will not change from that projected for the proposed action 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 the proposed action.

Conclusion

The impacts on the following coastal resources are estimated to be the same as those estimated under the proposed action: 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 109 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 the proposed action, so there would be no change in the impact projected under the proposed action. Impact to commercial fisheries and recreational marine fishing would also remain as under the proposed action.

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 91 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 the proposed action (Section II.B.1.c.(1)), the impact to the topographic features will be essentially the same for both the proposed action and Alternative B.

Conclusion

Selection of Alternative B would preclude oil and gas operations in the unleased blocks (109 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. Small areas 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 Mammals 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 85 m, which is the lower limit of the feeding habitat for these species. However, the pelagic stages of all marine 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 the proposed action. The impact on marine mammals is expected to result in primarily sublethal effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that are both chronic and sporadic. These impacts could cause acute or chronic physiological stress, alter normal behavior, and result in some degree of avoidance, either temporary or permanent, of the impacted area(s). Marine turtles and their habitats are expected to experience some temporary disturbance, but deaths are expected to be rare.

3. Alternative C - No Action

a. Description

Alternative C 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 Western Gulf are scheduled on an annual basis. By canceling the proposed sale, the opportunity is postponed or foregone for development of the estimated 0.04 BBO and 0.65 tcf of gas that could have resulted from proposed Sale 150 in the Western 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.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.

Strategies that could provide replacement resources for lost domestic OCS oil and gas production include a combination of energy conservation; onshore domestic oil and gas supplies; alternative energy sources; 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.

Market forces are assumed to be the predominant factor in determining substitutes for OCS oil and gas. Based on this, increased imports of foreign oil are assumed to be the largest replacement source. Much of this imported oil would enter the United States through the Gulf of Mexico, thus increasing the risks due to tanker spills. This is thoroughly analyzed in the Final EIS for the OCS Comprehensive Program (1992-1997).

4. Comparison of Alternatives

The following (Table 11-3) provides an impact comparison and summary for the Base and High Case 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 Sale 150.

Table 11-3

Comparison and Summary of Impacts for Alternatives A-C
and Cumulative in the Western Planning Area (Sale 150)

Alternatives	Resource Categories		
	Coastal Barrier Beaches and Associated Dunes	Wetlands	Deep-water Benthic Communities
Alternative A (Base Case)	The proposed action is expected to result in alteration of barrier beach configurations in localized areas downdrift from navigation channels that are jettied and maintained or deepened. Strategic placement of dredged material resulting from these actions can mitigate adverse impacts upon those localized areas.	The proposed action is expected to result in the loss of up to 1 ha, suppressed productivity of up to 1 ha for 4 years and 2 ha for 10 years, and a gain of up to 6 ha due to the beneficial use of dredged material.	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 as a result of physical disturbances is expected to take less than 2 years.
Alternative A (High Case)	Same as Alternative A - Base Case.	The High Case is expected to result in the loss of up to 21 ha, suppressed productivity of up to 3 ha for 4 years and 5 ha for 10 years, and a gain of up to 12 ha due to the beneficial use of dredged material.	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	Alternative C would preclude all adverse impacts from OCS activities associated with the proposal. However, it would not preclude OCS impacts discussed under the Cumulative Scenario, which are not attributable to the proposal. In addition, increased foreign oil imports could increase the risks of tanker spills and associated impacts to the marine and coastal waters of the Gulf of Mexico.	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes.	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes.

Table II-3. Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Western Planning Area (Sale 150) (continued)

Alternatives	Resource Categories		
	Coastal Barrier Beaches and Associated Dunes	Wetlands	Deep-water Benthic Communities
Cumulative Impacts	Coastal barrier beaches have received severe cumulative adverse impacts from both natural processes and human activities. Although natural processes are considered to be the major contributor to these impacts, human activities significantly accelerate coastal barrier deterioration. Human activities that have caused the greatest adverse impacts are pipelines and channel jetties. Deterioration of barrier beaches is expected to continue in the future.	Cumulative impacts to wetlands are primarily due to subsidence, channelization, and levees. Cumulative impacts are expected to result in the loss of up to 5,600 ha, suppressed productivity for 2 to 10 years of up to 32,400 ha, and a gain of up to 192 ha due to beneficial use of dredged material.	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 rarer, widely scattered, high-density Bush Hill-type chemosynthetic communities. Recovery from any damage is expected to take less than two years.

Table II-3. Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Western Planning Area (Sale 150) (continued)

Alternatives	Resource Categories			
	Topographic Features	Coastal and Estuarine Waters	Water Quality	Marine Waters
Alternative A (Base Case)	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 localized areas would be impacted by operational discharges (i.e., muds and cuttings), 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.	The proposed action will result in minor, localized, long-term changes in water quality within, or in the vicinity of navigation channels and support complexes. These changes will not preclude current uses of the waters affected. The proposed action will also result in localized short-term changes in water quality during dredging operations or from spill occurrences, which will alter uses of the affected waters for up to 6 months, or up to 5 years in two locations in Louisiana.		As a result of the proposed action, marine waters of the Gulf of Mexico will be degraded from discharges, oil spills, and bottom disturbances. Bottom disturbances (platform and pipeline emplacements and removals) and oil spills are expected to result in minor, localized, temporary impacts to water quality. Changes in water quality parameters will return to background within 6 months from the disturbance. Operational discharges are primarily muds and cuttings and produced waters. Drilling muds and cuttings, discharged intermittently throughout the life of a platform, are expected to contaminate a localized area around platforms (out to 3,000 m). Production wastes, discharged continuously throughout the life of most of the platforms, will change some water quality and sediment parameters within several hundred meters downcurrent from the discharge point for an average of 20 years. These discharges will also contribute, to a very small extent, to the long-term, regional contamination of Gulf waters and sediments.
Alternative A (High Case)	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.		As a result of the High Case, marine waters of the Gulf of Mexico will be degraded from discharges, oil spills, and bottom disturbances. Bottom disturbances (platform and pipeline emplacements and removals) and oil spills are expected to result in minor, localized, temporary impacts to water quality. Changes in water quality parameters will return to background within 6 months from the disturbance. Operational discharges are primarily muds and cuttings and produced waters. Drilling muds and cuttings, discharged intermittently throughout the life of a platform, are expected to contaminate a localized area around platforms (out to 3,000 m). Production wastes, discharged continuously throughout the life of most of the platforms, will change some water quality and sediment parameters within several hundred meters downcurrent from the discharge point for an average of 20 years. These discharges will also contribute, to a very small extent, to the long-term, regional contamination of Gulf waters and sediments.

Table II-3. Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Western Planning Area (Sale 150) (continued)

Alternatives	Resource Categories		
	Topographic Features	Coastal and Estuarine Waters	Water Quality Marine Waters
Alternative B ¹	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 localized areas would be impacted by operational discharges (i.e., muds and cuttings), 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.	Same as Alternative A - Base Case.
Alternative C ²	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes.	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes.	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes.
Cumulative Impacts	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. It is expected that any damage inflicted on these areas would be small, 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.	Routine discharges and runoff into Texas waters, resulting primarily from urban growth and the petrochemical industry, will maintain the current water quality status facing Texas. This state is experiencing low-level, regionally distributed degradation of a substantial percentage of its coastal waters. The extensive oil and gas industry operating both onshore and offshore in the Western Gulf will contribute, to a minor extent, to the petroleum contamination of coastal waters.	Land-based municipal and industrial low-level discharges and runoff will contribute to the greatest extent to the long-term degradation of marine waters in the Gulf. The Mississippi River, draining two-thirds of the United States, is the major source of pollution in the northern Gulf. Bottom disturbances resulting from platform and pipeline emplacements, dredging, and dredged material disposal operations are expected to result in minor, localized, temporary impacts to water quality. Operational discharges are primarily muds and cuttings and produced waters. Drilling muds and cuttings discharged intermittently throughout the life of a platform, are expected to contaminate a localized area around platforms, out to 3,000 m for 1 year after drilling ceases. Production wastes, discharged continuously throughout the life of most of the platforms, will change some water quality and sediment parameters within several hundred meters downcurrent from the discharge point for an average of 20 years. Operational discharges and spills from future oil and gas development and transportation offshore will also contribute, to a minor extent, to the regional petroleum contamination of Gulf waters.

Table II-3. Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Western Planning Area (Scale 1/2) (continued)

Alternatives		Resource Categories	
Alternative A (Base Case)	Emissions of pollutants into the atmosphere are expected to have concentrations that would not change onshore or quality classifications. Increases in onshore concentrations of air pollutants are estimated to be about 1 µgm. The impacts decrease during winter because onshore winds occur only about 34 percent of the time and impacts increase in summer because onshore winds occur 85 percent of the time.	Air Quality	
		Nonendangered and Nonturbulent	
Alternative B ¹ (High 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 C - Coastal Barrier Beaches and Associated Dunes.	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes.	
		Same as Alternative C - Coastal Barrier Beaches and Associated Dunes.	

Table II-3. Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Western Planning Area (Site 150) (continued)

Alternatives	Resource Categories		
	Air Quality	Marine Mammals	
		Nonendangered and Nonthreatened	Endangered and Threatened
Cumulative Impacts	<p>Emissions 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 5 $\mu\text{g}/\text{m}^3$ (from model steady concentrations). The impacts decrease during winter because onshore winds occur only 34 percent of the time and impacts increase in summer because onshore winds occur 85 percent of the time.</p>	<p>The impact on nonendangered and nonthreatened marine mammals is expected to result in a number of chronic and sporadic substantial effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that may serve to weaken individuals of a local group or population and make them more susceptible to infection from natural or anthropogenic sources. Some displacement of individuals or groups, either temporary or permanent is expected. Projected initial effects will remove individuals from local populations, restoration of which may take several years, depending upon both species and location.</p>	<p>The impact on endangered and threatened marine mammals is expected to result in a number of chronic and sporadic substantial effects (behavioral effects and nonfatal exposure to or intake of OCS-related contaminants or discarded debris) that may serve to weaken individuals of a local group (e.g., sperm whales) or solitary individuals and make them more susceptible to infection from natural or anthropogenic sources. Activities may displace individuals from specific preferred habitat or disrupt mating behavior. Lethal impacts are expected to be rare for all marine mammals, with the most likely impacts resulting from vessel collisions or lethal-type surfaced individual animals. The unexpected and unintentional removal of individuals of any species is considered an incidental take. Such removals have not been documented in the Gulf. Recovery times will vary with species size, gestation period, and rates of reproductive activity. These will vary from two to several (less than ten) years.</p>

Table II-3 Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Western Planning Area (Salt 1506 continued)

Alternative	Resource Categories		
	Marine Turtles	Coastal and Marine Birds	
		Nonendangered and Nonthreatened	Endangered and Threatened
Alternative A (Base Case)	The proposed action is expected to temporarily disturb some marine turtles and their habitats, but deaths are expected to be rare. All disturbances are expected to be temporary, and marine turtles are expected to recover within a period of weeks to months.	Nonendangered and nonthreatened coastal and marine birds may encounter periodic disturbance and temporary displacement of localized groups and individuals from proposed activities. Decreases in numbers of adults and/or nests could occur as a result of oil spills and spill-related coastal habitat loss or degradation. Groups experiencing the loss of individuals could require up to several years to recover to a pre-disturbance condition, depending on the species and existing conditions.	Endangered and threatened birds may encounter periodic displacement of individuals and/or localized groups from proposed activities. Decreases in numbers of adults and/or nests could occur as a result of OCS-related oil spills and spill-related coastal habitat loss. The loss of individuals represents a serious loss to the regional population; restoration of numbers to a pre-disturbance state could require up to several years, depending on the species and existing conditions.
Alternative A (High Case)	The High Case is expected to temporarily disturb some marine turtles and their habitats, but the number of deaths are expected to be low. All disturbances are expected to be temporary, and marine turtles are expected to recover within a period of weeks to months.	Same as Alternative A - Base Case.	Endangered and threatened birds may encounter periodic displacement of individuals and/or localized groups from proposed activities. Decreases in numbers of adults and/or nests could occur as a result of OCS-related oil spills and spill-related coastal habitat loss. The loss of individuals represents a serious loss to the regional population; restoration of numbers to a pre-disturbance state could require up to several years, depending on the species and existing conditions.
Alternative B	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative C	Same as Alternative A - Coastal Barrier Beaches and Associated Dunes.	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes.	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes.
Cumulative Impacts	The impact of the Cumulative Scenario on marine turtles within the CPA is expected to remove some animals from marine turtle populations and to displace remaining marine turtles from feeding, reproduction, and nesting habitats.	The cumulative effect on coastal and marine birds is expected to result in a distributive decline in the numbers of birds that form localized groups or populations, with associated change in species composition and distribution. Some of these changes are expected to be permanent, as exemplified in historic census data, and to stem from a net decrease in preferred and/or critical habitat.	The cumulative effect on endangered and threatened birds is expected to result in a distributive decline in the number of individuals or localized groups or populations of these species, with associated change in species composition and distribution. The decline will represent displacement of these species from their natural habitats, as well as some expected mortality. Some of these changes are expected to be permanent, as exemplified in historic census data, and to stem from a net decrease in preferred and/or critical habitat loss.

Table B-3. Comparison and Summary of Impacts for Alternatives A-C and Cumulative in the Western Planning Area (State DWH) (continued)

Alternatives	Resource Categories			
	Commercial Fisheries	Recreational Resources and Beach Use	History	Archaeological Resources
			Prehistoric	
Alternative A (Base Case)	The proposed action is expected to result in less than a 1 percent decrease in commercial fishery populations in coastal habitats or in commercial fishing. It will require less than six months for fishery activity and one generation for fishery resources to recover from the impacts.	The proposed action is expected to result in pollution events and nearshore operations that may adversely affect the enjoyment of some beach users on Mississippi and Louisiana beaches. However, there will have little effect on the number of beach users.	There is a very low probability 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 low probability 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.	The High Case is expected to result in one oil pollution incident causing a temporary beach closure and periodic loss of sand water items estimated to reach up to 100,000 beach items, which is expected to diminish enjoyment of some beach users but is unlikely to affect the number or type of users currently enjoying on Texas beaches. Although the level of chronic pollution to Texas beaches is estimated to increase from the Base Case, the level of beach use should not change.	Same as Alternative A - Base Case.	Same as Alternative A - Base Case.
Alternative B	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	Same as Alternative A - Coastal Barrier Beaches and Associated Dunes	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes	Same as Alternative C - Coastal Barrier Beaches and Associated Dunes
Cumulative impacts	The impact of the cumulative scenario is expected to result in less than a 10 percent decrease in commercial fishery populations in coastal habitats or in commercial fishing. It will require less than six months for fishery activity and one generation for fishery resources to recover from the impacts.	Although most one accident oil spills will continue to affect the enjoyment of Texas recreational beaches, the level of chronic pollution should decline during the life of the proposed action. Beach use is the regional area is unlikely to change, however closure of beach beaches or periodic beaching imposed by loss of oil spills is likely during cleanup operations.	The loss of OCS Program and non-Program-related impact producing factors has been evaluated and may result in loss of unique or significant or unique historic archaeological information.	The loss of OCS Program and non-Program-related impact producing factors has been evaluated and may result in loss of significant or unique prehistoric archaeological information.

Table 2. Comparison and summary of impacts for Alternatives A, C, and F, relative to the Western Planning Area (WPA) community

Alternative	Resource Category	
	Recreational (Wildlife)	Private Property and Infrastructure
Alternative A	<p>The impact on the population, when and employment of the community and residents of the WPA and Western Coast would be a significant increase in the number of jobs resulting from the expanded work schedule of those resulting from the expanded work schedule.</p>	<p>Population and employment impacts will not result in significant impacts to community infrastructure and public services, but will result in a significant increase in the number of jobs resulting from the expanded work schedule.</p>
Alternative B	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>
Alternative C	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>
Alternative D	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>
Alternative E	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>
Alternative F	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>
Alternative G	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>
Alternative H	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>
Alternative I	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>
Alternative J	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>
Alternative K	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>
Alternative L	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>
Alternative M	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>
Alternative N	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>
Alternative O	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>
Alternative P	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>
Alternative Q	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>
Alternative R	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>
Alternative S	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>
Alternative T	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>
Alternative U	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>
Alternative V	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>
Alternative W	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>
Alternative X	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>
Alternative Y	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>
Alternative Z	<p>Same as Alternative A - Same Case</p>	<p>Same as Alternative A - Same Case</p>

SECTION III

DESCRIPTION OF THE AFFECTED ENVIRONMENT

III

III

III. DESCRIPTION OF THE AFFECTED ENVIRONMENT

A. PHYSICAL ELEMENTS OF THE ENVIRONMENT

1. Geology

General Description

Throughout Cenozoic time, clastic sediments have poured into the Gulf of Mexico Basin from the north and west. The depocenters shifted progressively eastward and southward in response to changes in the source of sediment supply. During the early Tertiary, the primary sediment supply was carried from the west by the ancestral Rio Grande and Brazos River systems. The Houston and Rio Grande embayments were the major depocenters for these lower Tertiary deposits. As the major supply of sediment shifted to the north, the Mississippi River system became the major sediment carrier, and the major depocenters shifted to the north rim of the Gulf. Then, during Miocene time, there was a gradual southward shift of depocenters. By late Miocene, the major depocenter was the "Terrebonne Trough" in southern Louisiana.

The Mississippi is the largest river system in North America. It drains an area of 1.3 million mi². The estimated annual sediment discharge is 680 million tons (Coleman et al., 1980). The bedload sediment is 90 percent fine sand; the suspended load is 65 percent clay and 35 percent silt and fine sand.

The Central Planning Area (CPA) encompasses the continental shelf off the Louisiana coast, the area east of the Mississippi delta offshore Mississippi and Alabama to the eastern edge of Mobile Bay, and the deep-water areas of Mississippi Canyon, Atwater Valley, Green Canyon, and Walker Ridge. The area is largely a Mesozoic-Cenozoic basin comprising a series of Cenozoic depocenters that have shifted seaward with time to a Pleistocene depocenter at the shelf edge. The sedimentary package is a thick sequence of offlapping wedges that have been deformed by the movement of salt and overpressured shale.

The Western Planning Area (WPA) includes the entire Texas shelf and slope, and the deep-water areas of Corpus Christi, Port Isabel, East Breaks, Alaminos Canyon, Garden Banks, and Kenthley Canyon. This area is primarily an early Cenozoic depocenter overlying deeper Paleocene and Eocene strata. Sedimentation continued in the WPA throughout Cenozoic time, but was far less than in the CPA.

Regional dip of sediments in the Gulf of Mexico is interrupted by salt diapirs, shale diapirs, and growth faults. Structural deformation has been primarily in response to heavy sediment loading. The thick sedimentary sequence of the Gulf Coast basin was deposited over thick Jurassic Louann Salt deposits. The pressure of the overlying sediments caused the lower density salt to flow plastically both basinward and upward through the overlying sediments. In some areas, overpressured shales have formed diapirs similar to the salt structures. The overlying sediments have been upwarped, folded, and pierced by the diapiric structures. Peripheral and radial faulting are typically associated with the diapirism.

Regional systems of growth faults penetrate into the Cenozoic units beneath coastal Texas and Louisiana and the adjacent shelf. Growth faults form contemporaneously with sedimentation and are concave upward. They are characterized by increasing offset of strata with depth. Strata on the downthrown side are thicker than on the upthrown side. The faults result from spontaneous slope failure as deltas prograde at the edge of the continental margin (Martin et al., 1984).

One of the most significant factors controlling the hydrocarbon potential in the CPA and WPA is the environment of deposition. Sediments deposited on the outer shelf and upper slope have the greatest potential for hydrocarbon accumulation because this is the optimum zone for encountering the three factors necessary for the successful formation and accumulation of oil and gas: source beds, reservoir rocks, and traps. Both source beds and reservoir rocks are found at the outer shelf/upper slope where nearshore sands interfinger with deeper water marine shales. The organic-rich shales are the primary source rocks, and the sandstones provide the reservoirs into which the hydrocarbons migrate and are trapped. Organic material deposited with the fine-grained clays and muds was preserved and not-oxidized as it might have been in shallower, more turbulent water. Hydrocarbon traps formed with the growth of salt and shale diapirs and the associated fault systems.

The prospective horizons for hydrocarbon accumulation on the northwestern continental shelf are of Miocene, Pliocene, and Pleistocene age. Producing horizons become progressively younger in a seaward direction. Historically, the most prolific offshore production in the Gulf has come from the Miocene trends of the eastern Louisiana OCS. This area has more oil than the remainder of the Texas-Louisiana OCS. The next most productive trend is in Pliocene sediments of the central Louisiana OCS and yields about 50 percent oil and 50 percent gas. This producing trend dies out to the west. The Miocene section of western Louisiana is the third most productive trend, producing primarily gas. The Pleistocene trend offshore western Louisiana ranks fourth.

A number of discoveries have been made in Pleistocene sediments along the shelf and upper slope of Louisiana and Texas. This has been called the flexure trend. On the upper slope, areas between salt domes contain sediments as thick as 3,500 m, much of which appears to be muddy slump deposits with infrequent turbidite sand zones. Some of the turbidite sands are hydrocarbon reservoirs.

Geologic Hazards

Geologic hazards that may occur in the CPA and WPA include seafloor instability, shallow gas in seafloor sediments, and active faulting.

Geologic hazards pose engineering and operational constraints and can usually be effectively mitigated through existing or new technology and design. Detailed postlease surveying and sampling on a site-specific basis are necessary to fully evaluate hazards in relation to offshore development and operations.

Mass transport, or mass wasting, is the gravity-induced downslope movement of sediments. This type of slope failure may occur in response to seismic shaking, overloading or oversteepening of slopes, lowered shear strength of the sediments because of interstitial gas, cyclic loading, or a combination of these factors. Seafloor instability is considered the principal engineering constraint to the emplacement of bottom-founded structures, including pipelines, drilling rigs, and production platforms. The basic factors in slope stability are slope angle and the level of consolidation. Slopes of less than 0.5 degrees have failed in the Gulf of Mexico because of underconsolidation of the sediments.

Under normal circumstances, sediments compact by allowing pore fluids to escape. In the Gulf of Mexico, the high rate of sedimentation and the great amount of fine-grained sediments restrict the extrusion of pore fluids. The weight of the subsequent overlying sediments is supported by both the grains and the trapped pore fluids. This condition is overpressuring of the pore fluids or high pore pressure. Zones of abnormally high pore pressure require special drilling procedures.

Shallow gas in near-surface sediments can contribute to seafloor instability and slope failure. Decomposition of trapped organic matter is the primary source of biogenic interstitial gas. Thermogenic gas, originating in deeply buried source rocks, can also migrate upward and become trapped in shallow sediments. Shallow gas may weaken shallow geologic formations, providing avenues of escape for high pressure fluids and gas from deeper formations. Gas-charged sediments can contribute slope failure by effectively lowering the shear strength of the sediments. Dissolved gas in interstitial pore water can contribute spontaneous liquefaction when subject to cyclic loading, as with storm surges or seismic shaking. Shallow gas degrades seismic signals and so can be identified on high-resolution seismic profiles as acoustic anomalies such as turbid zones, opaque or "wipe-out" zones, or phase changes.

Other geologic factors can contribute to seafloor instability and slope failure. Oversteepening of the upper delta front slope occurs as sedimentation causes the delta front to migrate out over the continental slope. Uplift associated with diapirism can also cause oversteepening of slopes. Strong storms and hurricanes can induce sediment movement at depth and can generate mudslides along the delta front. Slump deposits can occur in submarine canyons as a result of undercutting of canyon walls by currents or by sediment transport in the canyons.

Active faults on the continental slope result from the upward movement of salt or shale through overlying sediments and from growth faulting caused by sedimentary loading. The rate and timing of movement of the faults is difficult to ascertain (Roberts, 1992).

Non-energy Mineral Resources

Several minerals in the Gulf of Mexico are potentially commercially exploitable. Known non-energy mineral resources include phosphate, sulphur, salt, oyster-shell, limestone, sand and gravel, and magnesia. As part of the ongoing investigations of marine mineral resources of the northern Gulf of Mexico, an Economic Exclusion Zone Gulf of Mexico task force was formed to conduct preliminary economic reconnaissance studies of non-energy marine minerals. The task force was made up of representatives from the MMS and from State agencies in Texas, Louisiana, Mississippi, and Alabama.

The State of Louisiana has mapped offshore sand deposits to determine possible sand sources for coastal restoration and protection against accelerating rates of wetland loss. Most of the potential sand sources occur within State waters, but some deposits have been found in Federal waters. Ship Shoal, a large sand shoal 15 km seaward of the Isles Dernieres barrier island system, contains high-quality sand that could be mined for beach replenishment (Byrnes and Groat, 1991). Deposits of high-quality, clean quartz sand in Federal and State waters off the coasts of Mississippi and Alabama are important for their potential use in the production of glass. Mining salt from diapiric structures beneath the OCS may be possible.

The DOI conducted an offshore sulphur lease sale on February 24, 1988. There are two producing sulphur operations offshore, both on the OCS. The Main Pass Sulphur Mine, located east of the modern Balize Delta lobe of the Mississippi River, has sulphur reserves that exceed all of the other remaining U.S. reserves combined. The other offshore sulphur operation is the Caminada Mine south of Grand Isle.

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.

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 lowest visibility. 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

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, millibars)	Stability Conditions Annual Percent		
						Unstable	Neutral	Stable
Corpus Christi, Tex.	0.77	21.7	5.4	89	1,014	11.0	61.0	28.0
Galveston, Tex.	1.07	20.9	4.9	83	1,015	16.0	61.4	22.6
Lake Charles, La.	1.35	19.9	3.9	90	1,016	23.0	44.0	33.0
Gulfport, Miss.	1.50	20.0	3.6	85	1,016	17.5	47.4	35.1
Pensacola, Fla.	1.55	19.9	3.7	85	1,013	18.0	22.0	60.0
Key West, Fla.	1.01	25.3	5.0	79	1,014	80.0	18.0	2.0

Sources: USDOC, NOAA, 1961-1986.

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

As stated previously, the Gulf of Mexico is part of the Atlantic tropical cyclone basin. Tropical cyclones generally occur in summer and fall seasons; however, the Gulf also experiences winter storms or extratropical storms. These winter storms generally originate in middle and high latitudes and have winds that can attain speeds of 15-26 ms^{-1} . The Gulf is an area of cyclone development during cooler months due to the contrast of the warm air over Gulf waters and the cold continental air over the United States. Cyclogenesis or formation of extratropical cyclones in the Gulf of Mexico is associated with frontal overrunning (Hsu, 1991). The most severe extratropical storms in the Gulf originate when a cold front encounters the jet stream over the warm waters of the Gulf. Statistics of 100-year data of extratropical cyclones reveal that most activity occurs above 25°N in the western Gulf of Mexico. The mean number of these storms ranges from 0.9 near the southern tip of Florida to 4.2 over central Louisiana (USDOL, MMS, 1988b). The ongoing Minerals Management Service's LATEX study contains an element to study the generation of extratropical storms in the Gulf.

The frequency of cold fronts in the Gulf exhibits similar patterns during the four-month period of December through March. During this time the area of frontal influence reaches 10°N. Frontal frequency is about nine fronts per month (1 front every 3 days on the average) in February and about seven fronts per month in March (1 front every 4-5 days on the average). By May, the frequency decreases to about four fronts per month (1 front every 7-8 days) and the region of frontal influence retreats to about 15°N. During June-August frontal activity decreases to almost zero and fronts seldom reach below 25°N. (USDOL, MMS, 1988b).

Tropical cyclones originate over the warm waters of the central Atlantic Ocean, Caribbean Sea, or the Gulf of Mexico. From a climatic point of view tropical storms provide a mechanism for transporting heat and water vapor from the tropics to midlatitudes. These storms are classified by the U.S. National Weather Service according to intensity. Tropical storms have wind speeds greater than 16 ms^{-1} ; storms with wind speeds greater than 32 ms^{-1} , are called hurricanes. Tropical cyclones occur most frequently between June and November. Based on 42 years of data, there are about 9.9 storms per year with about 5.5 of those becoming major hurricanes in the Atlantic Ocean (Gray, written communication, 1992). Data from 1886 to 1986 show that 44.5

percent of the storms originating in the Atlantic basin, or 3.7 storms per year, will affect the Gulf of Mexico (USDOl, MMS, 1988b). The same data, however, show that storm activity affecting the Gulf have decreased over the past 40-45 years. The number of hurricanes directly hitting the Gulf States are as follows: Florida, 54; Alabama, 10; Mississippi, 8; Louisiana, 24; and Texas, 36 (Herbert et al., 1992). The Yucatan Strait is the main entrance of Atlantic storms into the Gulf of Mexico, and a reduced translation speed over Gulf waters leads to longer residence times in this basin. There is a high probability that tropical storms will cause damage to physical, economic, biological, and social systems in the Gulf. The probability of storm occurrence in certain coastal areas and meteorological disturbance intensity is discussed in BLM Open File Report 80-02 (USDOl, BLM, 1982) and presented in Visual No. 7 of the Final EIS for Sales 131, 135, and 137. The visual shows the highest probabilities of at least one storm per season to be in the southern tip of Florida and west of the Mississippi River delta to Port Arthur, Texas. The coastline between Mississippi and west Florida also has areas of high probability for a hurricane hit. Table III-2 presents a summary of the most costly and deadliest storms in the Gulf of Mexico from 1900 to 1991. The deadliest hurricane, over 6,000 deaths, hit Texas in 1900. The costliest hurricane, Betsy in 1965, hit Florida and Louisiana and caused over \$6,461 million (1990 U.S. dollars) of damage. Most of the damage was caused by the storm surge, waves, and high winds. Storm surge depends on local factors, such as bottom topography and coastline configuration, and storm intensity. Surge observations in the Gulf have recorded water levels up to 7 m above mean sea level. Water depth and storm intensity control wave height during hurricane conditions. Wave heights up to 17 m have been predicted for areas between the Mississippi Delta and Matagorda, Texas (Visual No. 7). Winds for major hurricanes (Category 3 and above) are always higher than 49 ms⁻¹. The monetary cost of these storms have increased over time, mostly because of the population and construction increase along coastal areas.

Aside from the damages presented in Table III-2, tropical storms also affect OCS operations and activities. Dewald (1982) states that platform design needs to consider the wave and currents generated by tropical storms. He also reports that the cost of stopping production during the passage of a storm can be as high as \$500,000 per day for salaries, transportation, lodging, rental, and expenses related to evacuation. Notice that the above estimate does not include losses from stopping the crude oil or gas production. Oil spills can also occur after the passage of a hurricane as platforms and pipelines are damaged.

In the latter part of August 1992, Hurricane Andrew swept across the tip of Florida and into the Gulf of Mexico, making landfall in Louisiana on August 26, 1992. The coastal areas of Florida and Louisiana experienced destruction and damage estimated in excess of \$20 billion. Preliminary estimates conducted by MMS indicate that of the 3,850+ offshore oil and gas structures located in the Gulf of Mexico, 2,000 experienced hurricane force winds. Many of these structures were installed prior to 1972 and were not designed under today's more stringent requirements, that of having to withstand a 100-year storm. Several structures were toppled, others were found leaning in place, and a large number of structures incurred other damage. Numerous pipeline segments were damaged. Two fires were reported and both were extinguished. Seven oil spills were also reported. Some oil reached shore, while most was dissipated. As of this writing, an assessment, which takes into consideration the storm's impacts on the Gulf's coastal and marine environments, is in preparation.

Due to the extent of the damage incurred by the offshore oil and gas industry, MMS issued procedures (NTL 92-07, located in Appendix F) requiring industry to inspect for Hurricane Andrew storm damage to oil and gas structures and pipelines. NTL 92-07 requires Gulf of Mexico operators to conduct an underwater survey using trained divers to search for damage to structures and pipelines. This will be required for all areas within 50 mi of the path of the eye of Hurricane Andrew in the northeast quadrant (area of highest hurricane winds) and within 35 mi of the eye in the southwest quadrant. All pipelines in 50 ft of water will be inspected as far as the first 500 ft of the line, as well as all tie-ins and crossings.

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

Summary of Deadliest and Costliest Hurricanes in the Gulf of Mexico

<u>Hurricane</u>	<u>Year</u>	<u>Category¹</u>	<u>Damage² (million \$)</u>	<u>Deaths</u>
Alicia (Tex.)	1983	3	2,391	NA
Allen (Tex.)	1980	3	410	NA
Allison (Tex.)	1989	T.S.	511	NA
Audrey (La./Tex.)	1957	4	696	390
Betsy (Fla./La.)	1965	3	6,461	75
Beulah (Tex.)	1967	3	844	NA
Carla (Tex.)	1961	4	1,926	46
Camille (Miss./Ala.)	1969	5	5,242	256
Celia (Tex.)	1970	3	1,560	NA
Claudette (Tex.)	1979	T.S.	609	NA
Elena (Miss./Ala./Fla.)	1985	3	1,392	NA
Eloise (Fla.)	1975	3	1,081	NA
Fla.	1926	4	1,315	243
Fla. Keys	1919	4	NA	600*
Frederic (Ala./Miss.)	1979	3	3,502	NA
Hilda (La.)	1964	3	578	38
Juan (La.)	1985	1	1,671	NA
La.	1915	4	NA	275
La.	1909	4	NA	350
La.	1926	3	NA	25
Miss./Ala./Pensacola, Fla.	1906	3	NA	134
North Tex.	1915	4	1,177	275
Tex.	1900	4	NA	6,000+
Tex.	1909	3	NA	41
Tex.	1932	4	NA	40
South Tex.	1933	3	NA	40
Southeast Fla./La./Miss.	1947	4	707	51
Southeast Fla.	1906	2	NA	164
Southwest Fla.	1944	3	582	NA
Southwest La.	1918	3	NA	34

¹ Storm Category represents the Saffir/Simpson Scale

Category 1 = winds of 74-95 mph

Category 2 = winds of 96-110 mph

Category 3 = winds of 111-130 mph

Category 4 = winds of 131-155 mph

Category 5 = winds greater than 155 mph

² Damage in adjusted 1990 U.S. dollars.

T.S. = tropical storm.

NA= Data not available.

* Estimated deaths 600-900.

Source: Hebert et al., 1992.

protect public welfare. The National Ambient Air Quality Standards (40 CFR 50.4 to 50.11, 1990) are shown in Table III-3. 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. When measured concentrations of regulated pollutants exceed standards established by the NAAQS, the expected number of exceedances is calculated and both the concentrations and expected number of exceedances are employed to classify an area. Although the five states bordering the Gulf have adopted the standards established by the Clean Air Act, Florida has more restrictive standards for sulphur dioxide (SO_2). On occasion, the comparisons use stricter State-adopted standards. The USEPA classification for air quality is as follows:

<u>Classification</u>	<u>Definition</u>
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). All air quality nonattainment areas reported in Figure III-1 are for suspended particulate matter and ozone. 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 ozone 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). Concentrations of CO in the Beaumont-Port Arthur area had an 8-hr average of $3.435 \mu\text{gm}^{-3}$, which is well below the national standard of $10,000 \mu\text{gm}^{-3}$. All 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 $107.7 \mu\text{gm}^{-3}$; Corpus Christi reported a highest 24-hour average of $78.5 \mu\text{gm}^{-3}$. Both values are below the 24-hour average national standard of $365 \mu\text{gm}^{-3}$. Particulate matter (PM_{10}) concentration in the Houston-Galveston-Brazoria area reported a highest 24 hr average of $50 \mu\text{gm}^{-3}$ most of the year; this value is below the national standard of $150 \mu\text{gm}^{-3}$. Data for South Texas had highest 24-hr averages between 60 and $100 \mu\text{gm}^{-3}$; these averages are still below the standard. Ozone measurements are more comprehensive and continuous. Ozone concentrations in the Beaumont-Port Arthur and Brazoria areas reported 1-hr average monthly maximum values that exceed the national standard of $235 \mu\text{gm}^{-3}$; three times in 1988. The Houston area reported 1-hr average monthly maximum values that exceeded the national standard of $235 \mu\text{gm}^{-3}$ during most months of the year. Corpus Christi had 1-hr average monthly maximum values of near $200 \mu\text{gm}^{-3}$ during most months 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 $250.2 \mu\text{gm}^{-3}$, with the annual 1-hr mean varying between 41.3 and $48.9 \mu\text{gm}^{-3}$. This information shows that during the last five years the NO_2 standard has not been exceeded in New Orleans. Between 1985 and 1989

Table III-3
National Ambient Air Quality Standards for the Five Gulf of Mexico
States, with More Restrictive Standards Shown
for the State of Florida^a

Pollutant	Averaging Period	Primary Standards	Secondary Standards	Florida Standards
PM 10 particulate	annual (24-hour)	50 $\mu\text{g}/\text{m}^3$ 150 $\mu\text{g}/\text{m}^3$	50 $\mu\text{g}/\text{m}^3$ 150 $\mu\text{g}/\text{m}^3$	50 $\mu\text{g}/\text{m}^3$ 150 $\mu\text{g}/\text{m}^3$
Sulphur oxides	annual (arithmetic mean) 24-hour 3-hour ^b	80 $\mu\text{g}/\text{m}^3$ (0.03 ppm) ^d 365 $\mu\text{g}/\text{m}^3$ (0.14 ppm)	150 $\mu\text{g}/\text{m}^3$ (0.057 ppm) 260 $\mu\text{g}/\text{m}^3$ (0.1 ppm) 1,300 $\mu\text{g}/\text{m}^3$	60 $\mu\text{g}/\text{m}^3$ (0.02 ppm) 260 $\mu\text{g}/\text{m}^3$ (0.1 ppm) 1,300 $\mu\text{g}/\text{m}^3$ (0.5 ppm)
Carbon monoxide	8-hour ^b 1-hour ^b	10 mg/m ³ (9 ppm) 40 mg/m ³ (35 ppm)	(same as primary) (same as primary)	(same as primary) (same as primary)
Nitrogen dioxide	annual ^b (arithmetic mean)	100 $\mu\text{g}/\text{m}^3$ (0.05 ppm)	(same as primary)	(same as primary)
Photochemical oxidants ^c	1-hour ^b	235 $\mu\text{g}/\text{m}^3$ (0.12 ppm)	(same as primary)	0.12 ppm ^d

^aThe air quality standards and a description of the Federal Reference Methods (FRM) can be found in 40 CFR 50 on July 1, 1990.

^bNot to be exceeded more than once a year.

^cArithmetic mean is sum of the data collected during the given period divided by the number of observations in the same period not to be exceeded.

^dParts per million.

^eThe FRM measures O₃ (ozone).

Note: mg/m³ = milligrams per cubic meter = 1,000 $\mu\text{g}/\text{m}^3$.
 $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter.

Source: 40 CFR 50, 1990, and Florida Dept. of Environmental Regulation, 1987.

Figure III-1. Status of Air Quality in the Western and Central Planning Areas of the Gulf of Mexico.

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 1,257.2 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 SO₂ are reported in two coastal areas. The Metairie 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 (PM₁₀) 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).

Measurements of three air pollutants (PM₁₀, SO₂, and O₃) during 1990 and the first quarter of 1991 in Mobile County, Alabama, were obtained. 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 PM₁₀ 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 varied from 1 to 61 daily observations. The maximum ozone 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.

Six Louisiana parishes have nonattainment status for this pollutant (Section III A 3). Ozone measurements (Louisiana Dept. of Environmental Quality, 1989) between 1989 and 1990 were examined from Morgan City in St. Martin Parish, Thibodaux in Lafourche Parish, and Westlake in Calcasieu Parish. These measurements show that in Morgan City and Thibodaux the ozone concentration never exceeded the national standard. Concentrations at these stations were between 15 and 25 μgm^{-3} below the national standard (235 μgm^{-3}) during episodes of highest ozone concentrations. At other times concentrations were 45 to 50 units below the national standard. At Westlake in Calcasieu Parish, which is north of Cameron Parish, the ozone concentrations exceeded the national standards at least twice during 1989 and once during the first eight months of 1990. Another area with ozone problems is Baton Rouge. Recent air modeling there (Haney et al., 1990) indicates that ozone concentrations peak near 1600-1700 hours. The modeling effort, which included anthropogenic and biogenic sources, showed that some events could result from atmospheric overturning. During overturning episodes, ozone from previous days is mixed downward and, coupled with local and imported inputs of ozone, causes the concentrations to exceed the national standards. Recently, the MMS awarded a study to do a preliminary ozone modeling exercise with USEPA using the Regional Oxidant Model (ROM) for episodes with onshore transport. However, the results apply to the cumulative effects. A second study was awarded for a 3-year study of ozone formation and transport from OCS activities in the Gulf of Mexico.

The Breton National Wildlife Refuge and National Wilderness Area, located along the southwest west side of the Mississippi Delta, is a Class I air quality area administered by the U.S. Fish and Wildlife Service (see Visual No. 2 for Final FIS 142 and 143). Class I air quality areas are protected by stringent air quality standards and allow for very little deterioration of their air quality. The Prevention of Significant Deterioration (PSD) annual increments for Class I areas are as follows: 2.5 μgm^{-3} for NO_x, 2 μgm^{-3} of SO_x, and 5 μgm^{-3} of PM₁₀. Currently, the MMS is conducting a one-year study, with a possible extension to three years, to examine the impacts of OCS emissions (SO₂, H₂S, and H₂SO₄) on this area. Monitoring activities will include deployment of SO₂ monitors on Gosier Island and on a boat near Breton Island, coupled with taking meteorological soundings during southeasterly winds. The final report on this study is due in January 1994.

A recent report from the Lake Charles Ozone Task Force shows that out of 12 ozone exceedances in Calcasieu Parish, 3 cases show significant ozone contributions by transport from Texas. Another 3 cases with demonstrable transport ozone input occur, but the source areas are to the south or northwest. The report cites the Lake Charles industrial area to the south and the Beaumont and Orange, Texas, areas as the possible source areas in these cases. There were 5 other cases that showed local sources as the cause for the ozone exceedance episode. One episode cannot be studied with the methods employed by the Task Force for this analysis. Thus, there are 3 out of 12 cases where the ozone transport is correlated with southerly winds and

that can point to some inputs from OCS offshore sources. However, the report never indicates this as a possibility or even speculates about the OCS role. Ozone measurements made between 1989 and 1990 in Alabama show only one ozone exceedance episode near the Chickasaw station. Another station located on Highway 43 shows no episodes of ozone exceedance over the same period. Both stations showed that ozone is seasonal with a maximum during August and a decrease during the fall and winter, when ozone levels are about 50 percent below the national standard of $235 \mu\text{g}/\text{m}^3$.

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 km^3 ; the shelf's volume, assuming a mean water depth of 50 m, is 25,000 km^3 . 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 Aichalalaya 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 LIS for Sales 131, 135, and 137, range from nearly isothermal ($29-30^\circ\text{C}$) in August to a sharp horizontal gradient in January, ranging from 25°C in the Loop core to values of $14-15^\circ\text{C}$ 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 $18-19^\circ\text{C}$) grading into surrounding waters of $15-16^\circ\text{C}$ 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; Cochran 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 LIS 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 90-61 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 northern Gulf shelf. Figure 7 of Visual No. 7 for the EIS for Sales 131, 135, and 137 indicates that the front lies about 40-50 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 40 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 40 million m^3/s . Velocities up to 300 cm/s have been measured, but a range of 100-200 cm/s 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 cm/s . 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 km/d , 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 cm s^{-1} have been observed in this area (Vittor and Associates, Inc., 1985). The general circulation on the inner shelf is a two-season event. During winter, the water column is homogeneous and surface circulation is mainly alongshore and westward at mean speeds of $4\text{-}7 \text{ cm s}^{-1}$. 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 $2\text{-}7 \text{ cm s}^{-1}$. However, during periods of sustained winds from the west, northwest, north, and northeast, near-bottom speeds average 20 cm s^{-1} in water depths of 20 m. With sustained winds from the southeast, south, and southwest, the near-bottom average speed increases to 26 cm s^{-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). Using direct current measurements over the inner shelf, Dinnel (1988) proposed a counter-clockwise circulation in this area of the shelf. For the outer shelf and slope he hypothesized a clockwise circulation based on dynamic height maps relative to a 500-m level of no motion. In a recently completed MMS study, Kelly (1991) studied the circulation over this shelf. His ocean current measurements agree with Dinnel's inner shelf counter-clockwise circulation, but in the outer shelf and over the slope his measurements did not agree with Dinnel's circulation scheme. Instead, Kelly (1991) proposed a single counter-clockwise cell, which extends from the inner shelf and over the outer shelf and slope regions. However, more current measurements are needed to verify or reject this circulation scheme also. The study found conclusive evidence that Loop current intrusions modulate the wind-driven shelf circulation. Because the intrusions are random, frequent (occur 45% of the time), strong, and have variable area coverage, predictions of residence time and path of particles and pollutants are hard to make.

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 cm s^{-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 $0.2\text{-}7 \text{ cm s}^{-1}$ 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 $0.4\text{-}3 \text{ cm s}^{-1}$, and the general offshore speeds are less than 1 cm s^{-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 cm s^{-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 $25\text{-}50 \text{ cm s}^{-1}$ for conditions which are not extreme, 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 cm s^{-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.

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 shell waves. Also displayed are the expected 100-year maximum wave heights, which could range to 21 + m.

5. Water Quality

a. Marine Water Quality and Chemical Oceanography

Regional Overview

The Gulf of Mexico is a semienclosed body of water with oceanic input through the Yucatan Channel via the Caribbean and with principal outflow through the Straits of Florida. The presence of America's major river, the Mississippi, as well as a host of other major drainage systems, strongly influences the Gulf. Drainage 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, mixes 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.

Mixed-Layer Hydrography

The mixed layer, extending to a depth of approximately 100-150 m, is characterized by salinities between 36.0 and 36.5 parts per thousand (ppt) in the open Gulf (Barnard and Froelich, 1981). Salinity values in shelf and estuarine regions may vary widely from this range because of 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.

In the Eastern Gulf, maximum surface temperatures range from 20°C in late winter to about 29-30°C in the summer (Environmental Science and Engineering, Inc. et al., 1987; Smith, 1980). Temperatures encountered in the Louisiana-Mississippi shelf region may range as low as approximately 10°C at times of extremely high snow melt in the upper Mississippi valley.

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 (Barnard and Froelich, 1981).

Watermass Hydrography

Watermass hydrography is characterized by Figures 8 and 9 of Visual No. 7 of the Final EIS for Sales 131, 135, and 137. Vertical profiles of temperature, salinity, oxygen, and phosphate over six subareas of the Gulf identify five major watermasses down to 1,000 m.

Two types of unusual watermasses can be found in the Gulf of Mexico: hypersaline basins and midshelf freshwater vents. Two major basins containing hypersaline waters have been characterized. 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 (Barnard and Froelich, 1981; Rezak et al., 1985; Addy and Behrens, 1980). The southwest Florida shelf contains a number of submarine freshwater springs found in association with extensive karst topography.

Micronutrients

The principal micronutrients, generally depleted in the surface mixed layer, are phosphate, nitrate, and silicate. Phosphates range from 0 to 0.25 parts per million (ppm), averaging 0.021 ppm; silicates predominantly from 0.048 to 1.9 ppm; and nitrates from 0.0031 to 0.14 ppm, averaging 0.014 ppm. Shelf values for phosphates and silicates do not differ significantly from open Gulf values; shelf values for nitrates are slightly lower than open water values. In general, Eastern Gulf values for phosphates and silicates are somewhat lower than Central and Western Gulf values. There is no clear pattern in depth-integrated values between regions (Barnard and Froelich, 1981). Silicon is consumed for production of skeletal structures, particularly by diatoms, which are present in enormous numbers in Gulf waters. Mineralization of dead plankton returns the nutrients to the water column, although typically at a greater depth than that of initial assimilation, due to sinking.

Vertical distribution of nutrients show five general features related to both the identified watermasses and the biological activity: (1) low concentration in the mixed layer (to 100 or 200 m); (2) substantial increase from 200 m to 700 or 800 m; (3) maximum values at approximately 800-1,000 m; (4) small decreases in concentration below 1,000 m; and (5) homogeneous concentrations below about 1,500 m (Barnard and Froelich, 1981). Surface nutrient concentrations are often elevated in upwelling areas off Campeche Bank and the landward side of the Loop Current (Barnard and Froelich, 1981).

Suspended Particulate Matter and Optical Parameters

Photosynthesis in the ocean is light limited and, because of water-column attenuation, ineffective below a depth of about 75 m. At this depth, incident light is reduced to about 1 percent. The scattering of light induced by suspended particulate matter is the most highly variable component of total light-field attenuation in the water column. These particles, both organic and inorganic in nature, also act as substrates for bacterial activity, as transport sites for sorbed species, and as physical irritants to sensitive biological species. In general, the inorganic fraction of suspended particulate matter found in the Gulf 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, sharp discontinuities of suspended particulate matter separate near-bottom layers of turbid water from overlying waters. These nepheloid layers may be associated with resuspension of sediments by bottom 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, except the promontories of significant topographic highs (Brooks et al., 1981).

Central Gulf of Mexico

Estuarine and Inner Shelf

The estuarine and inner shelf areas of the Central Gulf are strongly influenced by freshwater flow from a number of major drainage systems, especially the Mississippi River and the Mobile-Tombigbee-Alabama river system. A complex geography of shallow sounds and bays and extensive tidal marshes protected by a chain of barrier islands acts to delay mixing, resulting in extensive areas of mesohaline conditions. Turbidity values are normally quite high, with suspended particles primarily composed of clay minerals (Hedges and Parker, 1976).

Mississippi Sound, adjacent to the coasts of Mississippi and Alabama, is subject to rapid changes in both temperature and salinity because of atmospheric variations, river discharges, rainfall, and tides. Within this estuarine system, significant stratification or water column inversions may occur at various times during the year. A salt wedge is detectable in all of the rivers in late summer and fall (Christmas and Eleuterius, 1973).

Louisiana's estuaries and open nearshore waters are generally characterized by large, shallow bays (depths less than 3 m); expansive salt, brackish, and fresh marshes; and extensive shallow, open water bodies. This estuarine environment constitutes the nation's major deltaic estuarine system, being a product of extensive sedimentation from the Mississippi River and a very small tidal range.

The Mississippi River input creates a lens of fresher, more turbid water, often curling to the west. Hydrographic studies, suspended-sediment characteristics, and chemical analyses demonstrate its influence as far west as South Texas. The most important characteristic of this fresh lens is its stratifying effect on the water column of nearshore waters. Hypoxic bottom-water conditions are frequently observed during summer months, particularly August, on the central Louisiana shelf. These hypoxic conditions are found 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).

Outer Shelf and Slope

Less is known about the outer shelf and slope of the Central Gulf than other zones. Observations indicate that the effects of the Mississippi are found here, although much reduced by distance. The MMS funded four cruises between March 1987 and March 1988 that measured chemical characteristics across the continental shelf of Mississippi and Alabama (Brooks and Giammona, 1988). The results of these cruises show that the surface temperature increased monotonically seaward from 15°C in shallow waters to 18°C over the shelf-slope. The scientists observed a tongue of water with lower salinity and higher dissolved oxygen values extending southward from Mobile Bay across the shelf. On the western side of the DeSoto Canyon area, surface waters with higher salinity and lower oxygen values were observed. Near the bottom, values of dissolved oxygen decreased monotonically from about 7.5 mg/l in shallow water to 4.5 mg/l at the 100-m isobath. A filament of the Loop Current containing water with higher temperature, salinity, and dissolved oxygen was measured.

Western Gulf of Mexico

Estuarine and Inner Shelf

Continental runoff influences nearshore surface concentrations in estuarine and inner shelf areas of the Western Gulf, especially in spring (Brooks et al., 1981). Dissolved oxygen values range from 4 to 9 mg/l and, in general, are high in November to March and low in summer, when both the effects of high temperatures and salinities reduce the level for saturation of dissolved oxygen (Texas A&M University, 1972; Danek and Tomlinson, 1981). A bottom nepheloid layer is nearly always observed (Brooks et al., 1981).

A well-defined annual cycle controls both temperature and salinity over most of the shelf. Generally, throughout the upper 70 m, temperatures over the inner shelf exhibit a maximum of 28-32°C in late August or early September and 12-13°C during late winter months (Smith, 1980; Texas A&M University, 1972). Temperature inversions for the top 20 m of water are normal for the months of January, February, and November (Danek and Tomlinson, 1981); bottom temperatures reflect transient upwelling in the summer months (Smith, 1980). Minimum salinities occur in late spring when values may decrease as low as 18 ppt over the inner shelf. These annual changes in salinity have been attributed to freshwater outflow, particularly Mississippi River runoff. Low salinity values in late spring have been related to increased runoff. The influence of the Mississippi River on Western Gulf salinities occurs several months after its peak outflow (Danek and Tomlinson, 1981).

Salinities in the western inner shelf also show a general north-south trend attributed to freshwater flow from the entire Gulf of Mexico coastline. The flow moves southwesterly along the inner shelf. Vertical

stratification may occur in fall and late spring in response to high levels of freshwater runoff. Generally, bottom waters do not vary in salinity seasonally as much as surface waters (Danek and Tomlinson, 1981).

Outer Shelf and Slope

On the outer shelf and slope, surface salinities may decrease to 32-33 ppt in late spring, in part because of river runoff, but they deviate little from 36 ppt at other times. In general, the influence of freshwater runoff is restricted largely to inner- and midshelf waters. Lowest temperatures range from 20-21°C over the outer shelf and reflect a dominant annual cycle through the upper 80 m. Near-bottom temperatures over the outer shelf vary over shorter time intervals, probably in response to vertical motions in the top of the permanent thermocline (Smith, 1980).

Marine Water Quality Concerns

Degradation of offshore waters is primarily associated with effluent discharges from offshore operations and contamination from mixing with degraded coastal and nearshore waters. Major offshore operations include OCS oil and gas development, sulfur mining, military activities, marine transportation, and ocean dumping. 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. Disturbances associated with oil and gas production are described in Section IV.A. 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. These discharges are characterized in Section IV.A.3.d. 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.

b. Coastal and Nearshore Water Quality

River outflows into the Gulf of Mexico, primarily that of the Mississippi River, determine coastal and nearshore water quality. Major point and nonpoint sources of contaminants occurring along the Gulf Coast include the petrochemical industry; hazardous waste 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 near 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 or near service bases and marine terminals, vessels 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.

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.

A good indicator of coastal and estuarine water quality is the quality of bivalve molluscs 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).

Louisiana

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 has been linked to density stratification caused by high temperatures combined with river discharges and high organic nutrient inputs (Boesch and Rabalais, 1987). Others feel that pollution carried in the rivers entering the Gulf and coastal waters contribute to this condition. 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).

Texas

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).

B. BIOLOGICAL RESOURCES

1. Sensitive Coastal Environments

a. Coastal Barrier Beaches and Associated Dunes

Coastal barriers of the Western and Central Gulf Coast consist of relatively low land masses that can be divided into several interrelated environments. The beach itself consists of the foreshore and backshore. The nonvegetated foreshore slopes up from the ocean to the beach berm-crest. The backshore may occasionally be absent due to storm activity. If present, the backshore is found between the beach berm-crest and the dunes and may be sparsely vegetated. 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 vegetation. 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.

When Gulf water levels are elevated by storms, water will overwash a coastal barrier. This action will create overwash fans or terraces behind and between the dunes. With time, these terraces will be vegetated by opportunistic species. Along more stable barriers, the area behind the dunes consists of broad flats that support scrubby woody vegetation. Saline or freshwater ponds may be found among the dunes or landward flats. Landward, these flats may grade into wetlands and intertidal mud flats that fringe the shore of lagoons, islands, and embayments. In other areas, these barriers may grade into scrub or forest habitat of the mainland, with no bay or lagoon separating the two landforms. Habitats found among the coastal barrier landforms provide a variety of niches that support many avian, terrestrial, aquatic and amphibious species, some of which are endangered or threatened. For discussions of these subjects, see the related sections in this EIS.

Stability of these habitats is primarily dependent upon the rates of geodynamic change for each coastal vicinity. The major sources of pressure that causes barrier landforms to change are storms, subsidence, delta abandonment, and human activity.

Barrier landforms of these coasts are continually adjusting their configuration in response to prevailing or changing environmental conditions. Landform changes can be seasonal and cyclical, such as seen with the transitional movement of sand onshore during the summer and the movement of sand offshore during the winter, due to winter storms. Changes in landforms can also be noncyclically progressive, such that landforms might move landward, seaward, or laterally along the coast.

Lateral movement of barrier landforms is of particular importance. As headland and beaches are eroded away, their sandy sediments are reworked and, under site-specific conditions, are transported laterally along the shoreline forming sand spits to the side of the headland or islands. As these sand spits extend themselves, they may encase marshes or previously open although shallow Gulf waters. By separating coastal waters from

Gulf waters and slowing the distribution of freshwater into the Gulf, the movement of barrier landforms can contribute to the area of estuarine habitat available along a coast.

Seaward advance of a shoreline may be caused by deltaic building processes by which sediments are imported into coastal waters and are deposited, thereby building land. Interruptions of the longshore sediment transport will cause the accumulation of sediments on the up-drift side of the obstruction, causing an accretion and seaward building of the shoreline. Man-made obstructions include jetties, groins, breakwaters, and bulkheads.

Landward retreat of a shoreline may be caused by subsidence, reduced sediment in longshore drift, or storm erosion.

The accumulation and movements of the sediments that make up barrier landforms are often described in terms of transgressive and regressive sequences. Transgressions and regressions are related to local relative sea-level change and rates of sedimentation and erosion. A transgressive sequence is one in which the shore moves landward and marine deposits form on terrestrial sediments. In contrast, a regressive sequence is one in which terrestrial sediments are deposited over marine deposits as the land builds out into the sea.

Transgressive coastal 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 Central and Western Gulf of Mexico.

From east to west, the barrier coasts of the Western and Central Gulf include Baldwin County Headland in Alabama, the barrier islands of Mississippi Sound, the Chandeleur Islands, the Modern Mississippi River Delta and its developing barrier islands, the Bayou Lafourche Headland and accompanying barrier islands, Isles Dernieres, the Cheniere Plain of Louisiana and Texas, Trinity River Delta, Brazos-Colorado River Delta and its accompanying barrier islands, barrier islands of Espiritu Santo Bay and Laguna Madre, and the Rio Grande Delta. 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 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.

Louisiana has the most rapidly retreating beaches in the nation. The statewide average for 1956-1978 was 27.2 ft/yr (van Beek and Meyer-Arendt, 1982). The sand beach formed between the Gulf and Bay Marchand retreated landward at rates of 60-75 ft/yr between 1887 and 1978 (Penland and Suter, 1988). The average retreat rate for Fourchon Beach over the past 100 years has been 35 to 65 ft/yr (Boyd and Penland, 1988).

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, submergence due to subsidence and sea-level rise transforms the abandoned delta into an erosional headland with flanking barriers. The Bayou Lafourche Headland is an example of an eroding and subsiding delta that transgressively generates a barrier island arc, the ends of which are separated from the mainland. Isles Dernieres is an example of a barrier arc of islands that separated from its headland due to subsidence (Penland and Suter, 1988). With continued subsidence and no source of sediment, Isles Dernieres will eventually submerge and form a submarine inner-shelf shoal (Penland and Boyd, 1985).

The coast of the Chenier Plain 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 due to 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. Sand beaches occurring along the Chenier Plain rest against the marsh. Although these beaches consist of 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 supports a continuous barrier shoreline. The barrier islands and spits were formed from sediments supplied from the three listed 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.

In recognition of the natural value of barrier islands and their associated habitats, Congress and the National Park System has established the Padre Island National Seashore and the Gulf Islands National Seashore in the Western and Central Gulf, respectively. These preserves are discussed in Section III.C.4.

b. Wetlands

Wetland habitat types occurring along the Gulf Coast include fresh, brackish, and saline marshes; forested wetlands; and small areas of mangroves. Wetland habitats may occur along narrow bands or across broad expanses. They can support sharply delineated zones of different species, monotonous stands of a single species, or mixed communities of plant species.

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. Wetlands on the deltaic plain are situated on a series of overlapping riverine deltas that have extended onto the continental shelf during the past 6,000 years. The alluvial and organic-rich sediments found on these areas are subject to high, natural-subsidence rates. The effects of subsidence are compounded by sea-level rise (1 cm/yr, van Beek and Meyer-Arendt, 1982), both of which have 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. Historically, areas of the deltaic plain that were located near an active channel of the Mississippi River tended to build outward, and marsh areas tended 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. Today, the Mississippi River is leveed, which greatly reduced the once natural formation of deltaic wetlands.

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 Gulf Coast. These ridges are separated by progradational mudflats that are now marshes or open water. The mudflats were built during times when the Mississippi River channel was located on the western side of the deltaic plain or when minor changes in localized hydrologic and sedimentation patterns favored 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 km² 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 km² per year (Britsch and Kemp, 1990).

Several factors contribute to wetlands loss in coastal Louisiana. Sediment deprivation is a result of a 50 percent decrease in the suspended-sediment load of the river since the 1950's, channelization of the river, and the primary cause, which was levee construction. Subsidence and sea level rise have caused submergence of lower wetland areas. Construction of ring levees have allowed drainage and development of extensive wetlands. Development activities in low areas, outside leveed areas, have caused the filling of wetlands. Construction of canals converts wetlands to open water and upland spoilbanks. Canals and subsidence have also contributed to increased tidal influence and salinities in freshwater and low-salinity wetlands, which in turn increase erosion and sediment export.

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.

Most of the wetlands in Alabama occur on the Mobile River delta or along the northern Mississippi Sound. Between 1955 and 1979, fresh marshes and estuarine marshes declined in these area by 69 and 29 percent, respectively. 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. Sparse bands of black mangroves are also found in this region. Freshwater marshes of the region occur primarily along the major rivers and tributaries. 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. Dominant 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 rise. 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 of wetlands were lost between 1952 and 1974 (Gosselink et al., 1979).

Seagrasses

There are an estimated 3 million ha of submerged seagrass beds in the exposed, shallow coastal waters of the northern Gulf of Mexico. An additional 166,000 ha confined to 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/m², and extremes up to 8,100 g/m² (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 tolerate 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 highly organic 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 sensitive offshore resources refers both 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 resources are treated in some detail in Sections III.B.2.a., b., and c. below.

Water-column biota include the plankton (drifters) and nekton (swimmers). 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 subtropical 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, tending to 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.6., and fishes and fisheries in Sections III.B.7. and 8., 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 bacteria, 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 180 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. 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 or are attached to 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, food 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.

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; IGL 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 the 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 egest 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 National Marine Fisheries Service (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 of 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 IGL 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 dominant, many of them reaching their maximum populations in this zone. Asteroids, gastropods, and polychaetes are common.

The Archibenthic Zone has two subzones. The Horizon A Assemblage is located between 475 and 750 m. Although less abundant, the demersal fish are a major constituent of the fauna, as are gastropods and polychaetes. Sea cucumbers are more numerous. The Horizon B Assemblage is 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.

At the onset of the Mesoabyssal Zone, 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, the 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 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 relief 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.

With the exception of the region defined as the pinnacle-trend area, 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 general 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 rough-tongue 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. 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 primarily associated with seismic wipe-out zones and hydrocarbon and H_2S seep areas beyond water depths of 400 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 well-developed seep communities are characterized by bacterial mats; 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 nonchemosynthetic stations 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 dense 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 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 m² to approximately 20 m².

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.

An 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 (*Bathynomus giganteus*).

Other chemosynthetic sites have similar biota, although few are as dense 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 (H₂S, CH₄, 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, H₂S-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.

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.

c. Topographic Features

The shelf and shelf edge of the Central and Western Gulf are characterized by topographic features that are inhabited by hard-bottom 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 temperature of 16°C 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 asterooides*. 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 vermillion 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.

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 surrounding communities. 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 reeffish, 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 rough-tongue 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

Bright Bank
McGrail Bank
Rankin Bank
Alderdice Bank
Rezak Bank
Sidner Bank
Ewing Bank
Jakkula Bank
Bouma Bank
Parker Bank
Sackett Bank
Diaphus Bank
Sweet Bank

Midshelf Banks

Sonnier Bank
29 Fathom Bank
Fishnet 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)).

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

Table III-4
Biotic Zones of Topographic Features
with Bank Crest and Seafloor Depth in Meters

	<u>Millepora- Sponge</u>	<u>Diplora Montastrea- Porites</u>	<u>Madracis</u>	<u>Stephanocoenia</u>	<u>Algal-Sponge</u>	<u>Transitional</u>	<u>Antipatharian- Nepheloid</u>	<u>Seafloor</u>
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
Geyer	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								
Sehree							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.

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.

It has been suggested that four other features in the Western Gulf be considered as sensitive offshore topographic features: Phleger, Sebree, and Big and Small Adam Banks. Phleger Bank (a shelf-edge bank) crests at 122 m, deeper than the lower limit of the No Activity Zones [85 m (100 m in the case of the Flower Gardens)]. The depth of the bank precludes the establishment of the Antipatharian Zone so that even though the bank is in clear water, the biota are typical of the nepheloid zone. The bank appears to be predominantly covered with sand, with scattered rock outcrops of approximately 1-2 m in diameter and 1 m in height. The sand substrate is devoid of sessile benthic organisms, although the rock outcrops support a number of epifaunal species such as cup-shaped and encrusting sponges, octocorals, and crinoids. Roughtongue bass was observed in video surveys to be the dominant fish species on this bank.

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, located in 36.5 m of water, is a low-relief feature of approximately 3 m in relief and is subject to high sedimentation. Clusters of the scleractinian coral, *Oculina diffusa*, have been observed on the rocky outcrops of this bank. This species tends to thrive in habitats exhibiting low light and high sedimentation. It forms twisted, rather low relief colonies, and does not create reefs or distinctive assemblages of reefal species. The bank attracts abundant nektonic species, including red snapper and other commercially and recreationally important finfish (Tunnel, 1981). On August 25, 1993, a cooperative dive effort on Sebree Bank was completed. Divers from MMS, the State of Texas, and Texas A&M University at Corpus Christi participated. The NOAA representatives were unable to participate in these dives due to manpower and scheduling difficulties. The results of this dive effort are being compiled at this writing and will be used to update information about Sebree Bank. Impacts to the biota of the nepheloid zone of Sebree Bank or Phleger Bank are not expected to be significant. Big and Small Adam Banks are also low-relief features subject to sedimentation. Rezak and Bright (1981) categorized these features as Class D banks, where protection is not recommended. A BLM study designed to map the bathymetry of the banks of the Gulf (Texas A&M Research Foundation, 1974) did not discern these features as mappable banks. Although the banks may contain the Antipatharian Zone, this designation is speculative (Rezak et al., 1983). The biota of Big and Small Adam Banks are not expected to be significantly affected.

3. Marine Mammals

Twenty-nine species of cetaceans, one sirenian, and one exotic pinniped (California sea lion) have been sighted in the northern Gulf of Mexico (Table III-5). Cetaceans are divided into two major suborders: Mysticeti (baleen whales) and Odontoceti (toothed whales and dolphins). The only member of the Order Sirenia found in the northern Gulf is the West Indian manatee, which is common throughout coastal and inshore waters north to the Suwannee River of Florida. They are uncommon along the Florida Panhandle and rarely venture as far west as the Central and Western Gulf Planning Areas, and thus, have been excluded from the analyses of this document. California sea lions exist in the northern Gulf of Mexico as feral individuals that were probably released or escaped from aquaria, animal shows, and marine parks.

Seven species of baleen whales have been reported in the Gulf of Mexico. These include the northern right whale and six species of balaenopterid whales (blue, fin, sei, Bryde's, minke, and humpback). Though sightings and strandings of these species are uncommon in the Gulf, historical sightings and stranding census data suggest that they more often frequent the north-central Gulf region.

Table III-5

Marine Mammals of the Gulf of Mexico

Order Cetacea

Suborder Mysticeti (baleen whales)

Family Balaenidae

<i>Eubalaena glacialis</i>	northern right whale	R*
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Family Balaenopteridae

<i>Balaenoptera musculus</i>	blue whale	R*
<i>Balaenoptera physalus</i>	fin whale	R*
<i>Balaenoptera borealis</i>	sei whale	R*
<i>Balaenoptera edeni</i>	Bryde's whale	R
<i>Balaenoptera acutorostrata</i>	minke whale	R
<i>Megaptera novaeangliae</i>	humpback whale	R*

Suborder Odontoceti (toothed whales)

Family Physeteridae

<i>Physeter macrocephalus</i>	great sperm whale	C*
<i>Kogia breviceps</i>	pygmy sperm whale	C
<i>Kogia simus</i>	dwarf sperm whale	U

Family Ziphiidae

<i>Mesoplodon bidens</i>	Sowerby's beaked whale	E
<i>Mesoplodon densirostris</i>	Blainville's beaked whale	R
<i>Mesoplodon europaeus</i>	Gervais' beaked whale	U
<i>Ziphius cavirostris</i>	Cuviers beaked whale	U

C = common, U = uncommon, R = rare, E = extralimital record, I = introduced, Ex = extinct,
 * = endangered

III-44 Table III-5. Marine Mammals of the Gulf of Mexico (continued)

Order Cetacea (continued)

Family Delphinidae

<i>Orcinus orca</i>	killer whale	R
<i>Pseudorca crassidens</i>	false killer whale	U
<i>Feresa attenuata</i>	pygmy killer whale	U
<i>Globicephala macrorhynchus</i>	short-finned pilot whale	C
<i>Grampus griseus</i>	grampus/Risso's dolphin	U
<i>Peponocephala electra</i>	melon-headed whale	R
<i>Tursiops truncatus</i>	Atlantic bottlenose dolphin	C
<i>Delphinus delphis</i>	common dolphin	R
<i>Steno bredanensis</i>	rough toothed dolphin	R
<i>Stenella coeruleoalba</i>	striped dolphin	C
<i>Stenella attenuata</i>	pantropical spotted dolphin	R
<i>Stenella clymene</i>	short-snouted spinner dolphin (Clymeni dolphin)	U
<i>Stenella frontalis</i>	Atlantic spotted dolphin	C
<i>Stenella longirostris</i>	long-snouted spinner dolphin	U
<i>Lagenodelphis hosei</i>	Fraser's dolphin	R

Order Carnivora

Suborder Pinnipedia (seals, sea lions)

Family Otariidae

<i>Zalophus californianus</i>	California sea lion	I, R
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Family Phocidae

<i>Monachus tropicalis</i>	Caribbean (West Indian) monk seal	Ex
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Order Sirenia

Family Trichechidae

<i>Trichechus manatus</i>	West Indian manatee	C*
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Source: Schmidly and Scarborough, 1990.

C = common, U = uncommon, R = rare, E = extralimital record, I = introduced, Ex = extinct,
* = endangered

Twenty-two species of toothed whales and dolphins have been reported in the Gulf of Mexico. These include the great sperm whale; pygmy and dwarf sperm whales; four species of beaked whales (Cuvier's, Gervais', Blainville's, and Sowerby's); killer whale; false and pygmy killer whale; short-finned pilot whale; grampus (Risso's dolphin); melon-headed whale; and nine other species of delphinid dolphins (bottlenose, Atlantic spotted, pantropical spotted, spinner, clymene, striped, common, Fraser's, and rough-toothed). Many of these species are distributed in warm temperate to tropical waters throughout the world (Mullin et al., 1991).

a. Nonendangered and Nonthreatened Species

Baleen whales from the Gulf of Mexico that are not listed as endangered include the Bryde's whale and the minke whale. The Bryde's whale is the second smallest of the balaenopterid whales commonly called rorquals, a Norse term meaning "red whale," referring to the pinkish tint of their characteristic throat pleats that expand during feeding. Bryde's whales are not noted for lengthy migrations and tend to remain within tropical to temperate waters. This species feeds on small pelagic fishes (such as herring, mackerel, and pilchard) and cephalopods (Cummings, 1985). It is believed that a small, resident population of Bryde's whales may inhabit the Caribbean Sea or Gulf of Mexico (Schmidly, 1981). The minke whale is the smallest of the rorquals and is cosmopolitan in distribution. It is widespread and seasonally abundant in the North Atlantic Ocean, migrating southward during winter months to the Florida Keys, the Gulf of Mexico, and the Caribbean Sea. Minke whales feed on zooplankton and fish (Stewart and Leatherwood, 1985).

With the exception of sperm whales, none of the toothed whales and dolphins from the Gulf of Mexico are listed as endangered or threatened. Dwarf and pygmy sperm whales are typically found in deeper waters (the continental shelf edge and beyond) and congregate in small herd sizes (2-10 individuals). Temporal distribution within the Gulf has been variable (Mullin et al., 1991). Their diet includes squid, benthic fish, and crabs (Caldwell and Caldwell, 1989). Beaked whales (family Ziphiidae) from the Gulf include Cuvier's beaked whale and three members of the genus *Mesoplodon* (North Sea beaked whale, Blainville's beaked whale, and antillian beaked whale). Taxonomy and life history data on these species are extremely limited. Observed herd sizes of beaked whales are in most cases small (1-2 individuals), and the typical behavioral response to survey aircraft and ships is for them to be evasive (Mullin et al., 1991). An analysis of stomach contents from captured and stranded individuals suggest that they are deep-diving animals, feeding predominantly on mesopelagic fish and squid or deep-water benthic invertebrates (Heyning, 1989; Mead, 1989).

The family Delphinidae is taxonomically broad and includes all remaining species of nonendangered whales and dolphins found in the Gulf. Most of the constituents inhabit deeper waters of the Gulf, save the bottlenose dolphins, and their specific distributions appear to be a function of preferred depth range. Bottlenose dolphins are the most common delphinid on the continental shelf and nearshore waters of the Gulf. Many regional studies have demonstrated the presence of morphologically discrete offshore and coastal adult forms (Mead and Potter, 1990). However, at present, there is no evidence to support the assumption that inshore/offshore populationals are genetically discrete (Hansen, personal communication, 1993). Atlantic spotted dolphins frequent mid-shelf to outer-shelf waters with some degree of overlap with bottlenose dolphins, especially the offshore forms. Grampus are also frequently sighted along the shelf edge. All other delphinids appear to prefer deeper slope waters and feed on fish and/or squid, depending upon the species (Mullin et al., 1991). Knowledge of the spatial and temporal abundance of most deep-water cetaceans in the Gulf has been, until this time, sparse and limited to a few survey areas. At present, MMS is funding a study (GULFCET) using broad-based aerial and shipboard surveys to determine the seasonal and geographic distribution of cetaceans along the continental slope in the north-central and western Gulf. Recent surveys have led to the discovery of at least one rather large herd (approximately 200 individuals) of Fraser's dolphins (hitherto known to the Gulf only via a single stranding on the Florida Keys). Sightings and acoustic recordings of shelf edge and deep-water species have been made using systematic transects (Texas A&M University, Texas Institute of Oceanography, 1992).

b. Endangered and Threatened Species

Six species of baleen whales (northern right, blue, fin, sei, minke, and humpback) and one species of toothed whale (sperm whale) found within the Gulf of Mexico are currently listed as endangered under the provisions of the Endangered Species Act of 1973. All are uncommon to rare in the Gulf except for the sperm whale.

The northern right whale is a robust, medium-sized baleen whale. As a result of extensive hunting pressure, it remains the rarest of the world's large whales. Current populations within the North Atlantic seasonally migrate around five discrete areas along the eastern seaboard of the U.S. (USDOC, NMFS, 1991a). Historical records of northern right whales in the Gulf of Mexico consist of a single stranding record in Texas in 1974 and a sighting of two individuals off the western coast of Florida (1963) (Moore and Clark, 1963; Schmidly, 1981). Right whales feed by systematically skimming through surface and subsurface concentrations of zooplankton with their enormous mouth held agape (Watkins and Schevill, 1976).

The blue whale is the largest of the whales and is cosmopolitan in distribution, migrating poleward to feeding grounds in spring and summer after wintering in subtropical and tropical waters (Yochem and Leatherwood, 1985). Records of the blue whale in the Gulf consist of two strandings on the Texas coast (1924 and 1940), and it is believed that the entire surviving population in the North Atlantic consists of only a few hundred individuals (Leatherwood and Reeves, 1983). It is the largest rorqual, and feeds almost exclusively on zooplankton via a combination of gulping and lunge-feeding in areas of heavy prey concentration (Yochem and Leatherwood, 1985).

The fin whale is the second largest rorqual in size and is also cosmopolitan in distribution. It is thought that fin whales segregate into independent stocks in each hemisphere and that there may be a small population which inhabits the Gulf of Mexico or Caribbean Sea (Schmidly, 1981). Fin whales feed on zooplankton, cephalopods, and fish, generally via surface and subsurface lunge-feeding (Gambell, 1985a). Sightings in the Gulf have typically been in deeper waters, more commonly in the north-central area (Mullin et al., 1991).

The sei whale is a medium-sized rorqual that is widely distributed in all oceans. They migrate between temperate waters and higher latitudes, though they do not go so far towards polar waters as do some other rorquals. Sei whales feed primarily on plankton via skimming, though they do consume small schooling fish in some areas via lunge-feeding (Gambell, 1985b). Two sei whales were sighted off the Mississippi River Delta in 1956 and off Gulfport, Mississippi, in 1973 (Mullin et al., 1991). Valid sighting and stranding records from the Gulf of Mexico, Caribbean Sea, and off eastern Florida suggest that there may be a resident population in the Gulf (Mead, 1977).

The humpback whale, though a member of the family Balaenopteridae, is distinctively different in appearance from the true rorquals. They occur in all oceans, and seasonally migrate from summer feeding grounds in higher latitudes to a winter range over shallow tropical banks where they calve and do not feed. Humpbacks feed on fish and zooplankton, which typically aggregate into dense or large patches. They capture prey using a diverse and oftentimes elaborate array of feeding techniques, either singly or within groups (Winn and Reichley, 1985). Sightings in the Gulf of Mexico have been sporadic and include the Central Gulf, in the Eastern Gulf off Florida, and most recently (1992) off Galveston Bay, Texas (Schmidly, 1981; Gainesville Sun, 1983).

The sperm whale is the only toothed whale listed as an endangered species. They have a cosmopolitan distribution within deep-sea areas and form social aggregations consisting of mature females, juveniles, and calves. Male sperm whales form separate bachelor herds of varying size or, in the case of large males, remain solitary. As a group they seem to prefer certain areas within each major ocean basin, which historically have been termed "grounds" (Rice, 1989). Large mesopelagic squid are the primary diet of sperm whales, though other cephalopods, demersal fishes, and occasionally benthic invertebrates are eaten (Rice, 1989). It is the most abundant large whale in the Gulf of Mexico and has been sighted on most surveys conducted in deeper waters (Fritts et al., 1983; USDOC, NMFS, 1988; Mullin et al., 1991). Congregations of sperm whales are commonly seen off the shelf edge in the vicinity of the Mississippi River Delta (Mullin et al., 1991). There is, as yet, no data available that suggests seasonal movements of sperm whales in the Gulf of Mexico (Schmidly, 1981). A component of the ongoing GULFCET study will include an attempt to tag and track a limited

number of sperm whales within the continental slope area of the north-central and northwestern Gulf using satellite telemetry to determine seasonal movements, diving behavior, and preferred habitat (Texas A&M University, Texas Institute of Oceanography, 1992).

4. 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 (USDOI, FWS, 1987). Their population has declined as a result of tropical storms, loss of habitat from coastal development, and predation (Ehrhart, 1978; Humphrey and Frank, 1992). Beach-mice habitat occupied at present is believed to no longer contain optimal elements (Meyers, 1983). Documented beach-mice range is chiefly in Perdido Key State Preserve (Florida), Grayton Beach State Recreational Area (Florida), St. Andrews State Recreation Area and Shell Island (Florida), Gulf Islands National Seashore (Alabama), and Gulf State Park (Alabama). Beach Mice habitat also includes Escambia County (Florida) and Baldwin County (Alabama). Portions of these areas have been designated critical habitat. Beach mice feed nocturnally on the lee side of the dunes and remain in burrows during the day. Their diet consists mainly of beach grass and sea oats, and sometimes sea rocket (*Cakile* sp.) and invertebrates (Ehrhart, 1978).

5. Marine Turtles

This section contains a brief, species account of the sea turtles of the Gulf of Mexico.

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 (Hildebrand, 1982). Reports of nesting in the northern Gulf are isolated and infrequent, except on Santa Rosa Island, Walton County, Florida. The closest significant nesting aggregations are on the Florida east coast and the Yucatan Peninsula. In feeding habitats green turtles prefer depths of less than 20 m, where seagrasses and algae are plentiful (Carr and Caldwell, 1956; Hendrickson, 1980). In coastal Texas, green turtles demonstrated site fidelity, remaining in one location for several months (NMFS Newsbreaker, 1993).

Leatherbacks (*Dermochelys coriacea*), the largest and most oceanic of marine turtles, seasonally enter coastal and estuarine habitats where jellyfish are plentiful (Lazell, 1980). Their nesting is concentrated on coarse-grain beaches in the tropical latitudes (Pritchard, 1971), but there are rare occurrences on the Panhandle and Flagler County coasts in Florida (Ogren, 1990). Leatherbacks have unique deep diving abilities (Eckert et al., 1986), a specialized jellyfish diet (Brongersma, 1972), and unique physiological properties that distinguish them from other sea turtles (Lutcavage et al., 1990; Paladino et al., 1990).

The hawksbill (*Eretmochelys imbricata*) is the least commonly reported marine turtle in the Gulf (Hildebrand, 1982). Stranded turtles are regularly reported in Texas (Hildebrand, 1982; Ogren et al., 1989), and recently, in Louisiana (Choromanski, personal communication, 1992) these tend to be either hatchlings or yearlings. Northerly currents may carry them away from their natal beaches in Mexico northward into Texas (Amos, 1989; Collard and Ogren, 1989). They are more common in tropical areas of the Atlantic, Gulf of Mexico, and Caribbean. Hawksbill turtles prefer reefs and shallow coastal waters where marine invertebrates are abundant (Carr and Stancyk, 1975; Witzell, 1983).

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 (Hildebrand, 1963) to less than 1,000 today (Pritchard, 1990). An estimated 700-1,000 nests are laid annually, primarily on a 17-km stretch of beach in Rancho Nuevo, Vera Cruz, Mexico (Marquez et al., 1989; Burchfield et al., 1992). 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 hatchling and rearing program on Padre Island National Seashore (Klima and McVey, 1982). Hatchlings appear to disperse offshore, and are sometimes found in sargassum mats (Carr and Meylan, 1980; Collard and Ogren, 1990). The Kemp's ridley's distribution is associated with the abundance of portunid and other crabs (Ogren, 1989; Shaver, 1991) and seagrass ecosystems (Carr and Caldwell, 1956; Lutcavage and Musick, 1985). In the Gulf, Kemp's ridleys

inhabit nearshore areas, and have also been recorded off the mouth of the Mississippi River (Fuller and Tappan, 1986; Byles, 1989). Although adult Kemp's ridleys primarily inhabit the Gulf of Mexico, subadults range on the Atlantic coast to Massachusetts (Lazell, 1980; Lutcavage and Musick, 1985; Standora et al., 1989). Carr (1980) and Hendrickson (1980) believed that young ridleys found beyond the Gulf of Mexico are lost to the breeding population, but some researchers dispute this view (Lutcavage and Musick, 1985; Henwood and Ogren, 1987; Standora et al., 1989). Juvenile ridleys recently tagged and released in Atlantic coastal habitats demonstrated movements southward along the coast of Florida (NMFS Newsbreaker, 1992), but to date their remigration to the Gulf is unverified.

The loggerhead sea turtle (*Caretta caretta*) occurs worldwide in habitats ranging from estuaries to the continental shelf (reviewed in Dodd, 1988). It is found in the Atlantic from Newfoundland to Argentina, and nesting occurs worldwide. Aerial surveys indicate that loggerheads are common in less than 50 m depth, but they are also found in deep water (Shoop et al., 1981; Fritts et al., 1983). The largest nesting concentration in the United States is on the southeast Florida coast from Volusia to Broward Counties (Hopkins and Richardson, 1984). 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 (Fuller et al., 1987). Nesting in Texas occurs primarily on North and South Padre Islands, although occurrences are recorded throughout coastal Texas (Hildebrand, 1982). The banks off of the central Louisiana coast and near the Mississippi Delta are also important marine turtle feeding areas (Hildebrand, 1982). Hatchlings have a pelagic phase followed by movement inshore. Loggerheads engage in omnivorous benthic (Hendrickson, 1980) and surface feeding (Plotkin, 1989). Adults and juveniles are frequently found in association with concentrations of portunid and horseshoe crabs, but the loggerhead's prey includes invertebrates from eight phyla (reviewed in Dodd, 1988).

The recently designated Archie Carr National Wildlife Refuge in Brevard and Indian River Counties, Florida, hosts the largest concentration of nesting loggerhead and green sea turtles in the United States (Ehrhart and Witherington, 1987). It is believed to be the second largest nesting beach for loggerheads in the world (Ross, 1982).

6. Coastal and Marine Birds

a. Nonendangered and Nonthreatened Species

The offshore waters, coastal beaches, and contiguous wetlands of the northern Gulf of Mexico are populated by both resident and migratory species of coastal and marine birds. They are herein separated into five major groups: seabirds, shorebirds, wading birds, marsh birds, and waterfowl. Many species are strongly pelagic, and therefore rarely seen from shore. The remaining species, which are most susceptible to potential deleterious effects resulting from OCS-related activities, are found within coastal and inshore habitats (Clapp et al., 1982). Recent surveys indicate that Louisiana and Texas are among the most important states in the south and southeastern U.S. in terms of nesting colony sites and total number of nesting coastal and marine birds (Martin and Lester, 1991; Martin, 1991). Fidelity to these nesting sites varies from year to year along the Gulf Coast, with site abandonment along the northern Gulf Coast often attributed to habitat alteration and excessive human disturbance (Martin and Lester, 1991).

Seabirds are defined as those species which spend extended periods away from land and obtain all or most of their food from the sea while flying, swimming, or diving (Nettleship, 1977). Some are coastal feeders and residents, whereas others remain offshore, foraging over deep water in pelagic regions (Nettleship, 1991). Within the Gulf of Mexico, the group comprises four taxonomic orders--Gaviiformes (loons), Podicipediformes (grebes), Procellariiformes (albatrosses, fulmars, petrels, shearwaters, and storm-petrels), Pelicaniformes (pelicans, tropicbirds, boobies and gannets, cormorants, and frigatebirds), and Charadriiformes (phalaropes, gulls, terns, noddies, and skimmers) (Clapp et al., 1982; Harrison, 1983). Evolutionary histories of all these species have been principally marine (Fisher and Lockley, 1954; Lack, 1968; Nelson, 1979). Many species migrate and are found within the Gulf region only seasonally. Others display more localized dispersal and

nomadic types of geographic movement in order to exploit food resources, which are patchy in distribution (Nelson, 1979). Seabirds, which nest along the Gulf Coast, typically aggregate into social assemblies, or colonies, with the degree of coloniality varying between species (Parnell et al., 1988). The laughing gull is the only regularly nesting species of gull along the northwestern Gulf Coast. Populations have apparently been increasing as of late, presumably as a result of their acceptance of omni-present and increasing anthropogenic food resources, e.g., garbage and discarded commercial fishing bycatch (Pashley, 1991). A total of eight species of terns nest along the northwestern Gulf, along with black skimmers. This region also supports the majority of several nesting tern species within the U.S. in terms of numbers of individuals, though some of these species appear to be in decline (Pashley, 1991). Recent surveys along the Gulf coastal areas suggest that the nesting colony on South Grand Gossier Island (Louisiana) may be the largest gull and tern colony in North America, numbering 40,000-60,000 pairs annually (Martin and Lester, 1991). Other nesting seabird species include pelicans and cormorants.

Shorebirds are a heterogeneous group belonging to the taxonomic order Charadriiformes. They rank among the world's greatest long-distance migrants, with species that seasonally traverse from the high Arctic to South America, to those which actually spill over into both Asia and the Old World (Pitelka, 1979). Within the Gulf of Mexico, shorebirds comprise five taxonomic families--Jacanidae (jacanas), Haematopodidae (oystercatchers), Recurvirostridae (stilts and avocets), Charadriidae (plovers), and Scolopacidae (sandpipers, snipes, and allies) (Hayman et al., 1986). Few of the species nest in the Gulf area. The remaining numbers of species are either only wintering residents and/or "staging" transients. Many coastal habitats along the Gulf of Mexico are critical for the survival of these birds, providing essential wintering grounds and staging areas where migrating shorebirds ready themselves physiologically (increasing body mass up to 100%) for migrational leaps and possibly to gain energy reserves for reproduction (Terborgh, 1989; Pitelka, 1979; Helmers and Castro, 1991). Suitability of habitat is coupled with the fact that shorebirds exhibit a high degree of site-fidelity, returning to their wintering and/or nesting sites year after year (Hayman et al., 1986). Along the central Gulf Coast, 44 species of shorebirds have been recorded, though only 6 nest in the area (Pashley, 1991).

Wading birds are conspicuous coastal and inshore species belonging to the taxonomic order Ciconiiformes, which contains the families Ardeidae (herons and egrets), Ciconiidae (storks), and Threskiornithidae (ibises and spoonbills) (Parkes, 1978). As a group they exhibit diverse foraging adaptations and strategies, and they are well distributed throughout the warmer regions of the globe. Most species nest in discrete colonies and many are virtually solitary outside of the nesting season (Mock, 1978). Seventeen species are currently known to nest in the U.S., with all but the wood stork nesting within the northern Gulf coastal region (Martin, 1991). Within the central Gulf Coast region, approximately 160 wader colonies were determined active during the 1990-1991 nesting seasons, with 150 of those in Louisiana. Louisiana also supported the majority of nesting individuals, with 110,000 of the 113,500 total nesting pairs in the region. Great egrets were the most widespread nesting species in the central region (Martin, 1991). Within the western Gulf Coast region, little blue herons, snowy egrets, and tricolored herons constituted the greatest number of coastal nesting pairs (Texas Parks and Wildlife Department, 1987, 1988, 1989, and 1990).

Marsh birds are omnivorous coastal and inshore species belonging to the taxonomic order Gruiformes, containing the families Gruidae (cranes) and Rallidae (rails, moorhens, gallinules, and coots). Cranes are long-legged and long-necked birds that resemble large herons. The two North American species are the whooping crane (refer to description under endangered species) and sandhill crane. They inhabit prairies, fields, and marshes. Members of the Rallidae family are compact birds of cryptical habits. Gallinules, moorhens, and coots swim and are commonly found within ponds, lakes, marshes, and bays. True rails are highly elusive and rarely seen within the low vegetation of fresh and salt marshes, swamps, and ricefields (Bent, 1926a; National Geographic Society, 1983; Ripley and Beehler, 1985).

Waterfowl belong to the taxonomic order Anseriformes and include swans, geese, and ducks and their allies. A total of 36 species are regularly reported along the north-central and western Gulf coast, consisting of 1 swan, 5 geese, 11 surface-feeding (dabbling) ducks and teal, 5 diving ducks (pochards), and 14 others (including the wood duck, whistling ducks, sea ducks, the ruddy duck, and mergansers) (Clapp et al., 1982; National Geographic Society, 1983; Madge and Burn, 1988). A diverse array of adaptations associated with foraging and food-getting between species is in parallel with the complement of habitats utilized (Johnsgard, 1975). Many species annually migrate from wintering grounds along the Gulf Coast to summer nesting grounds

to the north. These summer nesting grounds vary among species, ranging from low tundra in the Arctic to the broad belt across the northern plains of the U.S., which is known as the prairie pothole region (Terborgh, 1989). Waterfowl migration pathways have traditionally been divided into four parallel north-south paths, or "flyways", across the North American continent. These flyways actually consist of a complex series of crisscrossing routes of individual species (Lincoln, 1979). The Gulf of Mexico coast serves as the southern terminus of both Central (Texas) and Mississippi (Louisiana, Mississippi, and Alabama) flyways. Many waterfowl species are to be found either offshore and on large embayments during winter months, or while passing through during spring and autumn migrations. Other species prefer inshore areas, primarily the coastal marshes (Clapp et al., 1982). Except for certain pochards such as redheads, most wintering waterfowl along the Gulf Coast are neither static nor confined to any specific area on the coast. Ongoing modification of wetland habitats throughout the coastal region is thought to be partly responsible for declines in the populations of wintering waterfowl (Wolington, 1988).

b. Endangered and Threatened Species

The following coastal and marine bird species, which inhabit or frequent the north-central and western Gulf of Mexico coastal areas, are recognized by the FWS as either endangered or threatened: piping plover; whooping crane; eskimo curlew; bald eagle; peregrine falcon; eastern brown pelican; and interior least tern.

The piping plover (*Charadrius melodus*) is a distinctive ringed plover of central and eastern North America and is currently declining in numbers. It nests on sandy beaches along coasts or inland lakeshores, preferring areas with scant vegetation and cover. Uncontrolled hunting in the early 1900's brought the species close to extinction, and today expanding recreational use of its specific nesting and wintering habitat requirements have brought about the present decline in population numbers (Hayman et al., 1986; Collar and Andrew, 1988). Nesting areas include the Central and North Atlantic seaboard of the U.S., Atlantic Canada, the Great Lakes area, and a large swath of the Northern Great Plains (Goosen, 1990). Piping plovers spend most of their annual cycle associated with wintering areas. It winters on the Atlantic Ocean and Gulf of Mexico coasts and on Caribbean islands. Preliminary information indicates that Texas is the most important wintering area. In Texas, the extensive sand flats of the Laguna Madre and sand flats associated with barrier island passes and river mouths are the most important (Nicholls and Baldassarre, 1990). It has been hypothesized that specific wintering habitat, which includes coastal sandflats and mudflats in close proximity to large inlets or passes, may attract the largest concentrations of piping plovers because of a preferred prey base and/or because the substrate coloration provides protection from aerial predators due to chromatic matching, or camouflage (Nicholls and Baldassarre, 1990). In Louisiana, barrier islands appear to provide the most favorable habitat for this species. Unfortunately, some of these sites are experiencing dramatic rates of land loss via erosion (Martin, written communication, 1992). The piping plover was placed on the endangered species list as endangered in its northern regions and threatened in Gulf States on January 10, 1986, as a result of the marked decline in total numbers.

The whooping crane (*Grus americana*) is the tallest bird in North America. It formerly ranged from summer breeding grounds within the central Canadian provinces and northern prairie states to southern coastal wintering grounds from central Mexico to the Carolinas (Bent, 1926a). It is believed that depletion and modification of summer and winter habitats led to the decline in the population (USDOL, FWS, 1980; Collar and Andrew, 1988). Wild whooping cranes presently occur in two migratory populations. The first nests in northeastern Alberta and south-central Northwest Territories, Canada, and migrates in a nearly straight-line path to wintering grounds along the Texas coast on salt flats and islands in and around Aransas National Wildlife Refuge (ANWR). The second population was established in southeastern Idaho using greater sandhill cranes (*Grus canadensis tabida*) as foster parents for eggs taken from the Canada-Texas population (Armbruster, 1990). Results from the 1991 winter census indicated only 132 whooping cranes, including 8 juveniles, in the peak ANWR population. This represents a drop in the previous year's census of 146 birds (USDOL, FWS, 1992). Cranes are omnivorous and feed during the winter months on a wide variety of foods gathered from the coastal environment (USDOL, FWS, 1980). Human contact with cranes on ANWR largely involves vessel traffic along public waterways (Mabie et al., 1989).

The eskimo curlew (*Numenius borealis*) is a small American curlew that nests on Arctic tundra and migrates to wintering habitat in the pampas grasslands of southern South America. On migration, it formerly occurred in large flocks on the prairies and on coastal grasslands. It was greatly reduced by hunting pressure between 1850 and 1890, and perhaps also by habitat alteration. By 1929 it was thought to be extinct, but has occasionally been seen in very small numbers (Hayman et al., 1986; Gollop et al., 1986). The last confirmed sightings of the eskimo curlew were in Texas during 1981, Alaska in 1983, and Canada (Northwest Territories) in 1985 (Collar and Andrew, 1988). Census efforts are underway to ascertain whether the species is extinct (Ambrose, personal communication, 1992). Because of the uncertainty of the existence of the eskimo curlew, it has been omitted from the analyses of this EIS.

The bald eagle is the only species of sea eagle regularly occurring on the North American continent (Murphy, 1984). There are two subspecies of bald eagles: the smaller, southern race, *Haliaeetus leucocephalus leucocephalus*, and the northern race, *H.l. alascanus*. The two subspecies are separated by an arbitrary geographic line across the southern U.S., although migration and interbreeding creates uncertainty in racial distinction within some areas (Stalmaster, 1987). The bulk of the bald eagle's diet is fish, combined with opportunistic capture of a variety of vertebrate species. The bald eagle requires a large area for hunting and is sensitive to chemical contaminants in the food chain (Murphy, 1984). A precipitous decline in the population occurred subsequent to widespread application of the organochloride insecticide dichloro diphenyl trichloroethane (DDT) from the 1940's through 1972; the bald eagle was listed as endangered in 1967. Other factors that contributed to the species' decline included habitat loss and alteration, shooting, poisoning, and electrocution (*Federal Register*, 1990). The historical nesting range of the bald eagle within the Southeast U.S. included the entire coastal plain and along major rivers and lakes.

The peregrine falcon of North America has been separated into three subspecies: the arctic peregrine (*Falco peregrinus tundrius*), American peregrine (*F.p. anatum*), and Peale's peregrine (*F.p. peali*). The Arctic peregrine nests in tundra areas of North America and Greenland, and migrates south to the Gulf Coast, West Indies, and Central and South America. (USDOL, FWS, 1980). Coastal areas along the Gulf Coast are well known as foci for migrant peregrines, where beaches, flats, and wetlands are used for hunting and resting (Enderson, 1969). Peregrines feed almost exclusively on various bird species, and, similar to the brown pelican and bald eagle, experienced drastic declines as a result of the effects of DDT and its metabolite, dichloro diphenyl dichloroethane (DDE) (*Federal Register*, 1983). Recent surveys indicate that many local and regional populations of peregrines are reproducing well and are either stable or increasing (Nisbet, 1988; Macchtle, 1992).

The eastern brown pelican (*Pelicanus occidentalis carolinensis*) is one of two species of pelicans in North America. It is a colonial nesting species that feeds entirely upon fishes captured by plunge diving in coastal waters. It rarely ventures beyond 20 mi from the coast (Bent, 1926b). A severe reduction in the population during the late 1950's has been attributed to the toxic effects of the organochlorine pesticides (DDT and DDE). Subsequent to the 1972 U.S. ban on the use of DDT, there has been a marked increase in populations of the brown pelican along its entire former range. It remains classified as endangered within the states of Texas, Louisiana, and Mississippi (*Federal Register*, 1985). Surveys conducted from 1990 to 1992 showed one large nesting colony in Alabama (containing approximately 2,000 individuals), no colonies in Mississippi, six colonies in Louisiana (2,196 individuals), and three colonies in Texas (1,238 individuals) (Clay, personal communication, 1992; Eakes, personal communication, 1992; Martin and Lester, 1991; Texas Parks and Wildlife Department, 1990). Results from the Annual Christmas Bird Count for 1990 showed quantities of individual brown pelican sightings on the coasts of Alabama (925), Louisiana (212), and Texas (553), but only 23 sightings in Mississippi (National Audubon Society, 1991).

The least tern (*Sterna antillarum*) is the smallest North American tern. Populations occurring within the Mississippi basin have been eliminated as a result of destruction and alteration of nesting habitat along the Mississippi River and its tributaries. In Alabama, the least tern nests sporadically along the coast in colonies of less than 25 individuals (Clay, personal communication, 1992). Surveys from 1990 to 1992 showed 10 tern colonies in Mississippi, 14 colonies in Louisiana (with 4,460 breeding pairs), and 35 colonies in Texas (with 3,028 breeding pairs). Least terns are the only nesting tern species in Louisiana to use mainland beaches, and they will use human-made and managed spoil sites as well. Banded coastal individuals have been reported at inland nesting sites, which might suggest a source of recruitment from the coastal population (Pashley, 1991).

7. Fish Resources

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 communications, 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 (Horst, 1992a).

Recruitment is by far the most important, yet the least understood, factor contributing to the ups and downs in the numbers of harvestable Gulf fish (Sports Fishing Institute, 1992).

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; Horst, 1992a). 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 Department, written communication, 1989; USEPA, 1989).

Many of the commercially important fish species in the Gulf of Mexico are believed to be in decline due to overfishing (USDOC, NMFS, 1992a). 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 communication, 1989; Goodyear and Phares, 1990; USDOC, NOAA, 1986).

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 rising 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 continues 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 Mellwain, 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-dependent demersal 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).

Up to 15 species of penaeid shrimp can be expected to 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).

About eight species of portunid (swimming) crabs 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 (*Callinectes sapidus*) 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).

8. Gulf Sturgeon

The Gulf sturgeon was listed as a threatened species for protection under the Endangered Species Act on September 30, 1991. A subspecies of the Atlantic sturgeon, Gulf sturgeon are classified as anadromous, with immature and mature fish participating in freshwater migrations. Gill netting and biotelemetry have shown that subadults and adults spend eight to nine months each year in rivers and three to four of the coolest months in estuaries or Gulf waters. Sturgeon less than about two years old remain in riverine habitats and estuaries throughout the year (Clugston, 1991). According to Wooley and Crateau (1985) Gulf sturgeon occurred in most major river systems from the Mississippi River to the Suwannee River, Florida, and marine waters of the Central and Eastern Gulf of Mexico south to Florida Bay. It is not possible, at present, to estimate the size of Gulf sturgeon populations throughout its range, but extant occurrences in 1992 included Lake Pontchartrain, Louisiana to Charlotte Harbor, Florida (Patrick, personal communication, 1992). Gulf sturgeon historically spawned in major rivers of Alabama, Mississippi, and the Florida panhandle. Its present spawning is limited to those rivers from the Pearl to the Suwannee. The most studied spawning populations occur in the Apalachicola and Suwannee Rivers (Barkuloo, 1988). In spring, large subadults and adults that migrate from the estuaries or the Gulf into major river passes feed primarily on lancelets, brachiopods, amphipods, polychaetes, and globular molluscs. Small sturgeon that remain in river passes during spring feed on amphipods, shrimp, isopods, oligochaetes, and aquatic insect larvae (Clugston, 1991). 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 believed due to overfishing and habitat destruction, primarily the damming of coastal rivers and the degradation of water quality (Barkuloo, 1988).

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.

Figure III-6. Mobile Rig Utilization (USDOL 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, 1991a and b).

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.

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 4,836.8 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 1994 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.

Figure III-9. OCS Oil and Gas Production Louisiana and Texas, 1954 to 1990 (USDOl, MMS, 1992c).

Figure III-10. OCS Oil and Gas Production Values for Louisiana and Texas, 1954 to 1991 (USDOl, MMS, 1992c).

There are 12 SMSA's in the impact area of the Central and Western Gulf Region:

Central Gulf of Mexico

Alabama	-	Mobile
Mississippi	-	Pascagoula, Biloxi-Gulfport
Louisiana	-	New Orleans, Baton Rouge, Lafayette, Lake Charles

Western Gulf of Mexico

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.

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: LA-1, LA-2, LA-3, and MA-1 in the CPA, and TX-1 and TX-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-3 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 LA-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 (MA-1) 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-6

Population Statistics by Offshore Subarea*

	<u>1970</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1990</u>
Central Planning Area											
LA-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			
LA-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			
LA-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			
MA-1											
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											
TX-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			
TX-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 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 LA-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 LA-2, with parishes whose industrial composition is highly dependent on activity indirectly associated with oil and 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 LA-3, which has a strong tie to offshore oil and gas development but also has a somewhat more diversified economy, experienced a moderate decline in labor forces since the downturn in oil prices of 1986. Coastal Subarea LA-4, consisting of the Mississippi and Alabama coastal counties, 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 TX-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 TX-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 (USDOD, NCAA, 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 LA-3, which includes the New Orleans SMSA, has the greatest level of population in the CPA. Coastal Subarea TX-2, which includes the highly populated Houston-Galveston-Brazoria SMSA, has over three times as many inhabitants as LA-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 LA-3. In the Central Gulf, coastal Subarea LA-3 had the highest population density at almost 425 people/mi²; and LA-1 had the lowest, at slightly over 100 people/mi². In the WPA, Harris County in coastal Subarea TX-2, at over 1,600 people/mi², exhibited the highest population density during 1988.

Table III-7

Labor Force and Unemployment Statistics for the Central and Western Gulf Coastal Subareas*
(average annual data--thousands)

	<u>1970</u>	<u>1980</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>
Central Gulf							
LA-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
LA-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
LA-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	.9	5.8	10.8	10.0	9.5	7.1	6.0
MA-1							
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							
TX-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
TX-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.

Table III-8 reflects the 1987 industrial composition of the coastal subareas. Coastal Subarea LA-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 LA-1, accounting for the highest percentage payroll as well.

While the service industry was also the largest employer for coastal Subarea LA-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 LA-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 LA-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 MA-1 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.

The 1987 industrial composition for the Western Gulf of Mexico coastal subareas--TX-1 and TX-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 TX-1 accounted for almost 11 percent of all manufacturing employment in the area. About 5 percent of all employment for coastal Subarea TX-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 TX-1 experienced the highest unemployment rate through July 1990, but that rate still exhibited a marked improvement from earlier 1986 levels. Coastal Subarea TX-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

Table III-8
Industrial Composition of Central and Western Gulf Coastal Subareas* for 1987

	Total	Mining	Manufacturing	T. & P.U.	Wholesale Trade	Agric. Serv. Forestry & Fisheries	Contract Construction	Retail Trade	F.I.R.E.	Services	Unclassified Establishments
Central Gulf											
LA-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)	2351002.0	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
LA-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
LA-3											
Employment	413481.0	12002.0	77265.0	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
MA-1											
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											
TX-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
TX-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	6764402.0	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)	53891725.0	2886498.0	11236095.0	5396360.0	4661910.0	174684.0	4413575.0	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: USDOJ, NRES analysis of data from USDOC, Bureau of the Census, 1989.

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 TX-2), which is projected to add approximately 752,000 employees by the year 2010. In Louisiana, both Jefferson Parish (coastal Subarea LA-3) and East Baton Rouge Parish (coastal Subarea LA-2) are anticipated to experience sizeable increases in employment levels. By the year 2027, the largest employers will continue to

Table III-9

Population and Employment Projections for the Central and Western Gulf Coastal Subareas*

		<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>2000</u>	<u>2010</u>	<u>2027</u>
Central Planning Area								
C-1	Population	461,908	462,861	468,886	474,956	489,844	516,207	564,909
	% Growth		0.21%	0.65%	0.65%	0.61%	0.53%	0.53%
	Employment	240,032	237,622	242,009	258,663	274,408	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	637,025	663,248	708,263	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	978,620
	% 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	545,169
	% 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	3,192,809	3,681,104	4,691,690
	% Growth		-0.50%	2.42%	2.42%	1.96%	1.44%	1.44%

* See Figure IV-1.

Source: MPA Data Services, Inc., 1991.

be coastal Subarea TX-2 in the WPA and coastal Subarea LA-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.

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 (USDOL, 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 (LA-1, LA-2, LA-3, and MA-1) 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 (TX-1 and TX-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 MA-1, 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 LA-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 TX-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.

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.

c. Sociocultural Issues

The area that could be affected by the proposed actions includes coastal parishes and counties in the Central and Western Gulf of Mexico. The analysis areas have been defined as those parishes or counties that are expected to be directly impacted by the proposals. The coastal zone of the northern Gulf of Mexico is not a physically, culturally, or economically homogenous unit (cf Gramling and Brabant, 1984). Communities around the northern Gulf of Mexico in the area of potential impact range in size from small communities with minimal populations to large metropolitan areas containing more than 1 million inhabitants. Some of these

communities (particularly in the CPA) experienced extensive growth during the period of increased OCS oil and gas activity, which occurred in the late 1970's and early 1980's (Gramling and Brabant, 1984; Laska et al., written communication, 1992). Following the drop of world oil prices, many communities that were heavily involved in OCS oil and gas activities experienced a loss of population. Both the influx of large numbers of immigrants during boom periods and the exodus of workers during periods of decline have been associated with increases in social complexity (cf. Murray and Weber, 1982; Gramling and Brabant, 1986; England and Albrecht, 1984).

The Gulf of Mexico Region is unique in the scope of offshore oil and gas activity that has occurred during the last 50 years. The Central Planning Area has witnessed the greatest part of development in the Region. Twentieth-century history of coastal Louisiana is intricately linked to the oil and gas industry, both onshore and offshore. Examination of *Louisiana Energy Statistics: 1909-1989* (LSU, Center for Energy Studies, 1991) indicates that an extensive amount of oil and gas exploration and development have occurred in northern Louisiana, southern Louisiana, and in State controlled waters. Examination of the total wells drilled (as reported) indicates that the amount of wells drilled onshore Louisiana and in State waters exceeded the total number of wells drilled on the Federal OCS for every year through 1989 (LSU, Center for Energy Studies, 1991, Table I.14). Recent examination of OCS oil and gas activity impact along the coastal parishes and counties of the CPA and WPA found that most of the counties and parishes within the study area exhibit socioeconomic characteristics closely associated with the oil and gas industry; however, this association in some areas is more closely aligned with non-OCS oil and gas activity (McKenzie et al., written communication, 1992).

The rise in world oil prices, which began during the mid-1970's, resulted in an increase in the rate of development on the OCS. Increasingly depleted resources in the coastal plain furthered this shift in focus towards the OCS. The downturn in world oil prices, which occurred in the mid-1980's, slowed the rate of exploration extensively. In addition, the resource extraction that had occurred in the nearshore OCS waters resulted in production and depletion of many reservoirs in these areas and pushed exploration for new resources out into the deeper waters of the CPA. Extraction of these deeper water resources presented technological problems for resource identification, exploration, and production. These resources were more expensive to extract at a time when the world price of oil was declining or at a steady, low price.

The present state of OCS oil and gas activity in the Gulf of Mexico Region is one of change. Industry restructuring is apparently taking place as the major oil companies are directing their exploration efforts in other areas of the world. Smaller operators are beginning to filter into the Gulf as the larger operators depart. The financial resources of these smaller companies may be significantly less than that of the major operators, and this may have social and/or economic implications.

There is a differentiation across the northern Gulf of Mexico between the involvement of the states in the OCS oil and gas industry. Louisiana has historically been most dependent on oil and gas activity, both onshore and offshore. Mississippi, Alabama, and Florida are much less involved in oil and gas extractive activities. Texas may be considered to be analogous to Louisiana in that there is a long history of both onshore and offshore oil and gas activity. In a very real sense, it may be said that familial economic involvement in the oil and gas industry is a traditional occupation in coastal Louisiana and in portions of Texas. The translation of this traditional involvement with oil and gas extractive activities from onshore to the OCS is apparently more pronounced in Louisiana than Texas. This is likely reflective of the earlier and more intensive OCS activity in the CPA. Individual and familial patterns, world views, perceptions, etc. may reflect this long-term involvement (Freudenburg and Gramling, in press).

Other occupations in the Gulf coastal parishes and counties may be considered traditional. 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 and fishing. These activities occurred as a seasonal round, with the trapper or shrimper sometimes spending time away from the family in pursuit of the resource.

The Gulf of Mexico provides nearly 40 percent of the commercial fish landings in the continental United States. Species that are commonly harvested 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 fisherman frequently spends days or weeks at a time in pursuit of the resource, coming back to the dock only to unload and take on fuel and provisions.

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 leading producer of sugarcane in the United States. 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 gathering of Spanish moss in the coastal swamps 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.

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 (or Cajuns), located in southwest Louisiana, are the descendants of French-speaking immigrants displaced from the East Coast of Canada in 1755. 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; Dalmatian Coast Yugoslavs in the delta of the Mississippi River; and Oriental immigrants in the southeastern 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. However, today they exist as subcultures within the broader, American culture that is predominant throughout the analysis area.

The work schedule associated with OCS oil and gas activity usually involves the employee's absence from home for an extended period. This may be for one week, two weeks, or even longer periods of time. An extended work schedule places a burden on the remaining spouse (usually the wife) to assume roles more traditionally held by the absent family member.

Jobs associated with the OCS oil and gas industry in the Gulf of Mexico have generally been viewed as higher paying jobs. This is true at both the professional and blue-collar levels. It has been postulated that during the period of increased OCS oil and gas activity, it was more difficult for smaller businesses not involved in the economic sphere of resource extraction activities in the area to compete with the more well paying jobs associated with OCS oil and gas activity (Gramling, personal communication, 1992). A corollary postulate was the specialization of businesses to the OCS oil and gas industry, with a greater emphasis on speed and performance than on economy.

Other factors descriptive of the social and cultural environment in the parishes and counties of the northern Gulf of Mexico would include marriage patterns, health, religion, political organization, social pathology, aesthetics, etc. These should all be included under the broad "Social Issues" category. Very little quantitative study and analysis of these factors have been conducted in the Gulf of Mexico Region (cf. NRC, 1992). Therefore, a detailed analysis of these factors is problematic.

In September 1992, the MMS's Gulf of Mexico Region sponsored a socioeconomic workshop in New Orleans, Louisiana. This workshop was designed to provide a recommended social and economic studies agenda for the Region. National and international academic social scientists and in-house, MMS specialists defined broad areas of the social and economic environment that could be impacted by OCS oil and gas activity. A total of 18 proposed studies were designed by participants. The studies were ranked by workshop participants, with usefulness to MMS decisionmakers a major ranking criteria. The utility of this workshop and the resulting products have been to define gaps in the understanding of social and economic impacts of the OCS oil and gas industry in the Region and to provide a mechanism (the proposed studies) to provide this information to decisionmakers.

3. Commercial Fisheries

The Gulf of Mexico provides nearly 20 percent of the commercial fish landings in the continental United States. During 1991, commercial landings of all fisheries in the Gulf totaled nearly 1.5 billion pounds, valued at about \$641 million (USDOC, NMFS, 1992a).

Menhaden, with landings of 1.2 billion pounds, valued at \$41 million, was the most important Gulf species in quantity landed during 1991. Shrimp, with landings of 229 million pounds, valued at \$411 million, was the most important Gulf species in value landed during 1991 (USDOC, NMFS, 1992a). The 1991 Gulf oyster fishery accounted for 43 percent of the national total with landings of 13.7 million pounds of meats, valued at about \$35.5 million. The Gulf blue crab fishery accounted for 29 percent of the national total with landings of 65.4 million pounds, valued at \$23.5 million (USDOC, NMFS, 1992a).

Alabama ranked last among Central and Western Gulf states in total commercial landings for 1991 with 13.6 million pounds landed, valued at \$18.3 million. Shrimp was the most important fishery landed, with 6.5 million pounds, valued at \$14.2 million. In addition, during 1991, 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, 1992a). Alabama had about 3,470 and 2,515 commercial saltwater, licensed fishermen during 1991 and 1992, respectively (Lazauski, written communication, 1992).

Mississippi ranked second among Central and Western Gulf states in total commercial fishery landings for 1991 with an estimated 208.6 million pounds landed, valued at an estimated \$20.5 million. Shrimp was the most important fishery, with 6 million pounds landed, valued at about \$9.6 million. Menhaden landings during 1991, are estimated at 200 million pounds landed, valued at \$9.4 million. In addition, during 1991, the following four species each accounted for landings valued at over \$150,000: red snapper, blue crab, American oyster, and black mullet (USDOC, NMFS, 1992a). In 1991 and 1992, Mississippi had about 3,329 and 2,515 commercial saltwater, licensed fishermen, respectively (Quinn, written communication, 1992).

Louisiana ranked first among Central and Western Gulf states in total commercial fishery landings for 1991, with nearly 1.2 billion pounds landed, valued at \$163.4 million. Menhaden was the highest quantity finfish, with 1.0 billion pounds landed, valued at \$48 million. Shrimp was the highest value shellfish, with 27.3 million pounds landed, valued at \$36.7 million. In addition, during 1991, the following nine species each accounted for landings valued at over \$1 million: black drum, red mullet roe, shark, red snapper, spotted sea trout, bluefin tuna, yellowfin tuna, blue crab, and the American oyster (USDOC, NMFS, 1992a). In 1991 and 1992, Louisiana had about 19,923 and 19,241 commercial saltwater, licensed fishermen, respectively (Hunter, written communication, 1992).

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 1991, the following four species each accounted for landings valued at over \$500,000: red snapper, black drum, blue crab, and American oyster (USDOC, NMFS, 1992a). In 1991 and 1992, respectively, Texas had about 17,483 and 14,519 commercial saltwater, licensed fishermen (Clagett, written communication, 1992).

The Gulf of Mexico yielded the nation's second largest regional commercial fishery by weight in 1991. The Gulf fisheries landings were nearly 20 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 need of conservation (Angelovic, written communication, 1989; USDOC, NOAA, 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 communication, 1989; Christmas et al., 1988; Gulf States Marine Fisheries Commission, 1988). Conflicts between fishermen using fixed gear (traps) and mobile

gear (trawls) continue to be a problem in some parts of the Gulf (Anon., 1991a; Federal Fisheries News Bulletin, 1989a and b). Natural catastrophes may change the physical characteristics of offshore, nearshore, and inshore ecosystems and destroy gear and shore facilities. Hurricane Andrew in August 1992 caused extensive damage to Louisiana wetlands and killed at least \$7.8 million worth of saltwater finfish and \$3.5 million worth of oysters. Commercial fishery losses were estimated at \$54 million for the months of September and October alone. These figures do not include damage to boats, docks, and processing plants (Horst, 1992a).

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 butterflyfish, 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 71.5 percent of the total domestic production (USDOC, NMFS, 1992b). 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 33 percent of the value of total edible imports; continued decline in ex-vessel price of domestic shrimp; 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 communication, 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 (Anon., 1991b; Sports 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 (Goodyear and Phares, 1990; Horst, 1992b).

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 (Sports 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 (Anon., 1992a). For more information concerning the MFCMA, see Section I.B.4.e.

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 butterfly fishery in that butterfly 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 requested that Gulf States consider management measures within State waters and issued a FMP in 1992 (Justen, 1992).

4. Recreational Resources and Beach Use

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 Map 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, 1990).

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 account for 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). 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 15 million fishing trips in 1991, exclusive of Texas. Texas marine anglers using private boats expended over 4.5 million man-hours to land about 1.5 million saltwater fish during the 1990-1991 fishing years (USDOC, NMFS, 1992b).

Marine recreational fishing trips and catch along the Gulf coast had been declining for several years but began to rebound in 1991. 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. Marine recreational fishing in the Gulf Region from Texas to Alabama is a major industry important to these States' economies. The marine recreational 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 (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. Tourism in the central zone of the five Gulf Coast States has been valued at an estimated \$20 billion/year (USEPA, 1991).

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.

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.

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 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.

A Notice to Lessees (NTL No. 91-02) concerning archaeological resources in the Gulf of Mexico Region became effective on February 17, 1992. The NTL changed survey parameters for historic shipwreck surveys in the Gulf from a survey linespacing of 150 m to 50 m. Other methodological changes that were made include the use of a dual trace magnetometer recording device (at 100 gamma and 1,000 gamma scales) and the redefinition of the total area required for site-specific archaeological surveys. In data included in the archaeological/shallow hazard report.

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. Recent investigations in Louisiana and Florida indicate that mound building activity by prehistoric inhabitants may have occurred as early as 6,200 B.P. (cf. Haag, 1992; Saunders et al., 1992; Russo, 1992). Therefore, man-made features, such as mounds, may also exist in the shallow inundated portions of the OCS. 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 (USDOL, MMS, 1984c). Many large, late Pleistocene fluvial systems (e.g., the Sabine-Calcasieu River Valley) are within a few meters 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. However, at present there is no evidence for early mound building in the Western 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 policies 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 Coastal Zone Management Program's flexibility allows each State to tailor its responses to national interest needs to the specific issues of each segment of the Nation's coastline. Each program serves as a catalyst and focal point to identify priorities and to develop tools for addressing a State's needs for coastal management. These tools have been focused in the areas of improving government decisions and administration, protection of natural resources, public access, hazards mitigation, and natural resource development (Colgan, 1990).

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 MCP is built around 10 enforceable goals

that promote decisions that provide for comprehensive management of coastal resources and encourage a balance between environmental protection/preservation and development in the coastal zone. 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. Mississippi manages coastal resources by regulations and by promoting activities that use resources in compliance with the MCP. The BMR developed a coastal wetlands use plan, which includes designated use districts in coastal wetlands and Special Management Area Plans that steer development away from fragile coastal resources and help to resolve user conflicts. For the purposes of the coastal program, the boundary encompasses the three coastal counties of Hancock, Harrison, and Jackson and all coastal waters. The Mississippi coast has 369 mi of shoreline, including the coastlines of offshore barrier islands (Cat, Ship, Horn, and Petit Bois Islands).

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 (TCMP) 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 (GLO) 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 72nd Texas Legislature enacted S.B. 1053, which authorized the GLO to develop the TCMP. The GLO is drafting the TCMP document for public comment in December 1993. It will describe draft goals and policies, special management areas, authorities and structure to implement the TCMP, coordination of the TCMP with other plans, Federal consistency, consideration of the national interest and uses of regional benefit, and public participation. Formal submission to NOAA is projected for March 1994.

SECTION IV
ENVIRONMENTAL
CONSEQUENCES

IV

IV

IV. ENVIRONMENTAL CONSEQUENCES

A. OFFSHORE SCENARIO FOR FUTURE OCS OPERATIONS

This section describes the offshore infrastructure, activities, and disturbances associated with both the OCS Program and the proposed actions (Sales 147 and 150) that could potentially affect the biological, physical, and socioeconomic resources of the Gulf of Mexico area. Offshore is defined here as the OCS portion of the Gulf of Mexico that begins 3 leagues offshore the Texas coast and 3 mi offshore the Louisiana, Mississippi, and Alabama coasts, and extends seaward to the limits of the Exclusive Economic Zone (EEZ) (Figure IV-1). Coastal infrastructure, activities, and disturbances associated with the OCS Program and the proposed actions are described in Section IV.B. which follows.

The offshore activities and disturbances are described in the context of an OCS Program Scenario and a Proposed Action Scenario. The OCS Program includes all activities that occur during the 35-year life of the proposed actions that are associated with past, proposed, and future lease sales. Activity that takes place beyond the 35-year timeframe as a result of future sales is not included in this analysis. The impacts of activities and disturbances associated with the OCS Program on biological, physical, and socioeconomic resources are analyzed in the major cumulative actions sections of this chapter (Sections IV.D.1.d. and IV.D.2.d.).

The proposed actions are Sales 147 and 150. The MMS, 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 147 and 150, respectively). Each scenario 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 scenario necessarily presents only approximate conditions that might be associated with a sale, they 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, 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. 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. Activities and disturbances associated with the proposed actions are considered in the environmental analyses of proposed Central Gulf Sale 147 (Section IV.D.1.a.) and proposed Western Gulf Sale 150 (Section IV.D.2.a.).

1. Resource Estimates and Timetables

OCS Program

Tables IV-3, IV-5 through IV-7, IV-14, and IV-16 through IV-19 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 on the Gulf of Mexico OCS during the life of the proposed actions 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.

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 1994-2028 are 5.22 billion barrels of oil (BBO) and 46.57 trillion cubic feet (tcf) of gas (Table IV-1). It is projected that during this period approximately 94 percent of the total oil and gas resources and reserves available in the CPA at the time of the proposed action will be produced.

Figure IV-1. Gulf of Mexico OCS Planning Areas and Coastal and Offshore Subareas.

Table IV-1

Expected Oil and Gas Production in the Gulf of Mexico OCS Over the Life of the Proposed Actions (1994-2028)

	Existing		Projected (total/peak year)		
	Total to Date	1991 Annual	Proposed Action (Base Case)	OCS Program	Proposed Action (High Case)
Western Gulf of Mexico (Sale 150)					
Reserve/Resource Production					
Oil (Bbbl)	0.278 / 0.024		0.040 / 0.002	1.170 / 0.038	0.120 / 0.006
Gas (Tcf)	14.895 / 1.371		0.650 / 0.032	20.640 / 1.056	1.660 / 0.081
Central Gulf of Mexico (Sale 147)					
Reserve/Resource Production					
Oil (Bbbl)	8.127 / 0.266		0.120 / 0.006	5.220 / 0.248	0.270 / 0.013
Gas (Tcf)	83.616 / 3.321		1.210 / 0.059	46.570 / 3.174	2.580 / 0.126
Eastern Gulf of Mexico					
Reserve/Resource Production					
Oil (Bbbl)	0.000 / 0.000		NA / NA	0.040 / 0.002	NA / NA
Gas (Tcf)	0.000 / 0.000		NA / NA	1.000 / 0.039	NA / NA

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 1994-2028 are 1.17 BBO and 20.64 tcf of gas (Table IV-1). It is projected that during this period approximately 74 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 1994-2028 are 0.04 BBO and 1.00 tcf of gas. It is projected that during this period approximately 65 percent of the total oil and gas resources and reserves available in the EPA in 1994 will be produced.

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" values of total undiscovered, unleased resources; the High Case estimates are based on the high or 5 percent values, which 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, IV-2, IV-4, IV-13, IV-15, and IV-18 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 147: 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 147 is scheduled for March 1994. Under the Base Case, exploratory activity takes place over a 10-year period (1995-2004); the most intense level of exploratory activity occurs in 1999. Development activity begins in 1996 with the installation of the first production platform and ends in 2018 with the drilling of the last development wells, and production of oil and gas takes place from 1996-2027. Under the High Case, exploratory activity takes place over a 10-year period (1995-2004); the most intense level of exploratory activity occurs in 2000. Development activity begins in 1996 and ends in 2021, and production of oil and gas extends through 2027. By the end of 2028, all platforms associated with the proposed action will be removed.

Western Gulf Sale 150: 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-4 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-4 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 150 is scheduled for August 1994. Under the Base Case, exploratory activity takes place over a 10-year period (1995-2004); the most intense level of exploratory activity occurs from 1997-2001. Development activity begins in 1996 with the installation of the first production platform and ends in 2015 with the drilling of the last development wells, and production of oil and gas takes place from 1996-2027. Under the High Case, exploratory activity takes place over a 10-year period (1995-2004), development activity begins in 1996 and ends in 2018, and production of oil and gas extends through 2027. By the end of 2028, 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 for the OCS Program analysis, each planning area was divided into offshore subareas. Estimates of resources, facilities required, and peak annual facilities were distributed into each offshore subarea. The division of the planning area into subareas was done on the basis of geologic features related to oil and gas resource potential.

2. Offshore Activities

Exploring for, producing, and transporting the hydrocarbon resources that are developed as a result of the OCS Program and the proposed actions require a complex and interrelated series of operations that begins with the leasing of offshore blocks; continues through postlease seismic/surveying operations, and the drilling of exploration wells, the installation of production facilities; the drilling of development wells, and the movement of hydrocarbons via pipelines, barges, or shuttle tankers; and ends with the eventual dismantling and removal of production facilities. All of the offshore movements of personnel and supplies that are needed to maintain these operations are also part of the process. These diverse activities can be associated with potential impacts to offshore (and possibly onshore) resources of the Gulf. This section describes the various kinds of offshore activities that could affect the environmental and socioeconomic resources of the Gulf of Mexico area. The disturbances associated with these activities are described in the section that follows (Section IV.A.3.).

Tables IV-2, IV-4, IV-13, and IV-15 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 OCS Program and from the proposed actions. These quantities are expressed as the total amount generated over the life of the proposed actions. In some instances, a peak-year figure is also presented. 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 total amount generated over the life of the proposed action by the expected duration of the activity associated with the impact factor (10 years for exploratory activity, an average 20-year production life for platforms, etc.).

a. Infrastructure and Operations

(1) *Surveying/Seismic Operations*

Seismic operations are conducted from vessels, ranging from 20-75 m (65-245 ft) in length, that tow an array of geophysical instruments. An acoustic pulse (sound wave) is generated by an array of airguns, waterguns, or other sound source. The reflected signal is recorded at the water surface by hydrophones in long streamers towed behind the vessel. The recording streamers can be longer than 3 km (2 mi) in length. Vessel speed is typically 5-7 knots during operations.

Prior to 1989, explosives (dynamite) were used to generate seismic pulses. Explosives have been replaced by superior acoustic sources that do not cause the damaging environmental impacts associated with explosives. It is assumed that no explosives will be used in seismic survey activity during the life of the proposed action.

OCS Program Scenario: The MMS data indicate that in the past few years, a maximum of 150 prelease speculative seismic surveys were conducted per year in the CPA and 50 in the WPA. These numbers are assumed to represent the peak year seismic activity level during the 35-year life of the proposed actions. Peak-year is assumed to be the first year of the proposed actions. Prelease surveys are assumed to decline thereafter at an unknown rate as data coverage becomes complete and as oil and gas development declines. Some previously surveyed areas may be resurveyed to gather better data as technology advances.

It is assumed that one high-resolution geohazards seismic survey and one three-dimensional survey will be conducted in each block leased during the period 1994-2028.

Proposed Action Scenario: Under the proposed actions, it is assumed that one geohazards seismic survey and one 3D survey will be conducted in each leased block.

(2) Drilling Rigs and Platforms

(a) Exploration and Delineation Phase

Offshore exploratory activities are carried out from mobile drilling rigs. Depending primarily on water depth, four types of mobile drilling rigs are expected to be used during the life of the proposed actions.

<u>Drilling Rig</u>	<u>Water Depth</u>
Submersible	up to 15 m
Jack-up rig	up to 100 m
Semi-submersibles	100-500 m
Drill ship	greater than 500 m

This document assumes that the average time required to drill an exploration/delineation well is 40 days, and that the average well depth is 4,115 m. It is further assumed that an average of three wells will be drilled from one rig site and that the typical rig will drill eight wells per year. During drilling operations, 67 people are assumed to be working at the rig site per day.

OCS Program Scenario: The total number of exploration and delineation wells that are projected to be drilled in the CPA and WPA for the OCS Program is 3,330 and 3,420, respectively (Tables IV-3 and IV-5).

Proposed Action Scenario: The total number of exploration and delineation wells that are projected to be drilled in the CPA and WPA associated with the proposed actions is 1 and 120, respectively, under the Base Case, and 290 and 310 under the High Case (Tables IV-2 and IV-4).

(b) Development and Production 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 unit placed on the platform deck. On average, it is assumed that 12 wells will be drilled from each production platform, but the number of wells will vary with water depth, ranging from 4 per platform in water depths less than 150 m to 25 wells in water depths greater than 300 m. Fifteen percent of the development wells are projected to not produce. The average lives of gas and oil wells are estimated to be 12 and 14 years, respectively. The average depth of a well is assumed to be 3,050 m and is assumed to require 35 days to drill. During the development well drilling phase, it is assumed that 58 people per well will be employed on site.

Various kinds of facilities can be installed at a production site. The choice of a production facility depends mainly on water depth. In less than 450 m, it is assumed that fixed platforms rigidly attached to the seafloor will be used. Sixty-eight percent of these are expected to be major platforms, defined as having 6 or more well completions and 2 or more pieces of production equipment. In less than 150 m, 20 percent of the platforms will be manned (defined as having sleeping quarters on the structure). Manned platforms are assumed to have

14 people working on site per shift. It is also assumed that 60 percent of these platforms will have helipads, and 35 percent will have three-phase separators and will generate produced waters. In water depths between 150 and 450 m, all platforms are assumed to be manned and to have helipads. Fifty percent will have three-phase separators.

At water depths exceeding 450 m, traditional platform designs based on rigid attachment to the seafloor probably will not be used. This document assumes that at water depths exceeding 450 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 will be manned and will have a helipad.

A floating production system (FPS) will be used for liquid hydrocarbon development in water depths exceeding 450 m where the production site is too far from an existing pipeline system to justify the cost of installing a new pipeline. The hydrocarbons will be transported from the FPS directly to onshore terminals via shuttle tankers.

The average life of a platform is assumed to be 20 years. 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 potential impacts of platforms on offshore environmental resources. Details of the analysis, however, cannot be revealed in this document because of the proprietary nature of the information.

OCS Program Scenario: Tables IV-3 and IV-5 show the numbers of development wells to be drilled for all OCS Program activities (5,060 in the CPA and 1,940 in the WPA). In the OCS Program Scenario, it is assumed that 6 FPS's and 134 platforms will be installed in the WPA, and 2 FPS's and 328 platforms will be installed in the CPA.

Proposed Action Scenario: Tables IV-2 and IV-4 show the numbers of development wells to be drilled under the Base Case and High Case scenarios for the proposed actions (220 and 450, Base and High Cases in the CPA; 100 and 250, Base and High Cases in the WPA). Under the Proposed Action Scenarios, it is assumed that 2 FPS's and 8 platforms will be installed in the WPA, and no FPS's and 20 platforms will be installed in the CPA. The numbers of platforms installed associated with the proposed actions are found in Tables IV-2 and IV-4.

(3) Workover Operations and Other Well 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. 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. Tubing can be pulled and the casing at the bottom of the well pumped and washed free of sand that may have accumulated. Workover operations can require the use of a jack-up rig. Workovers, which can take from a few days to several months to complete, occur in all producing 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 in the Gulf, an estimated 2,400 of these require rig emplacement. Worldwide rig activity records show that workover activities accounted for 15 percent of rig drilling operations from 1986 through 1990 (The Offshore International Newsletter, 1991).

The following are assumptions that workover activities occurring in association with the proposed actions. It is assumed about 20 percent of all workover operations will require a jack-up rig or other major rig. A workover operation will average 10 days and use 58 employees to complete the operation. Each producing well will average one workover every 4 years (USEPA, 1993).

The following are assumptions regarding other well operations. A well treatment is assumed to occur every 4 years for each producing well. All plugging and abandonment operations conducted when the well has finished production require rig activity. There will be one plugging/abandonment operation per well.

OCS Program Scenario: Based on assumptions listed above, it is estimated that there will be approximately 78,000 workovers in the CPA (Table IV-3) and 18,600 in the WPA (Table IV-5) during the 35-year analysis period. These well operations will be conducted both on wells that were in place prior to Sale 147 and on those installed in future years. For existing wells, it is assumed that half their well life has expired.

Proposed Action Scenario: Tables IV-2 and IV-4 list the number of workovers and other well operations expected as a result of the proposed actions (1,590 and 3,251, Base and High Cases in the CPA; 714 and 1,785,

Base and High Cases in the WPA). These estimates take into account the fact that not all of the proposed wells drilled will be successful and go into production.

(4) Structure Removals

Lessees remove all structures and related underwater obstructions from their Federal OCS leases within one year of the lease's termination. Production platforms that are anchored into the seafloor by steel pilings are the dominant type of structure in water depths less than 450 m. The MMS data indicate that approximately 117 personnel are directly or indirectly employed for each removal and that approximately 80 percent of all platform removals require the use of explosives (Shaw, personal communication, 1992; USDOL, MMS, 1987a). For further discussion on explosive removal, see Section IV.A.3.c.(1).

The MMS and NMFS have conferred extensively in the development of platform removal precautions, and have employed data resulting from equations found in Connor (1991). The NMFS has instituted a comprehensive program to protect sea turtles and cetaceans. Since NMFS's protective observer program began in 1986, only one sea turtle is known to have been harmed as a result of platform removal operations. Others have been removed from platforms slated for removal, prior to detonation. If cetaceans are observed in the vicinity of a removal site, detonations are postponed until the animals have vacated the area. No cetacean has been recorded as harmed. The NMFS is responsible for training observers. While MMS observers have been on-site during removals, none have been employed directly as formal observers, recorders of data, nor in an advisory or decisionmaking capacity.

OCS Program Scenario: MMS data indicate that approximately 100 (80 explosive) and 125 (100 explosive) structures were removed from the Gulf of Mexico in 1991 and 1992, respectively, and nearly 75 percent of all removals occurred in the CPA. These numbers are assumed to reflect the prevalent distribution of OCS activity and to represent the gradual increase in removals as expected with the decline of OCS resources. The MMS projects that an average of 76 annual removals (131 in the peak year) will occur in the CPA; 9 annual removals (13 in the peak year) will occur in the WPA, and 1 annual removal (2 in the peak year) will occur in the EPA.

Proposed Action Scenario: All platforms installed as a result of the proposed action will be removed by the year 2028, 35 years after the sale. Based on MMS data, it is assumed that these platforms will be removed during the last 12 years of the life of the proposed actions, starting in 2017. The MMS projects that no more than 3 removals in the Base Case, 10 removals in the High Case, and 4 removals on average will occur annually in the CPA. For the WPA, MMS projects that no more than 1 removal in the Base Case, 3 removals in the High Case, and 3 removals on average will occur annually.

b. Offshore Transport of Oil and Gas

Transportation of petroleum to onshore terminal facilities in the Gulf of Mexico has relied on an 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 near the existing oil-pipeline network will occur during the next 35 years, shuttle tankering of oil is projected for the future in some cases. To date, all natural gas developed on the OCS has been transported via pipeline.

Some natural gas is projected to be developed under both the Base Case and OCS Program in some deep-water areas located 100 mi (160.9 m) or more outside of the existing pipeline network. In these areas, the development scenario for this EIS assumes that the oil, usually associated with the gas, will be produced from floating vessels (FPSO) and transported to shore by tanker. Natural gas would not be tankered, however, and this EIS assumes that all of the gas will be piped. This is based on the following information.

Offshore operators have been researching a number of options for dealing with the gas at sites where industry is proposing that oil tankering will take place. These options include consuming the gas at the production site, piping it to shore, or tankering the gas in some manner. Flaring of associated natural gas at the production site is prohibited by MMS regulations except during well testing. While it may be possible to get special permission to flare the gas, reinject it, or otherwise consume it rather than transport it to shore, at this time these options are not considered to be viable options.

A number of alternative methods for developing natural gas in very deep water using tanker transport have been studied (USDOL, MMS, 1983b; INTEC Engineering, 1985; Offshore, Incorporating the Oilman, 1992). These alternative methods include natural gas conversion to liquefied natural gas (LNG); natural gas conversion to methanol; natural gas conversion to ammonia; and natural gas conversion to hydrate form. These converted products would then be transported by tanker or ocean-going barge. Methanol conversion appears to be the most promising technology, especially as a solution to the problem of utilizing associated gas so that the oil in a field can be produced (USDOL, MMS, 1983). Floating LNG plants are feasible but considered unlikely for the use because they are best applied to very large fields (400 million to 1 billion cubic feet per day) and because of the extreme low temperatures required to store and handle LNG. Ammonia production is similar to methanol production but requires more processing steps. In addition, the ammonia must be stored and shipped under either cryogenic or pressurized conditions. Gas hydrates, formed with the use of helper gases, eliminate the need to maintain high pressures and remain stable at temperatures above 0°C. The hydrate slurry would be compacted aboard a tanker, the tanker submerged to maintain cool temperatures, and then resurfaced near a regasification facility located in shallower water or at a shore facility.

None of the above tankering options are being embraced by industry as feasible at this time. What will happen in the next 35 years as industry searches for oil and gas in even deeper waters and farther than the current boundaries is unknown. To develop a workable scenario of how projected gas will be transported from very deep-water fields in the future, this EIS relies heavily on the conclusions found in the *Gulf of Mexico Deep Water Floating Production and Transportation Systems Joint Industry Study* (INTEC Engineering, 1985) and on confidential information available from the Deepstar Project. The Deepstar project is part of continuing research into deep-water oil and gas development being conducted by a consortium of eight major offshore operators and MMS. It is noted that the water depths being addressed in the 1985 study and being considered by the Deepstar project only extend out to about 1,500 m, whereas this EIS considers leasing out past 2,000 m. The scenarios proposed in both studies assume that, although oil will likely be tankered especially from smaller fields in deep water, associated gas will still be piped.

Based on these studies, which are the best information available, this EIS assumes that piping of gas will remain the most promising option and that 100 percent of projected gas will be piped.

Information about oil and gas transportation can be found throughout Sections IV.A. and IV.B. Tables IV-2 through IV-6 present projected percentages of oil transported via each mode and total length of pipeline to be installed and currently existing in each planning area. Table IV-7 provides information about projected lengths of new trunklines. Tables IV-13 through IV-17 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 EPA. Tables IV-18 and 19 provide information on waterway usage, on the projected number of barge and shuttle tanker trips, and on the terminals where the offloading is expected to occur.

(1) Pipelines

Pipelines are the primary means of oil/condensate and gas movement in the Gulf. Pipelines in the Gulf include both 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 new production facility.

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 typically designed to transport production from several offshore leases. Because of the large expense of installing a new trunkline system, 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 solely as a result of the proposed actions. Only a portion of the new trunkline systems projected under the OCS Program Scenario are attributable to the proposed actions.

With the trend toward increasing 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. Deep-water pipeline installation challenges include the design of flow systems that can withstand the high external hydrostatic pressures at the seafloor, the adaptation of

Table IV-2
Offshore Scenario Information Related to the Proposed Action in the Central Planning Area
(Sale 147) for the Years 1994-2028

	OFFSHORE SUBAREA*										Total Central	
	Base Case C-1	High Case	Base Case C-2	High Case	Base Case C-3	High Case	Base Case C-4	High Case	Base Case	High Case	Base Case	High Case
	Total / Peak Year**											
Wells Drilled:												
Exploration and Development Wells	10 / 2	20 / 3	20 / 3	50 / 8	45 / 7	105 / 14	55 / 8	115 / 18	130 / 20	290 / 45		
Development Wells***	20 / 1	35 / 2	35 / 2	80 / 4	80 / 4	155 / 9	85 / 6	180 / 10	220 / 10	450 / 25		
Oil Wells	10 / 1	20 / 1	15 / 1	40 / 2	40 / 2	80 / 4	45 / 2	95 / 5	110 / 5	235 / 13		
Gas Wells	10 / 1	15 / 1	20 / 1	40 / 2	40 / 2	75 / 4	40 / 2	85 / 5	110 / 5	215 / 12		
Workovers and Other Well Activities	145 / NA	253 / NA	253 / NA	578 / NA	578 / NA	1120 / NA	414 / NA	1301 / NA	1590 / NA	3251 / NA		
Platform Installations and Removals												
Number Installed	5 / 1	6 / 1	3 / 1	8 / 1	8 / 1	17 / 2	6 / 1	19 / 2	20 / 2	50 / 5		
Space Use Loss (ha)	NA / 30	NA / 36	NA / 0	NA / 0	NA / 12	NA / 30	NA / 0	NA / 0	NA / 42	NA / 66		
Structure Removals Using Explosives	4 / NA	5 / NA	1 / NA	3 / NA	2 / NA	5 / NA	0 / NA	2 / NA	8 / NA	15 / NA		
Method of Oil Transportation:												
Percent Piped	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	97% / 97%	97% / 97%		
Percent Barged	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	1% / 3%	1% / 3%		
Percent Tankered	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	0% / 0%	0% / 0%		
Shuttle Tanker Trips:	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0		
Barge Trips:	84 / 4	192 / 9	7 / 1	14 / 1	104 / 5	234 / 11	0 / 0	0 / 0	197 / 10	442 / 21		
Length of Installed Pipelines (km)	50 / 5	60 / 6	50 / 5	80 / 8	120 / 11	200 / 19	55 / 5	175 / 17	275 / 25	515 / 50		
Pipeline Displaced Sediments (1,000 m ³)	250 / 25	300 / 30	0 / 0	0 / 0	215 / 44	487 / 54	0 / 0	0 / 0	523 / 90	921 / 118		
Bottom Area Disturbances (ha):												
From Rig Emplacements	5 / 2	10 / 2	1 / 2	8 / 2	4 / 2	9 / 2	4 / 2	8 / 2	16 / 3	34 / 5		
From Structure Emplacements	10 / 2	12 / 2	9 / 6	24 / 6	27 / 10	55 / 10	15 / 8	71 / 8	61 / 14	162 / 4		
From Pipeline Projects	14 / 2	19 / 2	14 / 2	24 / 3	38 / 4	44 / 6	18 / 2	54 / 5	88 / 8	165 / 16		
Accidents:												
Oil Spills												
>1 and < 50 bbl (Size 1)	****NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	18 / NA	61 / NA		
>50 and <1,000 bbl (Size 2)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	1 / NA	2 / NA		
> 1,000 bbl (Size 3)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	1 / NA	1 / NA		
Blowouts	0 / 0	0 / 0	0 / 0	1 / 1	1 / 1	2 / 1	1 / 1	2 / 1	2 / 1	5 / 1		
Diesel and Other Pollutant Spills	1 / 1	2 / 1	1 / 1	3 / 1	3 / 1	7 / 1	6 / 1	8 / 1	9 / 1	20 / 1		
Support Activities:												
Helicopter Trips (1,000 trips)	44 / NA	55 / NA	44 / NA	122 / NA	110 / NA	230 / NA	66 / NA	289 / NA	267 / 13	695 / 34		
Service-Vessel Trips	1,200 / NA	1,700 / NA	1,100 / NA	3,200 / NA	1,100 / NA	6,500 / NA	2,800 / NA	7,600 / NA	8,400 / 530	18,800 / 1,260		
Offshore Waste Discharges:												
Drilling Fluids (1,000 bbl)	195 / 22	341 / 35	341 / 35	858 / 84	818 / 78	1,726 / 178	924 / 84	1,949 / 200	2,300 / 215	4,893 / 499		
Drill Cuttings (1,000 bbl)	59 / 7	111 / 11	111 / 11	264 / 28	251 / 25	534 / 58	284 / 28	601 / 65	707 / 70	1,510 / 161		
Sanitary and Domestic Wastes (1,000 m ³)	18 / NA	31 / NA	32 / NA	77 / NA	72 / NA	151 / NA	75 / NA	177 / NA	197 / 16	437 / 36		
Produced Water (MMbbl)	22 / NA	63 / NA	34 / NA	88 / NA	62 / NA	117 / NA	98 / NA	207 / NA	243 / NA	514 / NA		
Offshore Air Emissions (tons):												
Nitrogen Oxides	10,449 / NA	12,205 / NA	6,249 / NA	16,353 / NA	14,718 / NA	34,751 / NA	8,159 / NA	38,819 / NA	61,794 / NA	102,709 / NA		
Carbon Monoxide	1,504 / NA	1,754 / NA	904 / NA	2,342 / NA	2,610 / NA	4,975 / NA	1,204 / NA	5,564 / NA	6,024 / NA	14,632 / NA		
Sulfur Oxides	120 / NA	128 / NA	72 / NA	170 / NA	192 / NA	362 / NA	94 / NA	405 / NA	481 / NA	1,064 / NA		
Volatile Organic Compounds	1,510 / NA	4,159 / NA	2,112 / NA	5,545 / NA	5,432 / NA	11,784 / NA	2,816 / NA	13,170 / NA	14,081 / NA	34,658 / NA		
Total Suspended Particulates	130 / NA	142 / NA	78 / NA	190 / NA	208 / NA	404 / NA	104 / NA	451 / NA	520 / NA	1,187 / 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 will produce

**** Information in these categories cannot be revealed by subarea because proprietary data related to projected hydrocarbon reserves would be exposed.

Table IV-3

Offshore Scenario Information Related to OCS Program Activities in the Central Planning Area
(Sale 147) for the Years 1994-2028

Offshore Subarea*												
Total to Date		1991 Annual	C-1 OCS Program Activities		C-2 OCS Program Activities		C-3 OCS Program Activities		C-4 OCS Program Activities		Total CPA OCS Program Activities	
Total / Peak Year**												
Wells Drilled:												
Exploration and Delineation Wells	7,598 /	168	500 /	45	1,030 /	90	1,105 /	96	695 /	61	3,330 /	290
Development Wells***	17,473 /	310	800 /	37	1,585 /	72	1,765 /	80	910 /	41	5,060 /	230
Oil Wells	9,545 /	148	455 /	21	920 /	42	1,155 /	52	490 /	22	3,020 /	137
Gas Wells	7,928 /	162	345 /	16	665 /	30	610 /	28	420 /	19	2,040 /	93
Workovers and Other Well Activities			25,317 /	NA	23,287 /	NA	24,247 /	NA	5,204 /	NA	78,049 /	NA
Platform Installations:												
Number Installed	3,460 /	38	53 /	4	95 /	6	116 /	8	66 /	4	330 /	22
Space Use Loss (ha)			NA /	8,118	NA /	5,586	NA /	5,454	NA /	0	NA /	19,158
Structure Removals Using Explosives:			862 /	44	623 /	30	625 /	30	0 /	0	2,110 /	105
Method of Oil Transportation:												
Percent Piped	97% /	97%	NA /	NA	NA /	NA	NA /	NA	NA /	NA	97% /	97%
Percent Barged	3% /	3%	NA /	NA	NA /	NA	NA /	NA	NA /	NA	3% /	3%
Percent Tankered	0% /	0%	NA /	NA	NA /	NA	NA /	NA	NA /	NA	<1% /	<1%
Shuttle Tanker Trips:	0 /	0	0 /	0	0 /	0	36 /	2	7 /	0	43 /	2
Barge Trips:			3,750 /	180	320 /	10	4,380 /	210	0 /	0	8,460 /	400
Length of Pipeline Installed (km):	29,765 /	1,170	570 /	35	1,095 /	67	2,015 /	124	870 /	54	4,550 /	280
Pipeline Displaced Sediments (1,000 m³):			2,850 /	NA	1,600 /	NA	3,619 /	NA	0 /	NA	9,007 /	NA
Bottom Area Disturbances (ha):												
From Rig Emplacements			250 /	23	342 /	30	229 /	20	47 /	4	869 /	76
From Structure Emplacements			106 /	106	255 /	255	365 /	365	247 /	247	972 /	972
From Pipeline Projects			182 /	11	350 /	21	645 /	40	278 /	17	1,456 /	90
Accidents:												
Oil Spills			****NA /	NA	NA /	NA	NA /	NA	NA /	NA	793 /	NA
>1 and < 50 bbl (Size 1)			NA /	NA	NA /	NA	NA /	NA	NA /	NA	31 /	NA
>50 and <1,000 bbl (Size 2)			NA /	NA	NA /	NA	NA /	NA	NA /	NA	7 /	NA
> 1,000 bbl (Size 3)			11 /	NA	18 /	NA	20 /	NA	10 /	NA	58 /	NA
Blowouts			87 /	1	115 /	1	138 /	1	41 /	1	381 /	1
Diesel and Other Pollutant Spills												
Support Activities:												
Helicopter Trips (1,000 trips)	12,191 /	NA	9,092 /	NA	9,171 /	NA	883 /	NA	31,337 /	1,662		
Service-Vessel Trips	199,300 /	NA	173,000 /	NA	177,900 /	NA	36,900 /	NA	587,100 /	30,933		
Offshore Waste Discharges:												
Drilling Fluids (1,000 bbl)	3,931 /	354	8,097 /	707	8,687 /	755	5,463 /	480	26,177 /	2,280		
Drill Cuttings (1,000 bbl)	6,070 /	153	7,711 /	274	8,197 /	290	3,361 /	196	25,338 /	908		
Sanitary and Domestic Wastes (1,000 m³)	1,614 /	NA	1,982 /	NA	2,105 /	NA	835 /	NA	6,536 /	648		
Produced Water (MMbbl)	2,042 /	NA	2,718 /	NA	1,607 /	NA	953 /	NA	9,006 /	NA		
Offshore Air Emissions (tons):												
Nitrogen Oxides	239,128 /	NA	428,626 /	NA	523,375 /	NA	297,782 /	NA	1,488,912 /	NA		
Carbon Monoxide	36,828 /	NA	66,012 /	NA	80,604 /	NA	45,861 /	NA	229,305 /	NA		
Sulfur Oxides	2,840 /	NA	5,091 /	NA	6,216 /	NA	3,537 /	NA	17,686 /	NA		
Volatile Organic Compounds	72,950 /	NA	130,759 /	NA	159,663 /	NA	90,842 /	NA	454,215 /	NA		
Total Suspended Particulates	4,855 /	NA	8,703 /	NA	10,626 /	NA	6,046 /	NA	30,230 /	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.

**** Subarea data cannot be revealed because proprietary information related to projected oil reserves would be exposed.

Table IV-4

Offshore Scenario Information Related to the Proposed Action in the Western Planning Area (Sale 150) for the Years 1994-2020

	Offshore Subarea*							
	W-1		W-2		W-3		Total Western	
	Base Case	High Case	Base Case	High Case	Base Case	High Case	Base Case	High Case
	Total / Peak Year**							
Wells Drilled:								
Exploration and Reclamation Wells	5 / 1	5 / 1	20 / 3	60 / 7	95 / 12	265 / 47	120 / 15	310 / 35
Development Wells***	5 / 1	5 / 1	15 / 1	30 / 2	80 / 4	215 / 13	100 / 5	230 / 15
Oil Wells	0 / 0	0 / 0	5 / 1	10 / 1	35 / 2	95 / 5	60 / 2	105 / 6
Gas Wells	5 / 1	5 / 1	10 / 1	20 / 1	45 / 2	120 / 7	60 / 3	145 / 9
Workovers and Other Well Activities	36 / NA	36 / NA	107 / NA	216 / NA	571 / NA	1535 / NA	716 / NA	1785 / NA
Platform Installations:								
Number Installed	2 / 1	2 / 1	3 / 1	6 / 1	5 / 1	22 / 3	10 / 1	30 / 4
Space Use Loss (ha)	NA / 0	NA / 0	NA / 6	NA / 12	NA / 0	NA / 0	NA / 6	NA / 12
Structure Removals Using Explosives:	2 / NA	2 / NA	2 / NA	4 / NA	1 / NA	3 / NA	4 / NA	8 / NA
Method of Oil Transportation:								
Percent Piped	---NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	82% / 82%	82% / 82%
Percent Barge	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	18% / 18%	18% / 18%
Shuttle Tanker Trips:	0 / 0	0 / 0	0 / 0	0 / 0	52 / 3	153 / 8	52 / 3	153 / 8
Barge Trips:	0 / 0	0 / 0	8 / 1	29 / 1	0 / 0	0 / 0	8 / 1	29 / 1
Length of Pipeline Installed (km):	60 / 7	60 / 7	65 / 12	90 / 15	115 / 21	250 / 43	220 / 60	300 / 65
Pipeline Displaced Sediments (1,000 m'):	21 / NA	21 / NA	92 / NA	167 / NA	0 / 0	0 / 0	113 / NA	160 / NA
Bottom Area Disturbance (ha):								
From Rig Emplacements	3 / 2	3 / 2	9 / 2	17 / 2	8 / 2	23 / 2	19 / 2	43 / 2
From Structure Emplacements	4 / 2	4 / 2	8 / 8	15 / 8	19 / 8	81 / 8	30 / 12	100 / 12
From Pipeline Projects	13 / 2	13 / 2	21 / 4	29 / 5	37 / 7	80 / 14	70 / 13	122 / 21
Accidents:								
Oil Spills								
>1 and < 50 bbl (Size 1)	-----NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	6 / NA	18 / NA
>50 and <1,000 bbl (Size 2)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	0 / 0	1 / 1
> 1,000 bbl (Size 3)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	0 / 0	1 / 1
Blowouts	0 / 0	0 / 0	0 / 0	0 / 0	1 / 1	3 / 1	1 / 1	3 / 1
Diesel and Other Pollutant Spills	0 / 0	0 / 0	0 / 0	1 / 1	3 / 1	8 / 1	3 / 1	9 / 1
Support Activities:								
Helicopter Trips (1,000 trips)	29 / NA	29 / NA	39 / NA	78 / NA	83 / NA	245 / NA	151 / 7	452 / 21
Service Vessel Trips	400 / NA	400 / NA	1,000 / NA	2,000 / NA	3,500 / NA	10,900 / NA	5,000 / 370	13,900 / 1,100
Offshore Waste Discharges:								
Drilling Fluids (1,000 bbl)	68 / 14	68 / 14	244 / 29	489 / 67	1,211 / 118	3,332 / 445	1,524 / 147	3,889 / 519
Drill Cuttings (1,000 bbl)	22 / 4	22 / 4	78 / 10	156 / 22	385 / 39	1,060 / 147	485 / 48	1,238 / 172
Sanitary and Domestic Waste* (1,000 m')	6 / NA	6 / NA	19 / NA	38 / NA	90 / NA	252 / NA	115 / 11	294 / 36
Produced Water (1,000 bbl)	1,266 / 253	1,266 / 253	12,305 / 2,208	24,609 / 2,208	79,083 / 6,415	216,044 / 11,545	93,573 / 6,669	241,939 / 14,006
Offshore Air Emissions (tons):								
Nitrogen Oxides	4,257 / NA	4,148 / NA	6,355 / NA	12,643 / NA	18,593 / NA	45,424 / NA	21,186 / NA	62,215 / NA
Carbon Monoxide	633 / NA	611 / NA	950 / NA	1,832 / NA	1,589 / NA	6,718 / NA	3,167 / NA	9,162 / NA
Sulfur Oxides	86 / NA	79 / NA	129 / NA	256 / NA	215 / NA	867 / NA	430 / NA	1,182 / NA
Volatile Organic Compounds	1,645 / NA	1,456 / NA	2,167 / NA	4,369 / NA	3,613 / NA	16,620 / NA	7,226 / NA	21,846 / NA
Total Suspended Particulates	55 / NA	50 / NA	82 / NA	151 / NA	137 / NA	5,511 / NA	2,735 / NA	754 / 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 will produce.

**** Information in these categories cannot be revealed by subarea because proprietary data related to projected oil reserves would be exposed.

Table IV-5

Offshore Scenario Information Associated With OCS Program Activities in the
Western Planning Area (Sale 150) for the Years 1994-2028

Offshore Subareas*									
	Total to Date	1991 Annual	W-1 OCS Program Activities		W-2 OCS Program Activities		W-3 OCS Program Activities		Total WPA OCS Program Activities
Total / Peak Year**									
Wells Drilled:									
Exploration and Delineation Wells	2,016 /	92	225 /	13	1,010 /	59	2,185 /	128	3,420 / 200
Development Wells***	1,947 /	18	145 /	6	610 /	23	1,185 /	46	1,940 / 75
Oil Wells	285 /	0	25 /	1	265 /	10	540 /	21	830 / 32
Gas Wells	1,662 /	18	120 /	5	345 /	13	645 /	25	1,110 / 43
Workovers and Other Well Activities			4,890 /	NA	7,050 /	NA	6,670 /	NA	18,600 / NA
Platform Installations:									
Number Installed	384 /	4	14 /	1	43 /	3	83 /	5	140 / 9
Space Use Loss (ha)			NA /	1,026	NA /	906	0 /	0	NA / 1,932
Structure Removals Using Explosives:			113 /	6	121 /	6	26 /	2	259 / 11
Method of Oil Transportation:									
Percent Piped	981 /	981	NA /	NA	NA /	NA	NA /	NA	871 / 871
Percent Barged	21 /	21	NA /	NA	NA /	NA	NA /	NA	21 / 21
Percent Tankered	0 /	0	NA /	NA	NA /	NA	NA /	NA	111 / 111
Shuttle Tanker Trips:	0 /	0	0 /	0	0 /	0	955 /	31	955 / 31
Barge Trips:			630 /	20	310 /	10	0 /	0	940 / 30
Length of Pipeline Installed (km):	4,844 /	190	540 /	40	855 /	63	1,605 /	118	3,000 / 220
Pipeline Displaced Sediments (1,000 m³):			1,646 /	127	1,236 /	40	0 /	0	2,882 / 167
Bottom Area Disturbances (ha):									
From Rig Emplacements			113 /	7	449 /	26	187 /	11	749 / 44
From Structure Emplacements			28 /	12	97 /	12	304 /	12	429 / 35
From Pipeline Projects			173 /	13	274 /	20	514 /	38	960 / 70
Accidents:									
Oil Spills									
>1 and < 50 bbl (Size 1)			***NA /	NA	NA /	NA	NA /	NA	178 / NA
>50 and <1,000 bbl (Size 2)			NA /	NA	NA /	NA	NA /	NA	7 / NA
> 1,000 bbl (Size 3)			NA /	NA	NA /	NA	NA /	NA	2 / NA
Slowvents			3 /	NA	10 /	NA	20 /	NA	33 / NA
Diesel and Other Pollutant Spills			5 /	1	35 /	1	45 /	1	85 / 3
Support Activities:									
Helicopter Trips (1,000 trips)	1,563 /	NA	1,563 /	NA	1,863 /	NA	1,144 /	NA	4,570 / 193
Service Vessel Trips	35,100 /	NA	35,100 /	NA	58,000 /	NA	68,800 /	NA	161,900 / 9,100
Offshore Waste Discharges:									
Drilling Fluids (1,000 bbl)	1,769 /	102	7,940 /	464	17,176 /	1,006	26,885 /	1,572	26,885 / 1,572
Drill Cuttings (1,000 bbl)	839 /	41	3,701 /	165	7,787 /	350	12,327 /	556	12,327 / 556
Sanitary and Domestic Wastes (1,000 m³)	338 /	NA	989 /	NA	1,795 /	NA	3,123 /	226	3,123 / 226
Produced Water (1,000 bbl)	168 /	NA	763 /	NA	1,227 /	NA	2,157 /	NA	2,157 / NA
Offshore Air Emissions (tons):									
Nitrogen Oxides	27,412 /	NA	84,114 /	NA	162,515 /	NA	274,121 /	NA	274,121 / NA
Carbon Monoxide	4,532 /	NA	13,919 /	NA	26,867 /	NA	45,318 /	NA	45,318 / NA
Sulfur Oxides	3,406 /	NA	10,460 /	NA	20,190 /	NA	34,055 /	NA	34,055 / NA
Volatile Organic Compounds	7,205 /	NA	22,129 /	NA	42,713 /	NA	72,056 /	NA	72,056 / NA
Total Suspended Particulates	1,347 /	NA	4,291 /	NA	8,282 /	NA	13,971 /	NA	13,971 / 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.

Table IV-6

Offshore Scenario Information Associated with OCS Program Activities in the Eastern Planning Area for the Years 1994-2028

	Total to Date	1991 Annual	Offshore Subareas*					Total EPA OCS Program Activities
			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	
Wells Drilled								
Exploration and Delineation Wells	44 / 0		375 / 19	20 / 1	5 / 1	0 / 0	0 / 0	400 / 20
Platform Installations	0 / 0		17 / 1	2 / 1	1 / 1	0 / 0	0 / 0	20 / 2
Development Wells***	0 / 0		100 / 7	15 / 2	5 / 1	0 / 0	0 / 0	120 / 10
Oil Wells	0 / 0		25 / 2	10 / 1	0 / 0	0 / 0	0 / 0	35 / 3
Gas Wells	0 / 0		75 / 5	5 / 1	5 / 1	0 / 0	0 / 0	85 / 7
Pipeline Length (km)	0 / 0		930 / 89	50 / 5	10 / 1	0 / 0	0 / 0	990 / 95

* 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.

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) of pipe onshore and to tow the assembled pipe to the production site. This approach has already been used successfully for projects in the Green Canyon and Mississippi Canyon Areas.

OCS Program Scenario: Most of the oil and gas resources discovered in the Gulf of Mexico will continue to be piped ashore, relying on the extensive existing and continually expanding pipeline network. The installation of new pipelines on the OCS will be needed to bring oil and gas resources ashore (trunklines) and to connect new production platforms to existing pipeline systems (gathering lines). Under the OCS Program scenario, 97 percent of the liquid hydrocarbons in the CPA and 98 percent in the WPA are projected to be transported by pipeline. Table IV-7 provides the length of trunklines projected to be installed by various water depths and subareas in the WPA and CPA.

Table IV-7

Projected New Central and Western Gulf Oil and Gas Trunklines (km) by the Water Depth

Offshore Subarea	0 - 1,000'		1,000 - 3,000'		>3,000'		Total	
	Oil	Gas	Oil	Gas	Oil	Gas	Oil	Gas
C-1	120	20	0	0	0	0	120	20
C-2	60	30	60	70	50	60	170	160
C-3	190	170	90	170	220	240	500	580
C-4	0	0	0	0	170	170	170	170
Total CPA	370	220	150	240	440	470	960	930

Offshore Subarea	0 - 1,000'		1,000 - 3,000'		>3,000'		Total	
	Oil	Gas	Oil	Gas	Oil	Gas	Oil	Gas
W-1	270	100	10	40	0	10	280	150
W-2	170	20	120	170	10	10	300	200
W-3	0	0	50	40	420	430	470	470
Total WPA	440	120	180	250	430	450	1,050	820

In the Central Gulf, there were an estimated 29,765 km of pipelines (trunk and gathering lines) as of 1991. Another 1,890 km of new trunklines (960 km for oil; 930 km for gas) and 2,660 km of new gathering lines are expected to be constructed to support current and future oil and gas activities in the CPA (Tables IV-3 and IV-7). Sixty-eight percent of all new trunklines will be constructed in water depths greater than 300 m. Peak-year pipeline construction is projected to be 280 km. Sixty-eight percent of all new pipeline construction in the CPA will occur in offshore Subareas C-2 and C-4. It is assumed that some deep-water trunkline and gathering line projects will use pipe towing from shore-based facilities.

In the Western Gulf, there were an estimated 4,844 km of pipelines as of 1991. Another 1,870 km of new trunklines (1,050 km for oil; 820 km for gas) and 1,130 km of new gathering lines are expected to be constructed to support current and future oil and gas activities in the WPA (Tables IV-5 and IV-7). Seventy percent of the projected new trunklines will be constructed in water depths greater than 300 m. Peak-year pipeline construction is projected to be 220 km. Fifty-four percent of all new pipeline construction will occur in offshore Subarea W-3 (1,723 km). It is assumed that some deep-water trunkline and gathering line projects will use pipe towing from shore-based facilities.

In the Eastern Gulf, there are currently no pipelines because no leases have begun production. There is a proposed pipeline system currently being considered by industry for oil from the Destin Dome Area. Approximately 990 km of new trunklines and gathering lines are projected to be constructed to support future oil and gas activities offshore Florida. No pipelines are projected to make landfall along the Florida coast; however, two new trunklines (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.

Proposed Action Scenario: No new trunkline systems are assumed to be built to support leases resulting solely from the proposed actions. Therefore, only a proportion of the trunkline lengths projected under the OCS Program (Table IV-7) are attributed to the proposed actions. Under the Base and High Case Scenarios, respectively, 275 and 515 km of new offshore pipelines (both trunklines and gathering lines) will be installed in the CPA, and 220 and 380 km in the WPA. Tables IV-2 and IV-4 also show the distribution of projected new pipelines by offshore subareas.

(2) Oil Barges

Historically, about 3 percent of the oil produced in the Gulf has been barged to shore. All of the lease blocks from which barging has occurred have been located fairly close to shore. It is assumed that the barging of new oil resources will only occur in offshore areas where barging is currently used. This section only presents projections of the number of barge trips from offshore production platforms to onshore terminal. Secondary intra-coastal barging of oil from terminal to terminal or terminal to refinery also occurs along the Gulf Coast and is discussed under the onshore scenario (Section IV.B.). The capacity of barges used for the transport of OCS-produced oil can range from 5,000 to 80,000 bbl. Barges typically remain offshore for as much as one week while collecting oil.

OCS Program Scenario: It is expected that the general level of barging activity will remain the same in the future and will remain restricted to water depths less than 914 m (3,000 ft). Projected percentages of oil to be barged during future OCS Program activities are 3 percent in the CPA and 2 percent in the WPA (Tables IV-3 and IV-5). In the CPA, more than 8,500 barge trips are estimated to occur from future OCS Program activities (Table IV-3). Most of the barging activity in the CPA will originate from Subareas C-1 and C-3. In the WPA, only 940 barge trips are expected to occur from OCS Program activities occurring during the 35-year analysis period. Most of these trips will originate in Subarea W-1, with the remaining coming from Subarea W-2 (Table IV-5).

Proposed Action Scenario: Projections of oil barging occurring as a result of the proposed actions are slightly greater than 3 percent in the CPA and less than 1 percent in the WPA.

Tables IV-2 and IV-4 provide the estimated number of barge trips from each of the offshore subareas projected for the Base Case and High Case Scenarios. In the CPA, 197 and 442 barge trips are estimated to occur due to the Base Case and High Case, respectively, with 10 and 21 trips occurring during the peak year. Most of the barging activity in the CPA will originate from Subarea C-1. In the WPA, only 8 and 29 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 Subarea W-2.

(3) Shuttle Tankers

Although shuttle tanker transport of OCS Gulf of Mexico oil has not occurred to date, it is expected some tanker transport will occur in the future from leases located in deep waters outside of the existing pipeline network. Tankering is projected to occur outside of a 160-km (100-mi) radius from the existing pipeline network. The oil will be loaded at the production site, projected to be a tanker-based floating production, storage, and offloading system (FPSO), and brought directly into a major terminal/port system to be offloaded. Shuttle tankers used for OCS operations in the Gulf are expected to have capacities ranging from 20,000 deadweight tonnage (dwt) (133,000 bbl) to 50,000 dwt (333,000 bbl). The specifications for a typical 20,000 dwt tanker are 172 m in length by 27 m in breadth with a draft of about 10 m.

OCS Program Scenario: Less than one percent of oil produced in the CPA as a result of OCS Program operations occurring during the 35-year analysis period is estimated to be transported via shuttle tanker (Table IV-3). A total of 43 tanker trips is projected. These trips will originate primarily in offshore Subarea C-3 and will offload at Mississippi River terminals (Tables IV-3 and IV-19). Eleven percent of the oil to be produced in the WPA as a result of OCS Program activities is estimated to be transported to onshore terminals by shuttle tankers (Table IV-5). A total of 955 trips are expected, all originating from Subarea W-3 and offloading at five major port areas in Texas and Louisiana. Table IV-19 identifies the port areas where the oil is projected to be offloaded.

Because no pipeline system exists in the EPA and because of the lack of an onshore infrastructure base to store and refine oil produced from OCS Program operations in the EPA, almost 38 percent of the oil

projected to be produced in the EPA will be transported by shuttle tankers to CPA onshore support facilities. Forty-five trips are expected to transport oil produced in the EPA to terminals along the Mississippi River.

Proposed Action Scenario: There is no projected shuttle tankering of oil produced in the CPA as a result of Sale 147 in the Base Case (Table IV-2). The projected pipeline system is expected to be able to carry all oil produced in deep waters as a result of the proposed action.

Under the Base Case, 18 percent of the oil to be produced in the WPA as a result of Sale 150 is projected to be transported to shore via shuttle tankering (Table IV-4). A total of 52 tankering trips are expected. These trips will originate from Subarea W-3 and will offload at five major port areas, both in Texas and at Lake Charles in Louisiana. Under the High Case, 153 trips are expected.

c. Offshore Transport of Personnel and Supplies

(1) Service Vessels

There are about 24 types of service vessels catering the OCS oil industry. Turner and Cahoon (1987) report an average of over 2,000 trips per month of service vessels in the Gulf of Mexico OCS, carrying an average of 337 tons of cargo per trip. These vessels produce noise, discharges, and air emissions; make waves that erode channel banks; and disturb the sea bottom with anchors.

Three categories of service vessels can be defined: supply, crew, and utility vessels. Service vessels are categorized by size as large usually between 50 and 60 m (160 and 200 ft) in length, or small, which mainly includes crew boats of 32 m (110 ft). About 68 percent of the service vessels are large supply boats (Turner and Cahoon, 1987) with a 3.5-m (12-ft) draft when loaded at a capacity of 300 tons. Crew boats draw 2-2.8 m (7-9 ft) of water. Utility boats perform various functions in the OCS and have typical lengths of 30.5 m (100 ft) and 3- to 3.7-m (10- to 12-ft) drafts. These vessels carry water, cement, drilling fluids, equipment, food, and miscellaneous supplies.

The following assumptions about service-vessel activity are made as part of the scenarios of this EIS: (a) crewboats have 6 personnel per boat; supply boats have 20 personnel; (b) a trip represents a round trip between the offshore sites and service base; (c) service vessels travel 3 times a week to exploratory and development wells sites; (d) service vessels make 1 trip per 5 production platform complexes a week; (e) a vessel takes 4 hours to reach a shorebase once in a navigational channel; and (f) during offshore journeys, vessels travel about 282 km (175 mi) per round trip in 15 hrs in the WPA, and about 418 km (260 mi) in 23 hours per trip in the CPA. Since larger, deeper-draft vessels are needed to reach distant oil and gas deepwater sites, it is assumed that some new vessels will be built.

OCS Program Scenario: Specific projections about the level of service-vessel activity applicable to the OCS Program are presented in Tables IV-3 and IV-5 (587,100 in the CPA and 161,900 in the WPA). The OCS Program Scenario service-vessel trips estimate includes trips to existing, as well as projected, OCS platforms.

Proposed Action Scenario: Service-vessel projections for the proposed actions are 8,400 and 18,800 trips for the Base and High Cases in the CPA, and 5,000 and 13,300 trips for the Base and High Cases in the WPA (Tables IV-2 and IV-4).

(2) Helicopters

Helicopters are the primary mode of transporting personnel between shore bases and offshore oil and gas platforms and drilling rigs. A helicopter trip is defined as one takeoff and one landing and an average trip lasts 30 minutes. On an average flight, a helicopter might visit 3-4 offshore facilities before returning to shore. All drilling rigs and pipelaying barges have helipads, and a 60 percent of nearshore (greater than 150 m (500 ft) water depth) production platforms have helipads. All new platforms in water depths greater than 150 m (500 ft) are likely to have helipads. It is assumed for analysis purposes that helicopters will visit exploratory drilling rigs, development drilling structures, and production platform complexes between 1 and 2 times per day, and pipeline lay barges 1 time per day.

OCS Program Scenario: Based on trip assumptions made by MMS for continuing exploration, production, and pipeline construction activity in the Gulf, it is estimated that offshore oil and gas operations over the next 35 years will stimulate 31,337,000 helicopter trips in the CPA (Table IV-3) and 4,570,000 helicopter trips in the

WPA (Table IV-5). The overall Gulf of Mexico helicopter fleet size is likely to decline over the next 35 years as the level of offshore oil and gas operations declines.

Proposed Action Scenario: Based on the assumptions stated above, 267,000 and 695,000 helicopter trips are projected in the CPA (Table IV-2) under the Base Case and High Case, respectively; and 151,000 and 452,000 trips in the WPA (Table IV-4) are projected to occur under the Base Case and High Case Scenarios, respectively, within the 35-year project life of the proposed action.

3. Offshore Disturbances

a. Infrastructure Emplacement

(1) Bottom Area Disturbance

Structures emplaced on the OCS to facilitate oil and gas exploration, development, and production include drilling rigs (jack-up rigs, semi-submersible rigs, and drill ships), production platforms, and pipelines. Such structure emplacement disturbs some area of the bottom directly beneath the structure and, if anchors are employed, some area around the structure is also disturbed. For analysis purposes, it is assumed that jack-ups and semi-submersibles will be used in water depths less than 450 m (1,500 ft) and will disturb about 1.5 ha (3.7 ac) each. In water depths deeper than 450 m (1,500 ft), dynamically-positioned drill ships will be used, disturbing no bottom area (except the very small area right where the well is drilled). With regard to production platforms, it is assumed that platforms installed in water depths less than 450 m (1,500 ft) will disturb about 2 ha (4.9 ac), while both tension leg platforms and floating production systems installed in water depths greater than 450 m (1,500 ft) will disturb 4 ha (9.9 ac) (due primarily to anchors in the latter case). Emplacement of pipelines will disturb 0.32 ha (0.8 ac) per kilometer (0.62 mi) of pipeline.

OCS Program Scenario: Tables IV-3 (CPA) and IV-5 (WPA) indicate the areal extent of bottom disturbances due to all OCS activities that are assumed to occur during the period 1994-2028.

Proposed Action Scenario: Tables IV-2 (CPA) and IV-4 (WPA) indicate the areal extent of bottom disturbances due to these activities that are assumed to occur as a result of the proposed actions during the period 1994-2028.

(2) Sediment Displacement

Sediment displacement (resuspension of sediments) is only considered when caused by pipeline trenching, which is only required in water depths less than 61 m. Such trenching or burying is required in shallow depths as an engineering precaution in order to reduce the movement of pipelines during periods of high currents and storms. It is assumed that 5,000 cubic meters of sediment will be resuspended for each kilometer (0.62 mi) of pipeline trenched.

OCS Program Scenario: Tables IV-3 (CPA) and IV-5 (WPA) indicate that 9,007 and 2,882 m³ of sediments, respectively, will be resuspended due to all OCS activities that are assumed to occur during the period 1994-2028.

Proposed Action Scenario: Tables IV-2 (CPA) and IV-4 (WPA) indicate the amounts of sediments resuspended due to these activities that are assumed to occur as a result of the proposed actions during the period 1994-2028 (523 and 921 m³ for the Base and High Cases in the CPA, and 113 and 168 m³ for the Base and High Cases in the WPA).

b. Infrastructure Presence

(1) Vessel Anchoring

Each exploration rig, platform, and pipeline placed on the OCS disturbs, in addition to some of the bottom area directly impacted by the structure, some surrounding area or areas where anchors are set to hold the vessel, structure, or support vessel in place. Bottom disturbance from anchoring associated with rigs and platforms is accounted for in considering bottom disturbance due to emplacement of those structures.

Pipelaying barges use an array of eight 9,000-kg 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.

Service-vessel anchoring is assumed to not occur in water depths greater than 150 m (in such water depths the vessels will always tie up to a platform or buoy) and only occasionally in shallower waters. Barges and shuttle tankers are assumed to always tie up to a production system rather than to anchor.

Drill ships are assumed to not anchor as they use dynamic positioning systems to remain in place.

Mooring buoys may be placed near drilling rigs or platforms so that service vessels need not anchor, especially in deeper water. 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.

OCS Program Scenario: No tabulated information is provided for actual numbers of anchoring incidents. However, Tables IV-3 (CPA) and IV-5 (WPA) indicate the numbers of platforms assumed to be installed and the lengths of pipelines assumed to be installed as a result of all OCS activities that are assumed to occur during the period 1994-2028. It is assumed that vessel anchorings will occur occasionally in association with activities in less than 150 m.

Proposed Action Scenario: Tables IV-2 (CPA) and IV-4 (WPA) indicate the numbers of wells assumed to be drilled, the numbers of platforms assumed to be installed, and the lengths of pipelines assumed to be installed as a result of activities that are assumed to occur as a result of the proposed action (Sales 147 and 150) during the period 1994-2028. It is assumed that vessel anchorings will occur occasionally in association with all of these activities in less than 150 m.

(2) Space Use Conflicts

During OCS operations the area occupied by structures, anchor cables, and safety zones is unavailable to commercial trawl fishermen. Exploratory drilling rigs spend approximately 40 days on site and are a short-lived interference to commercial fishing. However, a production platform, with a surrounding 100-m navigational safety zone, requires approximately 6 ha of space and has a minimum life expectancy of 20 years. Virtually all commercial trawl fishing in the Gulf of Mexico is performed in water depths less than 150 m (Louisiana Dept. of Wildlife and Fisheries, 1992) and those platforms constructed in greater depths will not conflict with commercial fishing. The MMS data indicate that the total area lost to commercial fishing due to the presence of production platforms has historically been less than 1 percent of the total area available to commercial trawling.

OCS Program Scenario: Tables IV-3 and IV-5 indicate the peak year amount of area lost to commercial fishing projected to occur in offshore subareas of the CPA and WPA as a result of all OCS activities during the period 1994-2028. The peak year amounts are based on the maximum number of platforms in place in water less than 150 m (500 ft) deep. The peak year for the CPA and WPA is assumed to be the first year after Sales 147 and 150, respectively. The MMS projects that 19,158 ha (47,320 ac) will be lost to commercial fishing in the CPA. For the WPA, MMS projects that 1,932 ha (4,772 ac) will be lost to commercial fishing.

Proposed Action Scenario: Tables IV-2 and IV-4 indicate the peak year amount of area lost to commercial fishing projected to occur in offshore subareas of the CPA and WPA as a result of the proposed actions during the period 1994-2028. The peak year amounts are based on the maximum number of platforms in place in water less than 150 m (500 ft) deep. The MMS projects that a maximum of 66 ha (163 ac) will be lost to commercial fishing in the CPA in any year over the life of the proposed action. For the WPA, MMS projects that a maximum of 12 ha (30 ac) will be lost to commercial fishing in any year over the life of the proposed action.

(3) Aesthetic Interference

Platforms and drilling rigs established in the first two or three tiers of nearshore Federal oil and gas lease tracts (5-16 km [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 16 km (10 mi) 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. On a clear night, lights from the top of drilling derricks could be visible almost to where they dip below the horizon from the curvature of the earth (about 32 km [20 mi]).

OCS Program Scenario: Based on an MMS assumption that 5 percent of the existing and projected platforms fall within shallow waters (less than 150 m [500 ft]), there are likely to be about 97 structures visible from accessible shorefronts in Louisiana, Mississippi, and Alabama (offshore Subareas C-1 and C-3) and 9 structures off Texas (offshore Subarea W-1) during the 35-year activity period as a result of all OCS activities.

Proposed Action Scenario: For purposes of this EIS, it is expected that only 1 offshore structure visible from shore will be installed in offshore Subareas C-1 and C-3 during the life of the proposed action, and no offshore structures visible from the Texas coast will be installed on the OCS.

c. Infrastructure Removal

(1) Explosive Removal Disturbance

Multi-leg platforms that are anchored into the seafloor by steel pilings predominate in water depths less than 450 m. Explosives sever conductors and pilings 5 m below the seafloor and are used because of the strongly overbuilt condition of these structures that must withstand probable hurricane conditions over an average 20-year life span. A number of offshore operators, dive companies, and engineering firms in the Gulf of Mexico are engaged in research and development of safe technology and removal methods alternative to explosives (Bottom Line Newsletter, 1992; Snyder, personal communication, 1992). However, alternative methodologies such as mechanical cutting and inside burning that might be used to sever pilings of multi-leg structures are often ineffective and always hazardous to underwater workers. Possible injury to biota from explosive use extends outward 900 m from the detonation source and upward to the surface. Based on these considerations and MMS data, it is assumed that approximately 80 percent of all removals in the Gulf of Mexico in water less than 450 m deep will be performed with explosives.

OCS Program Scenario: Tables IV-3 and IV-5 indicate the total and peak year number of explosive platform removals projected to occur in offshore subareas of the CPA and WPA as a result of all OCS activities during the period 1994-2028 (2,110 and 105 in the CPA, and 259 and 11 in the WPA). The peak year numbers indicate the maximum number of explosive removals expected in any one year.

Proposed Action Scenario: Tables IV-2 and IV-4 indicate the total number of explosive platform removals projected to occur in offshore subareas of the CPA and WPA as a result of the proposed actions during the period 1994-2028 (8 and 15 for the Base and High Cases in the CPA, and 4 and 8 for the Base and High Cases in the WPA).

(2) Abandoned Bottom Debris

Bottom debris is herein defined as material resting on the seabed (such as cable, tools, pipe, drums, and structural parts of platforms, as well as objects made of plastic, aluminum, wood, etc.) which are accidentally lost, or tossed, by workers from fixed structures, jack-up barges, and drilling ships, and during pipeline emplacement. Varying quantities of ferromagnetic bottom debris may be lost, or tossed, per operation. The maximum quantity of bottom debris per operation is assumed to be several tons. 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 450 m of the structure/jack-up/lay barge. Concerns about entanglement of fishing gear with abandoned debris at old platform sites has led to the issuance by MMS of NTL's 90-03 and 92-02 with establish guidelines for removing bottom debris and gear at a platform site after removal operations. It is assumed that offshore operators will adhere to these guidelines, and that the amount of bottom debris that remains at platform sites will be reduced in the future.

OCS Program Scenario: A total of 29,054 exploration, delineation, and development wells have been drilled to date in the Gulf of Mexico Region. In addition, 3,844 platforms have been installed and 34,609 km of pipelines have been laid on the OCS (Tables IV-3 and IV-5). It is estimated that several 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 OCS activities

for the next 35 years will likely add several tens of thousands of tons to the amount of bottom debris on the seafloor.

Proposed Action Scenario: A total of 450 exploration, delineation, and development wells are projected for the CPA and WPA under the Base Case. In addition, 30 platform installations are expected and 495 km (308 mi) of pipelines are projected for the CPA and WPA (Tables IV-2 and IV-4). It is assumed, therefore, that up to several hundreds of tons of bottom debris associated with OCS activity may result from the proposed actions.

d. Operational Waste Discharged Offshore

Operational wastes generated in the largest quantities 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--produced sand, 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. Oily wastes, such as produced water, are usually treated on the platform to remove the oil to reach acceptable USEPA limits. Sometimes separation equipment exists on a centralized offshore or shoreline facility and the wastes are transported there for all oil/water/solids separation. The water phase is then discharged overboard either at the surface or shunted to some depth. The oily sludge or 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 MMS Regional Director. In the development of estimates of future discharges, characteristics of the waste streams, and disposal methods, MMS assumes that the USEPA's effluent limitations are in place (Section I.B.3.d.(3)(e)).

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.

Naturally Occurring Radioactive Material Contamination

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 and produced water have raised the sensitivity of the public and regulators to the fact that naturally occurring radioactive materials (NORM) are generated from the mineral-extraction process.

It is now known that 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 the 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 pipe yards.

The NORM is defined as any naturally occurring radioactive material that emits low levels of radioactivity, originating from processes not associated with recovery of radioactive materials. The radionuclides of concern in NORM, by oil and gas extraction operations, are radium-226 and radium-228. Radium-226 is a long-lived nuclide with a 1,600-year half-life and when ingested, concentrates in the bones. Radium primarily emits alpha radiation. Alpha particles 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 to a lesser extent; these rays are very penetrating and considered hazardous at high concentrations.

At present, there are no Federal regulations for handling and disposing of NORM-contaminated materials. The States of Alabama, Texas, and Louisiana have all recently developed some form of NORM regulations. The Louisiana Department of Environmental Quality (DEQ) has 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 (revised June 20, 1992), that provide strict disposal requirements for all NORM materials emitting radiation greater than 50 microrentgens (micro-REMS) per hour and that establish guidelines for conducting NORM confirmatory surveys of suspected contaminated land. On August 30, 1993, the State of Texas, Texas Railroad Commission, received jurisdiction to develop regulations for the disposal of NORM oil-field wastes. These regulations are due January 1, 1995. The State of Texas, Health Department, finalized regulations, "Texas Regulations for Control of Radiation, Part 46, Licensing of NORM," in July 1993.

Part of the lack of regulation stems from the fact that, at present, little can be definitely concluded concerning the effects of this waste 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 about what this uptake means to the health of the marine ecosystem. Selection of criteria for contaminant levels and exposure rates for the oil industry based on radiation limits set for other industries is premature until more is known about the fate and effects of oil-field NORM. There is an extensive 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.

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. A total of 144 bbl of produced sand, containing from 19-68 picoCuries per gram (pCi/g) of radium-226, was discharged. Sediments around the discharge site showed radioactivity levels indistinguishable from background radioactivity (Randolph et al., 1992). Offshore sand discharge was also modeled using the Offshore Operator's Committee's (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 preceding year (Randolph et al., 1992). Produced sands can no longer be discharged overboard but must be transported to shore for disposal. Although available data show biological uptake of NORM by oysters and fish in inland coastal waters (Rabalais et al., 1991; St. P6, 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 NPDES general permit for the Western Gulf of Mexico (Section I.B.3.d.(3)(c)) requires the monitoring of water and fish tissue for radium levels near produced-water offshore outfalls. This monitoring has not yet begun.

(1) Drilling Muds and Cuttings

The major source of contamination from drilling operations is the drilling fluids ("muds") and cuttings from drilling. Drilling fluids are suspensions of solids and dissolved materials in a base of water or oil that are used in rotary drilling 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 or 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, 1993). Drilling fluids also may contain entrained formation hydrocarbons. The principle contaminants of concern regarding drilling muds include oil and grease, biochemical oxygen demand, chemical oxygen demand, suspended solids, and priority and nonconventional metals and organics. Stephenson (1991) has recently analyzed a limited data set of muds from 14 offshore wells for radium-226 and -228 content (NORM). The analysis showed that NORM concentrations in the mud averaged 4 pCi 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.

Silts, cuttings, water, oil, and gas are brought to the surface by the circulated mud. 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 fine particles 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.

The USEPA effluent limitations for drilling fluids and cuttings (a) limit the acute toxicity to a minimum 96-hour LC_{50} of 30,000 ppm as measured in the diluted suspended particulate phase, (b) prohibit the discharge of diesel oil, (c) prohibit the discharge of free oil (static sheen test), and (d) limit of the discharge of cadmium and mercury in stock barite to 1 mg/kg for mercury and 3 mg/kg for cadmium.

It is assumed that there will be 7,861 bbl of drilling fluids and 2,681 bbl of cuttings discharged overboard per exploratory well, and 5,808 bbl of drilling fluids and 1,628 bbl of cuttings produced per development well (USEPA, 1993). The different volumes are based on the expected different average depth for the two types of wells. It is assumed that the effluent limitations and NPDES general permit will be in effect for OCS discharges and that levels of contaminants discharged will adhere to limitations. It is assumed that oil-based muds will be used when drilling operations exceed 3,000 m (10,000 ft) in depth 15 percent of the time. These volumes do not include drilling wastes transported to shore for disposal when contaminant levels exceed the above limitations.

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.

OCS Program Scenario: Tables IV-3 and IV-5 provide quantities of fluids and cuttings projected to be discharged into marine waters from OCS operations during the next 35 years in association with drilling the wells projected (31,337,000 bbl of fluids and 587,100,100 bbl of cuttings in the CPA, and 26,885,000 bbl of fluids and 12,327,000 bbl of cuttings in the WPA).

Proposed Action Scenario: Tables IV-2 and IV-4 provide quantities of fluids and cuttings projected to be discharged into marine waters from OCS well drilling operations during the next 35 years in association with proposed Sales 147 and 150.

(2) 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 single largest waste stream by volume 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.

Table IV-8 provides a comparison of the concentrations of a number of components found in produced water effluents to that of seawater and USEPA water quality criteria. Produced waters are usually high in total

Table IV-8

Ranges in Salinity and Concentrations of Selected Contaminants of Produced Water Effluents

<u>Component</u>	<u>Range in Produced Water⁽¹⁾ ($\mu\text{g/l}$)</u>	<u>Range in Sea Water ($\mu\text{g/l}$)</u>	<u>USEPA Water Quality Criteria⁽⁶⁾⁽⁷⁾ (Saltwater aquatic life) ($\mu\text{g/l}$)</u>
Salinity	3,000 - 300,000	35,000	
Volatile Hydrocarbons	53 - 6,000	0.6 ⁽²⁾	
Benzene	26 - 3,500		700 - 5,100
Toluene	11 - 1,100		
Polynuclear Aromatic Hydrocarbons (PAH)	60 - 3,400	0.4 - 3.4 ⁽³⁾	
Naphthalenes	49.3 - 2,701	1.27 ⁽³⁾	2,350 (naphthalene only)
Fluorenes	<0.1 - 251		
Dibenzothiophenes	<0.1 - 62.6		
Phenanthrenes	1.1 - 392		
Metals			
Barium	2,500 - 280,000	0.12 - 0.26 ⁽⁴⁾	
Cadmium	1 - 46	0.04 - 0.05	9.3 - 43
Chromium	320 - 1,000		50 - 1,100
Copper	560 - 2,000		2.9
Lead	trace - 29		5.6 - 140
Mercury	trace - 230	0.03 - 0.09	0.25 - 2.1
Nickel	3,700 - 9,500		7.1 - 140
Vanadium	6,300 - 22,000		
Zinc	260 - 5,500		58 - 170
Radium (226+228)	4.1 - 2,801 pCi/l ⁽⁵⁾	0.05 pCi/l ⁽¹⁾	

¹Rabalais et al., 1991.²Sauer and Sackett, 1980.³Neff, 1979.⁴Menzie, 1982.⁵La. Dept. of Environmental Quality, 1990; Rabalais et al., 1991; Snively, 1989; Stephenson and Supernaw, 1990.⁶Federal Register, 1985.⁷Federal Register, 1980.

dissolved solids (salinity) and 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 seawater 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, 1993). New USEPA effluent limitation guidelines will require industry to reduce this level to a 29-mg/l monthly average for oil and grease (Section 1.B.3.d.(3)(c)). In addition, high concentrations (characteristically greater than 200 ppm) of other soluble organic compounds 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. The new NPDES permit will require industry to conduct aquatic toxicity analyses, biomonitoring testing, and bioaccumulation studies of produced-water discharges occurring over certain levels in the Gulf of Mexico.

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) (Snively, 1989; Rabalais et al., 1991; Stephenson and Supernaw, 1990; Louisiana Dept. of Environmental Quality, 1990). Snively found that 78 percent of the wells sampled in a number of studies 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 radium-226 (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. The new general NPDES permit also requires an analysis for NORM of both the produced water effluent and fish tissue collected around discharging platforms.

Produced water may be reinjected into the formation or treated water to decrease its oil content and then discharged into surface waters. An MMS examination of 28 years of data on production facilities showed that (a) in waters less than 500 ft (152 m), 35 percent of platform complexes discharge directly into surrounding waters and (b) in waters greater than 500 ft (152 m), 50 percent of the facilities discharge water directly. The other facilities transport their produced water to discharge and treatment facilities. Some of the water is piped ashore to Louisiana and then treated and disposed of at coastal separation facilities. (Section IV.B.2.c. discusses onshore disposal of produced waters.) No produced water is shipped to Texas or the other states.

Projections of the amount of produced water from offshore operations are derived from information contained in the development documents for USEPA (1993) effluent limitation regulations. 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. Of this amount, it is assumed that a portion of the produced water generated in the CPA will continue being piped to Louisiana for disposal. It is also assumed that the effluent limitations will be in effect and levels of contaminants reduced accordingly. The NORM levels, which will be monitored, are expected to average 160 pCi/l.

OCS Program Scenario: Total estimates of produced water discharged from production facilities are approximately 9 Bbbl in the CPA and 2 Bbbl in the WPA (Tables IV-3 and IV-5) over the 35-year analysis period. These volumes do not include an additional 20 percent that is generated offshore but piped to shore bases for disposal.

Proposed Action Scenario: Total estimates of produced water discharged over the average life of the producing platforms (20 years) are approximately 243 MMbbl in the CPA and 93 MMbbl in the WPA (Tables IV-2 and IV-4). These volumes do not include an additional 11 percent that is generated offshore but piped to shore bases for disposal.

(3) *Workover, Production, and Development Fluids*

Other discharges associated with OCS activities include well treatment, completion, and workover fluids; deck drainage; and minor discharges.

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 are usually low solid-weighted brines with specialty additives, or acidic solutions. Principle contaminants can include oil and grease, (range of 0.1 to 14,000 mg/l), metals, a variety of organic compounds, biocides, acids, 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. One Gulf operator reported well treatment fluid usage of 1,283 bbl for one discharge during a workover activity (USEPA, 1993). The new effluent limitations (Section 1.B.3.d.(3)(e)) will require that these fluids become mingled with the produced water system and meet all produced water requirements.

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 effluent oil and grease content range from 1 to 16,908 ppm; and oil and grease in the discharged drainage range from 1 to 673 ppm, showing that oil and grease can greatly exceed the discharge limits of produced waters (USEPA, 1993). The source of the oil in the deck drainage is any residual oil from previous spills and the 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 waste materials and effluent. The effluent can be treated, separated, or combined with produced water and then discharged overboard. The waste materials are treated, used in the drilling mud system, or transported to shore for disposal. The new USEPA effluent limitations for deck drainage will prohibit any discharge of free oil as determined by visual sheen.

The quantities of deck drainage can vary greatly. An analysis of 950 Gulf of Mexico platforms during 1982-1983 measured deck drainage quantities ranging from 1 to 4,304 bbl/day with an average of 50 bbl/day (USEPA, 1993).

The term "minor discharges" is defined by USEPA (1993) 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 (USEPA, 1993). 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, 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.

Based on the following assumptions, estimates can be made for workover, treatment, and completion fluids. Three hundred barrels of workover fluids will be used per job; these fluids will be recycled once and each well will require one workover for each 4 years of operation. (Therefore, to calculate total volumes, one can assume 150 bbl per well per 4-year period.) Two hundred fifty barrels of treatment fluids will be used per well treatment operation, which averages one treatment every 4 years (treatment fluids cannot be recycled). Three hundred barrels of completion fluids will be used per job. These fluids can be used twice, and completion only occurs once per well. (Therefore, one can assume 150 bbl/well.) Although deck drainage volumes can vary greatly, one can assume about 20 bbl per platform per day. It is assumed that the effluent limitations will be in effect and levels of contaminants reduced accordingly.

OCS Program Scenario: Total estimates can be calculated taking total well operations - new wells - old wells x 400 + new wells x 150 bbl.

Proposed Action Scenario: Total estimates for well operations are approximately 1.2 Bbbl of workover, well treatment, and completion fluids discharged over the life of the proposed action in the CPA and 0.65 Bbbl for the WPA. Total estimates for deck drainage are 2.9 MMbbl over the 20-year average platform life in the CPA and 1.5 MMbbl in the WPA.

(4) Production Sands and Solids

Solid wastes, as 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.3.e.

Produced sand and other solids, such as scale, corrosion by-products, and paraffin, 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, accumulations in tank bottoms are often referred to as sludges. If sand volumes are large, 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 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 pCi/l; for Louisiana soils, levels range from less than 1 to 7 pCi/g. Ra-226 levels for open ocean waters and marine sediments average 2 pCi/l and 1-17 pCi/g, respectively.

The new effluent limitation guidelines will impose a zero discharge on these wastes (Section I.B.3 d.(3)(e)). Industry will use either downhole injection (a process that, at present, they are consulting with MMS about) or shipment onshore for disposal. Historically about 33 percent of these wastes were shipped onshore for disposal (USEPA, 1993). About 25 percent of these wastes were contaminated above State of Louisiana regulatory limits and could not be disposed at landfills in the State. Section IV.B.2.c. discusses onshore disposal in more depth. About 17 percent of the wastes are assumed to be contaminated with NORM.

Not all scale is removed from equipment and disposed of with produced sands. Scale is a hard, rock-like substance that may form and adhere to downhole tubulars, restricting flow. Scale may occur in association with above-ground processing and adhere to transport 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. At present, 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. This issue is discussed in more detail in Section IV.B.1.a.(3)(e).

OCS Program Scenario: It is assumed that there will be no overboard discharge of these wastes.

Proposed Action Scenario: It is assumed that there will be no overboard discharge of these wastes.

(5) Treated Domestic and Sanitary 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.3.e. 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 m³ per person per day of treated sanitary wastes and 0.110 m³ per person per day of domestic wastes (USEPA, 1993). Discharges from service vessels are estimated at 0.227 m³ per person per day (NERBC, 1976). It is expected that such discharges are rapidly diluted and dispersed.

OCS Program Scenario: Total volumes of discharges from all exploration, development, and production operations and service vessel traffic can be found in Tables IV-3 and IV-5 and are approximately 9 million m³ for the CPA and 3 million m³ for the WPA.

Proposed Action Scenario: Total volumes of discharges from all exploration, development, and production operations and service vessel traffic related to the proposed actions can be found in Tables IV-2 and IV-4 and are approximately 243,000 m³ for the CPA and 115,000 m³ for the WPA.

(6) Vessel Operational Wastes

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 discharge). Operational discharges from vessels include bilge and ballast waters and fuel oil release. New regulations promulgated under the international protocols provided by MARPOL 73/78 (33 CFR 157) have significantly limited operational discharges from oil tankers and other large vessels. These regulations now require that terminal areas maintain onshore receptacles to receive these waste waters. Even greater restrictions on oil tankers carrying OCS-produced oil are specifically provided in 33 CFR 157.10B. 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 may still discharge oily bilge waters into the water but their treatment process must severely limit the oil content in this water, dependent on their distance from shore. Bilge water discharges from service vessels would be widespread.

Based on an NERBC (1976) analysis of bilge water generation from vessels of various deadweight tonnage (dwt) and on the information on size and tonnage of work boats described in Section IV.A.2.c.(1), 32 percent of the vessels are within 60 dwt and would discharge 1,300 liters/24-hr day; and 68 percent of the vessels are within 100 dwt and would discharge 22,000 liters/24-hr day.

OCS Program Scenario: Daily volumes of bilge water discharged from service vessels during the 35-year analysis period and volumes by subarea can be calculated by dividing the number of service-vessel trips by the assumptions of discharge volume rates found in Tables IV-2 and IV-4 and then multiplying by 35 years times 365 days.

Proposed Action Scenario: Daily volumes of bilge water discharged from service vessels during the 35 year time period and volumes by subarea can be calculated by dividing the number of service-vessel trips by the assumptions of discharge volume rates found in Tables IV-2 and IV-4 and then multiplying by 35 years times 365 days.

e. 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. Most of this waste is generated in association with galley and offshore food service operations, and with operational supplies such as shipping pallets, containers used for drilling muds and chemical additives (sacks, drums, and buckets), and protective coverings used on mud sacks and drilling pipes (shrink wrap and

pipe-thread protectors). Some personal items such as hardhats and personal flotation devices are accidentally lost overboard from time to time. Generally galley, operational, and household waste are collected and stored on the lower deck near the loading dock in large receptacles resembling dumpsters. These large containers are generally covered with netting to avoid loss, and returned to shore by service vessels for disposal in approved landfills. See Section IV.B.1.a.(3)(e) for a discussion of onshore disposal sites.

The MMS regulations and international agreements (MARPOL, Annex V) discussed in Section I.B.3.d.(3)(e) prohibit the disposal of any trash and debris into the marine environment. Victual matter or organic food waste are allowed to be ground up into small pieces and disposed of overboard from structures located more than 20 km (12 mi) from shore.

Although it is unknown how much oil and gas related trash is likely to be generated offshore, and what percentage might be accidentally lost overboard in the offshore environment over the life of the proposed actions, information provided by industry gives some indication on the amount of trash historically generated offshore during the drilling of an average well. Typically a well requires 9,300 mud sacks, 100 pails, 250 pallets, 225 shrink wrap applications, and two 55-gallon drums. Drilling operations require the most supplies, equipment, and personnel, and therefore generate much more solid waste than production operations.

In the last few years companies have begun waste reduction and improved waste handling practices in order to reduce the amount of trash brought offshore that could potentially be lost into the marine environment. Improved waste management practices such as substituting paper cups and reusable ceramic cups and dishes for those made of styrofoam, recycling offshore waste, and transporting and storing supplies and materials in bulk containers when feasible are becoming much more commonplace. Experimental technology such as reinjection of waste materials reduced to slurry into downhole formations is also under development. Therefore improved waste management and an overall decline in well-drilling activities over the next 35 years should lead to a marked decline in accidental loss of trash and debris.

OCS Program Scenario: The generation of trash over the next 35 years that will be associated with levels of offshore drilling and production activities are indicated in Tables IV-3 (CPA) and IV-5 (WPA). Additionally, drilling operations associated with several thousand workovers will also occur.

Proposed Action Scenario: The generation of trash over the next 35 years that will be associated with the levels of offshore drilling and production activities are indicated in Tables IV-2 (CPA) and IV-4 (WPA). Workover operations will also result from the proposed actions.

f. Air Emissions

The OCS activities that use pumps, generators or engines; transport and/or transfer hydrocarbons; or result in accidental releases of hydrocarbons emit regulated air pollutants which are regulated by the Clean Air Act or its subsequent amendments. Some of these regulated air pollutants are precursors to ozone which is formed by photochemical reactions in the atmosphere.

The regulated pollutants which are considered here are nitric oxide (NO), carbon monoxide (CO), sulphur oxides (SO_x), volatile organic compounds (VOC), and total suspended particulate mater (TSP). Emission of regulated pollutants from OCS platforms and drilling operations are estimated using the emission rates presented below. These emission rates are derived from a 1985 MMS inventory of offshore OCS structures.

Average Annual Emissions from OCS Infrastructures in the Gulf of Mexico

	<u>NO_x</u>	<u>CO</u>	<u>SO_x</u>	<u>VOC</u>	<u>PM₁₀</u>
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

¹Assumes a 13,500-ft hole, 45-day drilling period, and a power consumption of 60 horsepower hour per foot.

²Assumes a 10,000-ft hole, 45-day drilling period, and a power consumption of 60 horsepower hour per foot.

Source: USDOl, MMS, Gulf of Mexico OCS Region estimates, 1989.

Emissions of regulated pollutants from oil spills or blowouts OCS related accidents are presented below. It is assumed that emissions of air pollutants from oil spills cease completely after three days.

Emissions Associated with OCS Accidents
(tons/hour)

<u>Accident Type</u>	<u>THC*</u>	<u>NO_x</u>	<u>SO_x</u>	<u>CO</u>	<u>PM¹⁰</u>
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 MMcf/d(gas) and 1,000 BPD (oil)

Source: USDOl, MMS, 1983.

Emissions of air pollutants during loading, storage, and transporting of crude oil and gas are calculated using the methodology and emission factors presented in USEPA publication AP-42 of 1985 with supplements A, B, and C. Helicopter emissions are also calculated using the methodology presented in the previous reference. For purposes of calculation, each platform is assumed to be visited 1.5 times per day by helicopters.

OCS Program Scenario: Total amounts of emissions of the primary air pollutants are presented in Tables IV-3 and IV-5. These amounts include emissions from existing major platform complexes.

Proposed Action Scenario: Total amounts of emissions of the regulated air pollutants associated with the proposed actions are presented in Tables IV-2 and IV-4.

g. Noise

Noise emissions resulting from OCS oil and gas development are associated with seismic surveys, the operation of fixed structures such as offshore platforms and drilling rigs, and helicopter and service-vessel

traffic. Noise generated from these activities can be transmitted through both air and water, and may be constant, intermittent, or transient. The intensity level and frequency of the emissions are highly variable, both between and among the various sources. Noise emissions from proposed OCS activities may affect resources proximate to the activities.

Seismic vessels generally operate at low hull speeds and follow a systematic pattern during survey. Noise generated is intermittent, with airgun pulses generally less than one second in duration, for relatively short survey periods (Gales, 1982). Maximum pressure levels are expected to be less than 200 dB at distances beyond 90 m from the source (Gales, 1982).

Machinery noise generated during the operation of fixed structures can be constant or intermittent, and variable with respect to intensity. Underwater noise from fixed structures ranges from about 20-40 dB above background levels within a frequency spectrum of 30-300 Hz at a distance of 30 m from the source (Naval Ocean Systems Center, 1982). These levels vary between the types of platforms and their respective water depths.

Noise generated from helicopter and service-vessel traffic is transient in nature and extremely variable in intensity, depending upon the source. Helicopters, while flying offshore, generally maintain altitudes above 700 ft during transit to and from the working area and 150 m between platforms. Service vessels transmit noise through both air and water. The source of vessel noise is mechanical, from propulsion and generator machinery, and from hull noise generated during transit. The intensity of noise from service vessels is dependent upon their speed; therefore, the major impact of such noise is within the offshore environment.

OCS Program Scenario: Information relating to the estimated number of fixed platforms, helicopter trips, and service-vessel trips (including shuttle tankers, barges, and other service vessels) can be found in Table IV-3 for the CPA and Table IV-5 for the WPA.

Proposed Action Scenario: Information relating to the estimated number of seismic surveys, fixed platforms, helicopter trips, and service-vessel trips (including shuttle tankers, barges, and other service vessels) associated with the proposed actions can be found in Table IV-2 for the CPA and Table IV-4 for the WPA.

h. Accidents

(1) Blowouts

Improperly balanced well pressures that result in sudden, uncontrolled release of petroleum hydrocarbons are called blowouts. Blowouts have caused the greatest number of fires, explosions, deaths, injuries, and property damage or loss of rigs 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. A correlation analysis has shown that the number of wells can be used to predict the number of expected blowouts. Based on this analysis, a rate of 6 blowouts per 1,000 wells drilled is used to calculate the number of blowouts. It is assumed from the historical distribution of blowouts with oil spills that 23 percent of all blowouts will be associated with oil spills, 8 percent will result in oil spills greater than 50 bbl, and only 4 percent will result in oil spills greater than or equal to 1,000 bbl is applicable. The duration of these blowouts is variable: 61 percent lasted one day, 25 percent lasted 1 week, and 13 percent lasted over 1 week. If sand is released, it is assumed that in water depths of 30 m or less it will settle within 400 m. In subsurface blowouts, sediment of all sizes available will be resuspended and the bottom disturbance will be within a 300-m radius. Sands, again, will settle within 400 m but finer sediments will remain in suspension for periods of 30 days or longer. Fine sediments will be distributed over larger distances.

OCS Program Scenario: The number of blowouts projected to occur (58 in the CPA and 33 in the WPA) is presented in Tables IV-3 and IV-5.

Proposed Action Scenario: Specific assumptions regarding the number of blowouts associated with the proposed actions (2 and 5 under the Base and High Cases in the CPA, and 1 and 3 under the Base and High Cases in the WPA) are presented in Tables IV-2 and IV-4.

(2) Offshore Spills

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, e.g., equipment malfunction, ship collisions, pipeline breaks, human error, severe storms, and other causes. Many oil spills are not directly attributable to the oil-extraction process, but are indirectly related to the support activities necessary for recovery and transportation of the resource. In addition to crude oil spills, chemical, diesel, and other oil-product spills can also occur in association with OCS activities. Of the various potential OCS-related spill sources, the great majority of the spills have resulted from production and transportation activities.

Oil spill size can vary 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. Presently it is unknown if there is a direct relationship between the spill size and the cause of the spill. Because of this, discussions of estimates of the number, volume, location, and impacts resulting from oil spills are based on spill size rather than source. For purposes of analysis, oil spills are divided into three categories based on size. Size 1 are oil spills greater than 1 bbl, and less than or equal to 50 bbl. Size 2 are oil spills greater than 50 bbl, and less than 1,000 bbl. Size 3 are oil spills greater than or equal to 1,000 bbl. This terminology will be used throughout the document.

Oil spill information used for environmental assessments are size, weathering, length of coastline contacted, spill response, and probability of occurrence and contact with environmental resources. The information is obtained by statistical analysis of historical oil spill data, use of models such as the Oil Spill Risk Model and Oil Weathering Model, and current industry and government practices. Assumptions regarding each of the six aspects--size, weathering, length of coastline contacted, spills response, spill occurrence, and spill contact--will be presented below.

The estimated mean numbers of Size 1 and 2 oil spills are calculated by multiplying a spill rate times the appropriate oil volume. The spill rates employed are presented in the Final EIS for Sales 142 and 143 for Sizes 1 and 2 spills, and the Oil-Spill Risk Analysis (OSRA) Report (Price and Lear, 1992) for Size 3 spills. Table IV-9 shows the occurrence probabilities and mean number for Size 3 spills. The estimates of mean number of spills are used to make assumptions about the occurrence of oil spills in the different size categories.

(a) Spill Size

Statistical analysis for Size 3 spills yields a median size of 6,500 bbl for a pipeline oil spill and a median size of 5,000 bbl for a platform oil spill. Statistical data are not available for Size 1 and 2 spills. The mean spill size for non-OCS spills (diesel and other spills) is 34 bbl (Size 1).

It is assumed that a 6,500-bbl pipeline spill is the most likely spill that will result in contact to environmental resources.

(b) Weathering

A number of processes, which alter the chemical and physical characteristics of the original hydrocarbon mixture, occur when oil is spilled. Collectively, these are referred to as weathering or aging of the oil. Weathering, primarily, together with atmospheric and oceanographic conditions, determines the time frames that the oil remains on the surface of the water and the characteristics of the oil at the time of impact. Chemical, physical, and biological processes operate on the spilled oil to change its hydrocarbon compounds, selectively reducing many of the components in the slick, and breaking down the slick until it can no longer be recognized as a cohesive mass floating on the surface of the water. Such weathering processes include evaporation of volatile hydrocarbons into the atmosphere, dissolution of soluble components, dispersion of oil droplets into the water column, emulsification and spreading of the oil on the surface of the water, chemo- or photo-oxidation of specific compounds creating new components that are often more soluble, and biodegradation of the oil reducing its remaining mass. Over time, if the oil is not completely dissipated, a tar-like residue may be left which breaks up into smaller tar lumps that usually sink.

Numerical computer modelling of weathering processes is used to project a material balance of oil remaining on the ocean surface and to predict the composition of oil as a function of time for the spills estimated to occur from the proposed actions. For this EIS, the MMS open-ocean oil weathering model

Table IV-9

Oil-spill Occurrence Probability Estimates for Spills Greater than or Equal to 1,000 Barrels (Size 3) Resulting Over the Life of the Proposed Actions, from OCS Program Activities* for Proposed Sales 147 and 150

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									
<u>Base Case</u>									
WPA	(0.04)	0.02	0.02	0.01	0.05	2	2	1	5
CPA	(0.12)	0.07	0.08	0.00	0.15	7	8	n	14
<u>High Case</u>									
WPA	(0.12)	0.07	0.06	0.02	0.16	7	6	2	15
CPA	(0.27)	0.16	0.18	0.00	0.34	15	17	n	29
<u>OCS Program Activities*</u>									
WPA	(1.17)	0.70	0.70	0.11	1.52	50	50	11	78
CPA	(5.22)	3.13	3.49	0.01	6.63	96	97	1	99+
EPA	(0.04)	0.02	0.02	0.01	0.05	2	2	1	5

*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 and Lear, written communication, 1993.

(Kirstein, 1992) has been utilized. The oil type chosen was a crude oil composite carried by the largest volume pipeline system in the central Gulf into the Gibson terminal. Some of the lighter components of this oil had already been purged. The oil type was about 21 percent volume gasoline plus naphtha, 31 percent residuum, and had a bulk API gravity of 34.5. Wind speeds used in the model represent the passage of a cold front and range from 4 to 8 ms⁻¹. The assumed temperature of the water 23°C (73°F) was indicative of late fall conditions. The spill is assumed to be a 6,500-bbl spill (Size 3).

Table IV-12 provides the model results of the weathering of a pipeline spill. This information is used in collaboration with the analysis of occurrence and contact of Size 3 oil spills provided by the OSRA model. The OSRA model provides the likelihood of contact within certain time frames but does not provide the most likely time of contact. A time period must be selected to determine the characteristics of the slick using Table IV-12. Therefore, the OSRA probability results are extrapolated to determine when a 10 percent risk of contact to a resource will occur, and this time is used to estimate slick characteristics.

(c) Length of Coastline Affected

Table IV-12 also provides data on the likely length of shoreline contacted. These data are calculated using formulas found in Ford (1985). Ford performed a statistical analysis of worldwide historical spill occurrences to describe the median length of coastline affected from spills of various sizes and under various climatological conditions and different geographical regions.

(d) Spill Response

This document assumes that mechanical containment and recovery will be the primary response method utilized offshore. Dispersant application will be approved for a large spill if it appeared sensitive shoreline resources could be at risk and it could be applied far enough offshore. Dispersant application will result in the dispersion of 30-50 percent of the oil slick. The use of mechanical or chemical cleanup or other means offshore to prevent landfall will be preferable to shoreline cleanup. Bioremediation will not be used, however, as an offshore response option.

It is assumed that about 10 percent of Size 3 spills will be removed from the water if the spill does not make landfall. Spills less than 50 bbl (Size 1) will not likely be cleaned up because the oil will spread to a thickness not recoverable by mechanical skimming equipment, and would likely dissipate prior to equipment reaching the spill site.

(e) Occurrence and Contact

OCS Program Scenario: The assumed numbers of occurrences for the three sizes of oil spills during the 35-year analysis period are presented in Tables IV-3 and IV-5.

It is assumed that only a few Size 1 spills will contact land (Figure IV-2) in the WPA and the CPA. It is assumed for Size 2 oil spills that one will contact land in the WPA and a few will contact land in the CPA. Contact with environmental resources by Size 3 spills is estimated from probabilities using the OSRA Model. The estimated probabilities are calculated for various seasons and for various sources (platforms, pipelines, and tankers). The results of the analysis are presented in the OSRA Report (Price and Lear, written communication, 1993). The combined probabilities of a Size 3 oil spill occurring and contacting Gulf of Mexico environmental resources within 10 days are presented in Tables IV-10 and IV-11.

Proposed Action Scenario: The assumed number of occurrences for the three sizes of oil spills associated with the proposed actions are presented in Tables IV-2 and IV-4.

For Size 1 oil spills, it is assumed that none will contact land in either the WPA or the CPA under both the Base Case and the High Case Scenarios. For Size 2 oil spills, it is assumed that none will contact land under the Base Case Scenario, and that one will contact land in the CPA and none will contact land in the WPA under the High Case Scenario. For Size 3 spills, contacts are estimated from probabilities using the OSRA Model. The estimated probabilities are calculated for various seasons and for various sources (platforms, pipelines, and tankers). The results of the analysis are presented in the OSRA Report (Price and

Numbers adjacent to the coast indicate land segments (coastal counties/parishes).

Numbers offshore indicate oil spill launch sites.

Figure IV-2. Land Segments and Launch Sites Used in the Minerals Management Service Oil Spill Risk Analysis Model.

Table IV-10

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 147)

Land Segment/ Environmental Resource	Base Case (CPA)		High Case (CPA)		Gulfwide Import Tankering		OCS Program Activities	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	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.	-	-	-	-	4	0.0	2	0.0
6 - Aransas, Tex.	-	-	-	-	9	0.1	2	0.0
7 - Calhoun, Tex.	-	-	-	-	6	0.1	3	0.0
8 - Matagorda, Tex.	-	-	-	-	n	0.0	1	0.0
9 - Brazoria, Tex.	-	-	-	-	3	0.0	1	0.0
10 - Galveston, Tex., et al.	-	-	-	-	28	0.3	8	0.1
11 - Jefferson, Tex.	-	-	-	-	3	0.0	1	0.0
12 - Cameron, La.	-	-	-	-	17	0.2	6	0.1
13 - Vermilion, La.	-	-	-	-	n	0.0	5	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	31	0.4
17 - Lafourche, La.	-	-	-	-	1	0.0	9	0.1
18 - Jefferson, La.	-	-	-	-	1	0.0	10	0.1
19 - Plaquemines, La.	1	0.0	1	0.0	21	0.2	53	0.7
20 - St. Bernard, La., et al.	-	-	-	-	1	0.0	1	0.0
21 - Hancock, Miss., et al.	-	-	-	-	3	0.0	4	0.0
22 - Mobile, Ala.	-	-	-	-	2	0.0	1	0.0
23 - Baldwin, Ala.	-	-	-	-	n	0.0	1	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	2	0.0	4	0.0	74	1.3	84	1.8
Western Deepwater Boundary	n	0.0	n	0.0	71	1.2	29	0.3
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	0.0	10	0.1	96	3.3	56	0.8
Timbalier Bay	n	0.0	1	0.0	1	0.0	19	0.2
Barataria Bay	n	0.0	n	0.0	9	0.1	35	0.4
Mississippi Sound	n	0.0	n	0.0	7	0.1	7	0.1
Caminada Headland	n	0.0	n	0.0	4	0.0	19	0.2
West Plaquemines Coastal Barrier	1	0.0	1	0.0	28	0.3	54	0.8
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	43	0.6
W. Winter Menhaden Spawning Ground	n	0.0	1	0.0	n	0.0	32	0.4

Table IV-10. 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 147) (continued)

<u>Land Segment/ Environmental Resource</u>	Base Case (CPA)		High Case (CPA)		Gulfwide Import Tankering		OCS Program Activities	
	<u>Prob</u>	<u>Mean</u>	<u>Prob</u>	<u>Mean</u>	<u>Prob</u>	<u>Mean</u>	<u>Prob</u>	<u>Mean</u>
C. Winter Menhaden Spawning Ground	n	0.0	n	0.0	19	0.2	25	0.3
Eastern Deepwater Boundary	n	0.0	n	0.0	57	0.8	3	0.0
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 Ground	n	0.0	n	0.0	n	0.0	n	0.0
Survey Block 1	n	0.0	n	0.0	16	0.2	9	0.1
Survey Block 2	n	0.0	1	0.0	10	0.1	15	0.2
Survey Block 3	1	0.0	1	0.0	30	0.4	23	0.3
Survey Block 4	1	0.0	2	0.0	59	0.9	26	0.3
Survey Block 5	1	0.0	3	0.0	64	1.0	20	0.2
Survey Block 6	2	0.0	3	0.0	39	0.5	27	0.3
Survey Block 7	1	0.0	3	0.0	28	0.3	24	0.3
Florida Key National Marine Sanctuary	n	0.0	n	0.0	30	0.4	n	0.0
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	28	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	28	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	28	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	33	0.4	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	28	0.3	8	0.1
Sea Rim Rec. Beaches	n	0.0	n	0.0	3	0.0	1	0.0

Table IV-10. 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 147) (continued)

<u>Land Segment/ Environmental Resource</u>	<u>Base Case (CPA) Prob Mean</u>		<u>High Case (CPA) Prob Mean</u>		<u>Gulfwide Import Tankering Prob Mean</u>		<u>OCS Program Activities Prob Mean</u>	
Chenier Plain Coastal Barrier	n	0.0	n	0.0	17	0.2	11	0.1
Grand Isle/Grand Terre Coastal Barrier	n	0.0	n	0.0	1	0.0	10	0.1
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	1	0.0
Mobile Bay/Perdido Bay Seagrass Beds	n	0.0	n	0.0	2	0.0	3	0.0
Vermilion/Atchafalaya Bays	n	0.0	n	0.0	n	0.0	14	0.1
Mobile Bay	n	0.0	n	0.0	2	0.0	2	0.0
Chenier Plain Marshes	n	0.0	n	0.0	17	0.2	11	0.1
Cameron Parish Rec. Beaches	n	0.0	n	0.0	17	0.2	6	0.1
Fourchon Rec. Beaches	n	0.0	n	0.0	1	0.0	9	0.1
Grand Isle Rec. Beaches	n	0.0	n	0.0	1	0.0	10	0.1
Mississippi Mainland Rec. Beaches	n	0.0	n	0.0	3	0.0	4	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	1	0.0

Note: n = less than 0.5% probability. Segments with less than 0.5% probability of one or more contacts within 10 days are not shown.

Source: Price and Lear, written communication, 1993.

Table IV-11

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 150)

Land Segment/ Environmental Resource	Base Case (WPA)		High Case (WPA)		Gulfwide Import Tankering		OCS Program Activities	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	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.	-	-	-	-	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	n	0.0	28	0.3	8	0.1
11 - Jefferson, Tex.	-	-	-	-	3	0.0	1	0.0
12 - Cameron, La.	-	-	-	-	17	0.2	6	0.1
13 - Vermilion, La.	-	-	-	-	n	0.0	5	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	31	0.4
17 - Lafourche, La.	-	-	-	-	1	0.0	9	0.1
18 - Jefferson, La.	-	-	-	-	1	0.0	10	0.1
19 - Plaquemines, La.	-	-	-	-	21	0.2	53	0.7
20 - St. Bernard, La., et al.	-	-	-	-	1	0.0	1	0.0
21 - Hancock, Miss., et al.	-	-	-	-	3	0.0	4	0.0
22 - Mobile, Ala.	-	-	-	-	2	0.0	1	0.0
23 - Baldwin, Ala.	-	-	-	-	n	0.0	1	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	n	0.0	1	0.0	74	1.3	84	1.8
Western Deepwater Boundary	2	0.0	5	0.0	71	1.2	29	0.3
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	56	0.8
Timbalier Bay	n	0.0	n	0.0	1	0.0	19	0.2
Barataria Bay	n	0.0	n	0.0	9	0.1	35	0.4
Mississippi Sound	n	0.0	n	0.0	7	0.1	7	0.1
Caminada Headland	n	0.0	n	0.0	4	0.0	19	0.2
West Plaquemines Coastal Barrier	n	0.0	n	0.0	28	0.3	54	0.8
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	43	0.6
W. Winter Menhaden Spawning Ground	n	0.0	n	0.0	n	0.0	32	0.4

Table IV-11. 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 150)
(continued)

IV-42

Land Segment/ Environmental Resource	Base Case (WPA)		High Case (WPA)		Gulfwide Import Tankering		OCS Program Activities	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
C. Winter Menhaden Spawning Ground	n	0.0	n	0.0	19	0.2	25	0.3
Eastern Deepwater Boundary	n	0.0	n	0.0	57	0.8	3	0.0
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 Ground	n	0.0	n	0.0	n	0.0	n	0.0
Survey Block 1	n	0.0	n	0.0	16	0.2	9	0.1
Survey Block 2	n	0.0	n	0.0	10	0.1	15	0.2
Survey Block 3	n	0.0	n	0.0	30	0.4	23	0.3
Survey Block 4	n	0.0	n	0.0	59	0.9	26	0.3
Survey Block 5	n	0.0	n	0.0	64	1.0	20	0.2
Survey Block 6	n	0.0	n	0.0	39	0.5	27	0.3
Survey Block 7	n	0.0	n	0.0	28	0.3	24	0.3
Florida Keys National Marine Sanctuary	n	0.0	n	0.0	30	0.4	n	0.0
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	28	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	28	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	28	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	1	0.0	33	0.4	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	17	0.2	11	0.1

Table IV-11. 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 150) (continued)

<u>Land Segment/ Environmental Resource</u>	<u>Base Case (WPA)</u>		<u>High Case (WPA)</u>		<u>Gulfwide Import Tankering</u>		<u>OCS Program Activities</u>	
	<u>Prob</u>	<u>Mean</u>	<u>Prob</u>	<u>Mean</u>	<u>Prob</u>	<u>Mean</u>	<u>Prob</u>	<u>Mean</u>
Grand Isle/Grand Terre Coastal Barrier	n	0.0	n	0.0	1	0.0	10	0.1
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	2	0.0	3	0.0
Vermilion/Atchafalaya Bays	n	0.0	n	0.0	n	0.0	14	0.1
Mobile Bay	n	0.0	n	0.0	2	0.0	2	0.0
Chenier Plain Marshes	n	0.0	n	0.0	17	0.2	11	0.1
Cameron Parish Rec. Beaches	n	0.0	n	0.0	17	0.2	6	0.1
Fourchon Rec. Beaches	n	0.0	n	0.0	1	0.0	9	0.1
Grand Isle Rec. Beaches	n	0.0	n	0.0	1	0.0	10	0.1
Mississippi Mainland Rec. Beaches	n	0.0	n	0.0	3	0.0	4	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	1	0.0

Note: n = less than 0.5% probability. Segments with less than 0.5% probability of one or more contacts within 10 days are not shown.

Source: Price and Lear, written communication, 1993.

Table IV-12

**Weathering Characteristics* and Projected Shoreline Contacted by a 6,500-bbl Pipeline Spill
during Winter Cold Front Conditions**

<u>Time Elapsed</u>	<u>Barrels Remaining**</u>	<u>Volume Remaining (%)</u>	<u>Slick Area (m²)</u>	<u>Slick Thickness (mm)</u>	<u>Mass Evaporated (%)</u>	<u>Mass Dispersed into Water (%)</u>	<u>Likely Kilometers of Shoreline Contacted</u>
4 hrs	5,600	86	2.1 x 10 ⁶	4.20	11	1	22
12 hrs	5,100	78	3.3 x 10 ⁶	2.50	17	2	21
1 day	4,800	74	4.5 x 10 ⁶	1.70	19	4	20
2 days	4,300	66	6.0 x 10 ⁶	1.10	24	8	19
3 days	3,900	60	7.1 x 10 ⁶	0.87	26	11	18
4 days	3,800	58	8.1 x 10 ⁶	0.73	28	12	18
5 days	3,600	55	8.7 x 10 ⁶	0.65	29	13	18
6 days	3,500	54	9.3 x 10 ⁶	0.58	31	14	17
7 days	3,300	51	1.0 x 10 ⁷	0.52	32	15	17
8 days	3,300	51	1.0 x 10 ⁷	0.49	32	15	17
9 days	3,100	48	1.1 x 10 ⁷	0.45	33	16	16
10 days	3,000	46	1.1 x 10 ⁷	0.42	34	17	16

*Does not account for any changes to spill volume from subsurface occurring as oil rises from the ocean floor to the surface of a water body.

**% volume loss will not equal % mass evaporation plus % mass dispersion. Mass calculations are based on the weight of different oil components.

Lear, written communication, 1993). The combined probabilities of a Size 3 crude oil spill occurring and contacting Gulf of Mexico environmental resources within 10 days are presented in Tables IV-10 and IV-11.

(3) Vessel Collisions

Vessel collisions with OCS infrastructure have been minimized through the implementation of Coast Guard regulations for marking both fixed structures and moored objects via lights and sound-producing devices, and the inclusion of these structures on nautical charts. Notification of the addition or removal of such infrastructure is listed in the Coast Guard's Notice to Mariners.

The OCS service vessels can collide with marine mammals, turtles, and other marine animals during transits. The probability of such collisions increases with vessel speed and the number of trips (and probably visibility), yet varies according to the spatial and temporal variability in the distributions of living resources subject to collisions with service vessels. Operational speeds of vessels are much higher in the offshore environment, and the pathways of traffic are not defined and constant as in coastal areas.

OCS Program Scenario: The estimated number of seismic surveys and service-vessel trips, including shuttle tankers, barges, and other service vessels, associated with all OCS activities can be found in Table IV-3 for the CPA and Table IV-5 for the WPA.

Proposed Action Scenario: Information relating to the estimated number of seismic surveys and service-vessel trips, including shuttle tankers, barges, and other service vessels, associated with activities resulting from the proposed actions can be found in Table IV-2 for the CPA and Table IV-4 for the WPA.

B. ONSHORE SCENARIO FOR FUTURE OCS OPERATIONS

This section describes the disregard of infrastructure, activities, and disturbances associated with the OCS Program and the proposed actions (Sales 147 and 150) that could potentially affect the biological, physical, and socioeconomic resources of the Gulf of Mexico region. Onshore is defined here as the area between the State-Federal offshore boundary and the inland extent of the coastal region (Figure IV-1).

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 pipe yards) assemble and prepare the structures that are used to develop and transport offshore hydrocarbons. Processing and storage facilities (terminals, separation facilities, gas treatment plants, refineries, and disposal sites) provide temporary storage sites for hydrocarbons, remove various impurities from the hydrocarbon stream, separate and distill various hydrocarbon fractions from the raw product, and provide disposal sites for wastes generated offshore. Onshore and coastal activities associated with these facilities and with offshore operations include service-vessel and barge traffic through coastal waters, offloading oil at terminals, movement of oil through pipelines, helicopter flight patterns over the coast, onshore disposal and treatment of offshore wastes, and others.

1. Onshore Facilities and Activities

a. Infrastructure

Impacts from onshore infrastructure can result from the construction of new facilities, the operation of existing facilities, and the transportation of supplies, personnel, and hydrocarbons to and from the infrastructure sites. The number of and location by coastal subarea of existing and projected new facilities are indicated in Tables IV-14, IV-16, and IV-17.

(1) Service Facilities

(a) Service Bases

Service bases serve as loading and storage facilities for equipment, supplies, and personnel needed at offshore work sites. Table IV-17 shows the number of service bases located in different onshore subareas along the Gulf Coast.

No new service base construction is projected for either the proposed action scenario or OCS Program Scenario. This assumption is based on the widespread distribution of existing service base capacity throughout Texas and Louisiana, and on the adequacy of the existing service base facilities to support OCS operations in previous years when activity levels exceeded those projected to occur during the life of the proposed actions. While future OCS operations are projected to be associated with increased oil and gas activities in deep-water areas of the Gulf, which may utilize larger, deeper draft service vessels, it is assumed that existing facilities can be used either as they currently exist or with modifications to the navigation channels that provide access to the service base (navigation channels are discussed in Section IV.B.2.a.(1)).

OCS Program Scenario: Declines in the use of existing service bases are expected during the period 1994-2028 in association with projected declines in OCS activities during the same period. With projected future industry interest in deep water tracts, it is likely that service base activity will remain high at locations that can be accessed by deeper draft vessels. These bases currently include Corpus Christi and Galveston, Texas, and Berwick and Venice, Louisiana. Deepening of the navigation channel leading to Port Fourchon, Louisiana, is also projected. Closings of some other service bases are expected. It is assumed that 60 percent of the existing service base capacity will be used to support OCS operations, based on the ratio of tideland to OCS oil production for the year 1989. The amount of vessel traffic expected to use service bases over the 35-year life of the proposed actions is indicated in Tables IV-14, IV-16, and IV-17 for onshore subareas and Table IV-19 for individual service bases.

Proposed Action Scenario: No new service base construction is projected as a result of the proposed actions. It is assumed that 3 and 6 percent of existing service base capacity will be used to support Base and High Case activities, respectively. The amount of vessel traffic expected to use service bases over the life of the proposed actions is indicated in Tables IV-13 and IV-15 for onshore subareas and Table IV-18 for individual service bases.

(b) Helicopter Hubs

Heliports are facilities where helicopters can land, offload and load passengers and supplies, and be refueled and serviced. A total of 325 heliports have been built and are used throughout the coastal area affected by the proposed actions. Of this number, there were 33 operating helicopter hubs, or major base locations, in the coastal areas of Texas, Louisiana, and Alabama in 1990. Based on an examination of the helicopter industry's flight patterns, it is assumed that 60 percent of the offshore flights result in a coastal helicopter crossing.

OCS Program Scenario: No helicopter hub closings are anticipated during the next 35 years. Although the number of helicopter trips are expected to decline, the duration of a typical trip will increase as activities move into more distant locations in deeper water. This document assumes that, although the number of trips per year will decline by 50 percent over the life of the proposed actions, the total amount of flying time will remain relatively constant. It is assumed that 90 percent of heliport usage will be for OCS activities. The number of helicopter coastal crossings are indicated in Tables IV-14, IV-16, and IV-17 (17,549,000 associated with activities in the CPA, and 2,559,000 associated with activities in the WPA).

Proposed Action Scenario: Three percent and 6 percent of heliport capacity will be used to support the Base and High Case Scenarios, respectively. The number of helicopter coastal crossings are indicated in Tables IV-13 and IV-15 (149,600 and 389,200 under the Base and High Cases in the CPA).

Table IV-11

Onshore Scenario Information Related to the Proposed Action in the Central Planning Area (Sale 147) for the Years 1994-2028

	Onshore Subareas*														Total CPA	
	LA-1		LA-2		LA-3		MA-1		TI-1		Total CPA		Base Case	High Case		
	Base Case	High Case	Base Case	High Case	Base Case	High Case	Base Case	High Case	Base Case	High Case	Base Case	High Case				
	Total / Peak Year**															
Oil Transport to Shore	0 / 0	0 / 0	100 / NA	225 / NA	16 / NA	36 / NA	0 / 0	0 / 0	0 / 0	0 / 0	116 / 6	261 / 13	0 / 0	0 / 0		
Pipeline Transported Oil (MMbbl)	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0		
Shuttle Tanker Trips	99 / 5	221 / 11	49 / 2	111 / 5	44 / 2	99 / 5	0 / 0	0 / 0	5 / 0	11 / 1	197 / 10	442 / 21	0 / 0	0 / 0		
Barge Trips	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	36 / NA	81 / NA	25 / NA	5 / NA		
Oil Spills (crude and oil products)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	11 / NA	25 / NA	5 / NA		
1 bbl or less	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA		
>1 and <50 bbl (Size 1)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA		
>50 and <1,000 bbl (Size 2)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA		
>1,000 bbl (Size 3)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA		
Support Activities:																
Helicopter Coastal Crossings	26,900 / 1,300	70,100 / 3,400	61,300 / 2,900	159,600 / 7,800	53,900 / 2,600	140,100 / 6,800	4,500 / 200	11,700 / 400	3,000 / 100	7,800 / 400	149,600 / 7,200	389,200 / 19,000				
Service Vessels																
Trips	3,000 / 187	6,700 / 439	3,000 / 189	6,700 / 443	1,900 / 118	4,200 / 278	200 / 14	500 / 33	300 / 20	700 / 46	8,400 / 528	18,800 / 1,240				
Bilge Water Discharged (1,000 l)	946 / 59	2,112 / 138	946 / 59	2,112 / 140	599 / 37	1,324 / 88	63 / 4	158 / 11	95 / 6	221 / 14	2,648 / 166	5,926 / 391				
Onshore Disposal of Offshore Wastes																
Produced Sands (1,000 bbl)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	60 / NA	135 / NA				
Produced Waters (MMbbl)	0 / 0	0 / 0	0 / 0	0 / 0	26 / NA	59 / NA	0 / 0	0 / 0	0 / 0	NA / NA	26 / NA	59 / NA				
Drilling Muds and Cuttings (1,000 bbl)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	379 / NA	823 / NA				

* See Figure IV-1. These subareas are considered to be in the area of potential impact from the proposed action.

** Peak-year figures for individual subareas may not add to the peak-year figure for the total planning area because the subarea peak-years may not occur simultaneously.

Table IV-14
Onshore Scenario Information Related to OCS Program Activities in the Central
Planning Area for the Years 1994-2028

	Onshore Subareas*					
	LA-1 OCS Program Activities	LA-2 OCS Program Activities	LA-3 OCS Program Activities	MA-1 OCS Program Activities	TX-2 OCS Program Activities	Total CPA OCS Program Activities
	Total / Peak Year**					
Oil Transport to Shore						
Pipeline Transported Oil (MMbbl)	584 / NA	2,986 / NA	1,580 / NA	79 / NA	0 / 0	5,255 / 250
Shuttle Tanker Trips	0 / 0	0 / 0	46 / 3	0 / 0	0 / 0	46 / 3
Barge Trips	4,230 / 200	2,115 / 100	1,904 / 90	0 / 0	212 / 10	8,460 / 400
Oil Spills (crude and oil products)						
1 bbl and less	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	1190 / 57
>1 and <50 bbl (Size 1)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	390 / 19
>50 and < 1,000 bbl (Size 2)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	70 / 3
> 1,000 bbl (Size 3)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	6 / 1
Support Activities						
Helicopter Coastal Crossings (1000's)	3,159 / 168	7,195 / 382	6,318 / 335	526 / 28	351 / 19	17,549 / 931
Service Vessels						
Trips (1,000's)	208 / 11	210 / 11	132 / 7	16 / 1	22 / 1	587 / 31
Bilge Water Discharged (1000 l)	65,600 / 3,500	66,200 / 3,500	41,600 / 2,200	5,000 / 300	6,900 / 300	185,000 / 9,800
Onshore Disposal of Offshore Wastes						
Produced Sands (1,000 bbl)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	2,610 / 124
Produced Waters (MMbbl)	86 / NA	0 / 0	1,600 / NA	0 / 0	0 / 0	1,686 / NA
Drilling Muds and Cuttings (1,000 bbl)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	12,817 / 41
	Existing / New ***					
Onshore Infrastructure						
Refineries	5 / 0	3 / 0	7 / 0	2 / 0	14 / 0	31 / 0
Gas Processing Plants	13 / 0	8 / 0	5 / 0	0 / 1	0 / 0	26 / 1
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 / 1	0 / 0	50 / 1
Navigation Channels	4 / 0	4 / 0	10 / 0	3 / 0	3 / 0	24 / 0
Pipeline Landfalls	49 / 1	53 / 0	46 / 0	2 / 2	0 / 0	150 / 3
Onshore Pipelines (km)	1,453 / 40	1,571 / 0	1,246 / 0	179 / 32	0 / 0	4,449 / 72
Helicopter Hub	8 / 0	8 / 0	4 / 0	1 / 0	6 / 0	27 / 0

* See Figure IV-1. These subareas are considered to be in the area of potential impact from the proposed action.

** Peak-year figures for individual subareas may not add to the peak-year figure for the total planning area because the subarea peak years may not occur simultaneously.

*** Existing infrastructure refers to the maximum number of existing facilities that will be used to support future operations (decline in number of facilities is expected in some cases). New infrastructure refers to new facilities projected to be built to support future operations.

Table IV-15

Onshore Scenario Information Related to the Proposed Action in the Western Planning Area (Sale 150) for the Years 1994-2028

	Onshore Subareas*															
	Base Case	TX-1	High Case	Base Case	TX-2	High Case	Base Case	LA-1	High Case	Base Case	LA-2	High Case	Base Case	LA-3	High Case	Total WPA
	Total / Peak Year**															
Oil Transport to shore																
Pipeline Transported Oil (MMbbl)	10 / NA	30 / NA	20 / NA	60 / NA	2 / NA	6 / NA	2 / NA	6 / NA	2 / NA	6 / NA	0 / 0	0 / 0	0 / 0	0 / 0	34 / NA	102 / NA
Shuttle Tanker Trips:	19 / 2	55 / 4	28 / 3	84 / 6	5 / 1	14 / 1	5 / 1	14 / 1	5 / 1	14 / 1	0 / 0	0 / 0	0 / 0	0 / 0	52 / 4	153 / 12
Barge Trips:	4 / 1	14 / 1	2 / 1	7 / 1	2 / 1	6 / 1	2 / 1	6 / 1	2 / 1	6 / 1	0 / 0	0 / 0	1 / 1	1 / 1	8 / 1	29 / 1
Oil Spills (crude and oil products)																
1 bbl or less	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	8 / NA	24 / NA
>1 and <50 bbl (Size 1)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	2 / NA	6 / NA
>50 and <1,000 bbl (Size 2)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	0 / 0	0 / 0
>1,000 bbl (Size 3)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	0 / 0	0 / 0
Support Activities:																
Helicopter Coastal Crossings	15,240 / 720	45,560 / 2,110	34,720 / 1,630	103,790 / 4,810	30,480 / 1,430	91,130 / 4,220	2,540 / 120	7,590 / 350	1,690 / 80	5,060 / 230	84,670 / 3,970	253,140 / 11,730				
Service Vessels																
Trips	1,800 / 130	4,700 / 419	1,800 / 133	4,700 / 423	1,100 / 82	3,000 / 265	100 / 10	400 / 32	200 / 14	500 / 44	5,000 / 400	13,300 / 380				
Bilge Water Discharged (1,000 liter)	570 / 40	1,480 / 130	570 / 40	1,480 / 130	350 / 30	950 / 80	30 / 4	130 / 10	60 / 4	160 / 10	1,580 / 130	4,190 /				
Onshore Disposal of Offshore Wastes:																
Produced Sands (1,000 bbl)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	20 / 1	60 / 3
Drilling Muds and Cuttings (1,000 bbl)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	293 / 32	752 / 117

* See Figure IV-1. These subareas comprise the area of potential impact from the proposed action.

** Peak-year figures for individual subareas may not add to the peak-year figure for the total planning area because peak years in subareas may not occur simultaneously.

Table IV-16

Onshore Scenario Information Related to OCS Program Activities in the Western Planning Area
for the Years 1994-2028

	Onshore Subareas*										
	TX-1 OCS Program Activities		TX-2 OCS Program Activities		LA-1 OCS Program Activities		LA-2 OCS Program Activities		LA-3 OCS Program Activities		Total WPA OCS Program Activities
	Total / Peak Year*										
Oil Transport to Shore:											
Pipeline Transported Oil (MMbbl)	213 /	NA	675 /	NA	68 /	NA	68 /	NA	0 /	0	1,024 / 33
Shuttle Tanker Trips	432 /	35	435 /	35	66 /	4	0 /	0	22 /	2	955 / 64
Barge Trips	470 /	15	235 /	8	212 /	7	0 /	0	24 /	1	940 / 30
Oil Spills (crude and oil products)											
1 bbl or less	NA /	NA	NA /	NA	NA /	NA	NA /	NA	NA /	NA	280 / 12
>1 and <50 bbl (Size 1)	NA /	NA	NA /	NA	NA /	NA	NA /	NA	NA /	NA	70 / 4
>50 and < 1,000 bbl (Size 2)	NA /	NA	NA /	NA	NA /	NA	NA /	NA	NA /	NA	2 / 1
> 1,000 bbl (Size 3)	NA /	NA	NA /	NA	NA /	NA	NA /	NA	NA /	NA	2 / 1
Support Activities											
Helicopter Coastal Crossings (1000's)	819 /	35	973 /	41	768 /	32	0 /	0	0 /	0	2,559 / 108
Service Vessels											
Trips	57,340 /	3,200	57,830 /	3,300	36,300 /	2,000	4,400 /	200	6,020 /	300	161,900 / 9,100
Bilge Water Discharged (1000 l)	18,070 /	1,010	18,230 /	1,040	11,440 /	630	1,390 /	60	1,900 /	90	51,030 / 2,870
Onshore Disposal of Offshore Wastes											
Produced Sands (1,000 bbl)	NA /	NA	NA /	NA	NA /	NA	NA /	NA	NA /	NA	585 / 19
Drilling Muds and Cuttings (1,000 bbl)	NA /	NA	NA /	NA	NA /	NA	NA /	NA	NA /	NA	7,846 / 403
	Existing / New***										
Onshore Infrastructure Construction											
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 /	1	8 /	0	3 /	0	0 /	0	0 /	0	16 / 1
Navigation Channels	6 /	0	3 /	0	4 /	0	4 /	0	3 /	0	20 / 0
Pipeline Landfalls	2 /	2	14 /	1	4 /	0	0 /	0	0 /	0	20 / 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. These subareas are considered to be in the area of potential impact from the proposed action.

** Peak-year figures for individual subareas may not add to the peak-year figure for the total planning area because the subarea peak years may not occur simultaneously.

*** Existing infrastructure refers to the maximum number of existing facilities that will be used to support future operations (decline in number of facilities is expected in some cases). New infrastructure refers to new facilities projected to be built to support future operations.

Table IV-17

Onshore Scenario Information Related to OCS Program Activities in the Gulf of Mexico for the Years 1994-2028

	Onshore Subareas*						
	LA-1 OCS Program Activities	LA-2 OCS Program Activities	LA-3 OCS Program Activities	MA-1 OCS Program Activities	TX-1 OCS Program Activities	TX-2 OCS Program Activities	OCS Program Activities
	Total / Peak Year**						
Oil Transported to Shore							
Pipeline Transported Oil (MMbbl)							
From WPA and CPA	652 / NA	3,054 / NA	1,580 / NA	79 / NA	213 / NA	675 / 0	6,279 / 283
From EPA	0 / 0	0 / 0	0 / 0	25 / NA	0 / 0	0 / 0	25 / NA
Shuttle Tanker Trips							
From WPA	66 / 4	0 / 0	22 / 2	0 / 0	432 / 35	435 / 35	955 / 64
From CPA	0 / 0	0 / 0	46 / 3	0 / 0	0 / 0	0 / 0	46 / 3
From EPA	0 / 0	0 / 0	45 / 2	0 / 0	0 / 0	0 / 0	45 / 2
Total	66 / NA	0 / NA	113 / NA	0 / NA	432 / NA	435 / NA	1046 / NA
Barge Trips	4,442 / 207	2,115 / 100	1,927 / 91	0 / 0	470 / 15	447 / 18	9,400 / 430
Oil Spills (crude and oil products)							
1 bbl and less	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	1470 / 68.54
>1 and <50 bbl (Size 1)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	460 / 23
>50 and < 1,000 bbl (Size 2)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	72 / 4
> 1,000 bbl (Size 3)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	8 / 2
Support Activities:							
Helicopter Coastal Crossings (1000's)	3,927 / 200	7,195 / 382	6,318 / 335	526 / 28	819 / 35	1,324 / 60	20,108 / 1,039
Service Vessels							
Trips (1,000's)	244,300 / 13,000	214,400 / 11,200	138,000 / 7,300	16,000 / 1,000	57,300 / 3,200	79,800 / 4,300	749,800 / 40,100
Bilge Water Discharged (1000 l)	77,040 / 4,130	67,590 / 3,560	43,500 / 2,290	5,000 / 300	18,070 / 1,010	25,130 / 1,340	236,330 / 12,670
Onshore Disposal of Discharges:							
Produced Sands (1,000 bbl)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	3,195 / 143
Produced Waters (MMbbl)	86 / NA	0 / 0	1,600 / NA	0 / 0	0 / 0	0 / 0	1,686 / NA
Drilling Muds and Cuttings (1,000 bbl)	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	NA / NA	20,663 / 443
	Existing / New***						
Onshore Infrastructure							
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 / 1	0 / 0	2 / 0	28 / 1
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 / 1	5 / 1	8 / 0	63 / 2
Navigation Channels	4 / 0	4 / 0	10 / 0	3 / 0	6 / 0	3 / 0	30 / 0
Pipeline Landfalls	49 / 1	53 / 0	46 / 0	2 / 2	2 / 2	14 / 1	166 / 6
Onshore Pipelines (km)	1,453 / 40	1,571 / 0	1,246 / 0	179 / 32	NA / 80	NA / 40	NA / 192
Helicopter Hub	8 / 0	8 / 0	4 / 0	1 / 0	6 / 0	6 / 0	33 / 0

* See Figure IV-1. These subareas are considered to be in the area of potential impact from the proposed action.

** Peak-year figures for individual subareas may not add to the peak-year figure for the total planning area because the subarea peak years may not occur simultaneously.

*** Existing infrastructure refers to the maximum number of existing facilities that will be used to support future operations (decline in number of facilities is expected in some cases). New infrastructure refers to new facilities projected to be built to support future operations.

Table IV-18

Waterway Usage by OCS-Related Navigation Associated with the Proposed Actions (Sales 147 and 150) for the Years 1994-2028

Coastal Subarea	Waterway	Service Base/Terminal	% OCS Usage Base Case	Number of Service Vessel Trips (Sale 147)		Number of Service Vessel Trips (Sale 150)		Number of Barge Trips (Sale 147)		Number of Barge Trips (Sale 150)		Number of Shuttle Tanker Trips (Sale 147)		Number of Shuttle Tanker Trips (Sale 150)	
				Base Case	High Case	Base Case	High Case	Base Case	High Case	Base Case	High Case	Base Case	High Case	Base Case	High Case
LA-1	Calcasieu Ship Channel	Cameron	<0.1%	1,850	4,130	690	1,830							3	9
		Lake Charles						39	88	1	4			1	3
	Freshwater Bayou	Gibbstown						20	44	0	1				
		Intracoastal City	<0.1%	1,010	2,270	380	1,000								
	Mermentau Navigation Channel	Kaplan		20	50	10	20								
		Grand Chenier	1.9%	70	150	30	70								
LA-2	Vermilion Bay/Bayou Teche	Louisa		20	50	10	20								
		Weeks Island						39	88						
	Atchafalaya River	Amelia	0.9%	50	120	10	10								
		Bayou Boeuf		30	60	0	10								
		Berwick		30	60	0	10								
		Freshwater City		50	120	10	10								
		Morgan City		1,710	3,840	180	470								
		Gibson						15	33						
	Bayou Lafourche/Belle Pass	Fourchon	1.2%	290	660	30	80								
		Leeville		160	360	20	40								
	Bouma/Caillou/Terrebonne	Dulac	2.2%	370	840	40	100								
		Bouma		270	600	30	70								
		Theriot		30	60	0	10								
		Gibson						15	33						
		Cocodrie						20	44						
LA-3	Barataria Waterway/LaLoutre	Grand Isle	<0.1%	160	350	0	0								
	Miss. River Gulf Outlet	Hopedale	<0.1%	30	60	0	0								
	Miss. River Passes	Venice	<0.1%	1,670	3,740	0	0								
	Empire Waterway	Empire	0.6%					44	99						
	LaLoutre/St Malo/Yscloskey		0.5%												
	Miss. River/Harvey Canal	Harvey		30	60	0	0								
MA-1	Bayou LaBatre	Bayou LaBatre	<0.1%	10	30										
	Mobile Bay	Mobile	<0.1%	170	390										
	Pascagoula/Bayou Casotte	Theodore	<0.1%	10	30										
		Pascagoula		30	60										
TX-1	Aransas Pass	Port Aransas	<0.1%			40	120								
		Ingleside				490	1,300								
		Rockport				40	120								
	Bravos Santiago Pass	Port Isabel	<0.1%			90	240								
	Corpus Christi Ship Channel	Corpus Christi	<0.1%			40	120							19	56
	Matagorda Ship Channel	Port O'Connor	<0.1%			750	2,000								
	Port Mansfield Cut	Port Mansfield	<0.1%			40	120								
	Freeport Harbor Channel	Freeport	<0.1%	80	170	500	1,340							11	32
TX-2	Houston/Galv. Channel	Surfside	<0.1%	10	20	70	190							13	38
		Galveston		90	200	610	1,620			3	13				
		Felican Island		40	80	250	670								
	Sabine Pass Ship Channel	Sabine Pass	<0.1%	100	220	650	1,720							5	15
		Port Arthur						5	11	3	10				

Table IV-19
Waterway Usage by OCS-Related Navigation Associated With the OCS Program for the Years 1994-2028

Coastal Subarea	Waterway	Service Base/Terminal Range	OCS Range	Number of Service-Vessel Trips			Number of Barge Trips			Number of Shuttle Tanker Trips		
				CFA Program	WPA OCS Program	WPA OCS Program	CFA Program	WPA OCS Program	WPA OCS Program	CFA Program	WPA OCS Program	WPA OCS Program
LA-1	Calcasieu Ship Channel	Cameron Lake Charles Gibbston	<101	139,150	22,220		1,692	141				66
	Freebaster Bayou	Yatracostal City Kaplan	<101	70,930	13,260							
	Mormontau Navigation Channel	Grand Chenier	<101	1,610	280							
LA-2	Vermilion Bay/Bayou Teche	Louise Weeks Island	691	4,840	830							
	Atchafalaya River	Amelia Bayou Lafourche Bayou Lafourche Bayou Lafourche Freebaster City Morgan City Gibson	331	1,610	280		1,692					
	Bayou Lafourche/Belle Pass	Fourchon Levee	421	3,750	180							
LA-3	Boutte/Caillon/Terrebonne	Dulac Boutte Boutte Gibson Cocodrie	311	20,600	990							
	Bayou Lafourche/Belle Pass	Fourchon Levee	421	11,230	540							
	Miss. River Gulf Outlet	Grand Isle	<101	10,970								
MA-1	Miss. River Passes	Bayou Lafourche	<101	1,830								
	Empire Waterway	Venice	<101	117,000								
	LaPointe/St. Malo/Sacloskey	Harvey	191	1,830								
TX-1	Bayou Lafourche	Bayou Lafourche	<101	940								
	Mobile Bay	Mobile Thaddeus	<101	12,210	940							
	Pascagoula/Bayou Casotte	Pascagoula	<101	1,880								
TX-2	Arenas Pass	Port Arenas Ingleside Rockport	<101	1,430	13,770							
	Brazos Santiago Pass	Port Isabel	<101	2,870								
	Corpus Christi Ship Channel	Corpus Christi	<101	1,430								
TX-3	Matagorda Ship Channel	Port O'Connor	<101	24,370								
	Port Mansfield Cut	Port Mansfield	<101	1,430								
	Freeport Harbor Channel	Freeport	<101	5,270	16,260							
TX-4	Boutte/Gulv. Channel	Surfside Galveston Pelican Island	<101	750	2,320							
	Sabine Pass Ship Channel	Sabine Pass Port Arthur	<101	6,780	20,900							
	Total			587,300	161,940		8,460	940		43	22	935

(2) Construction Facilities

These facilities include platform fabrication and pipe yards. Platforms used to develop offshore oil and gas fields are fabricated and assembled at platform fabrication yards. Because of the large size of offshore structures, access to a large navigation channel is of prime importance in the location of these facilities. As indicated in Table IV-17, the largest number of platform yards occurs in coastal Subarea LA-2, which includes the Atchafalaya River.

Pipe yards store and coat pipe that will be used for offshore pipelines. The external surfaces of pipes are coated with metallic, inorganic, and organic materials to protect the pipe from external corrosion and abrasion, and to add weight to counteract buoyancy.

OCS Program Scenario: The number of platform and pipe yards in the Gulf are expected to decline during the life of the proposed actions. This assumption is based on the projected declines in OCS activity levels anticipated over the life of the proposed actions, and the closure and/or idling of 11 platform yards and closure of 4 pipe yards in the Gulf in the past few years.

Although it is difficult to quantify the magnitude of the projected decline in the number of platform and pipe yards over the 35-year time period being analyzed, the range is likely to be from a few closures to a major decline. If a major decline occurs, this trend will not likely begin until the first decade of the next century. This document assumes that 90 percent of the platform yards and 88 percent of the pipe yards will be used to support the OCS Program during the life of the proposed actions. The locations of platform and pipe yards by coastal subarea are shown in Table IV-17.

Proposed Action Scenario: Under the Base and High Case Scenarios, respectively, 3 percent and 6 percent of the existing pipe and platform yard capacity will be used for proposed action activities.

(3) Processing/Storage/Disposal Facilities

(a) Refineries

A refinery separates the naturally occurring components of crude oil into marketable products. In the Gulf of Mexico, oil is either delivered directly to a refinery 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.

OCS Program Scenario: Table IV-17 shows the locations of existing refineries in the Gulf coast that process, or could process in the future, OCS crude. It is assumed that OCS crude will account for 21 percent of the refinery capacity of these facilities (Rainey, 1992), averaged over the life of the proposed actions. Although the percentage of the refinery capacity accounted for by OCS oil will decline during the 35-year period of analysis, refineries are expected to remain at current capacity by switching to imported crude sources.

Proposed Action Scenario: Under the Base and High Case Scenarios, 1 percent and 2 percent, respectively, of the utilized capacity of refineries are expected to be used for OCS crude oil.

(b) Gas Processing Plants

Gas processing plants remove impurities from raw gas to preset standards of the purchasing utility before the gas is commercially distributed. Some processing plants are constructed to also recover saleable natural gas liquids, such as butane, propane, and ethane from condensate, if these components are present in quantities that make extraction economically feasible. The number of gas processing plants in the Central and Western Gulf that process OCS hydrocarbons are 26 and 2, respectively (Table IV-17). These gas processing plants are assumed to be devoted entirely to OCS production. The concentration of processing plants in the western part of the Central Gulf (coastal Subareas LA-1 and LA-2) is related to the occurrence of gas-prone fields in nearby offshore areas. The average design capacity for existing OCS-related gas plants is 570 MMcf/d. As of 1990, only 64 percent of the processing capacity of these plants was being used. The average space requirement of a gas processing plant is 20-30 ha (50-74 ac).

OCS Program Scenario: Because of the large unused capacity of existing OCS-related processing plants, a new plant will not be constructed in association with a new gas pipeline landfall except under the following two circumstances. First, if a new landfall occurs in a coastal area that does not have an existing gas

infrastructure, such as coastal Subarea TX-1 and parts of TX-2, then a new plant may need to be built. No new landfalls are projected for these areas; consequently, no new gas plant construction is projected. Second, a new processing plant will be constructed in an area receiving offshore gas from fields that have different chemical compositions with respect to impurities such as hydrogen sulfide. In these cases, a plant has to be designed to the specifications of the field's chemical composition. This situation is likely to occur in onshore Subarea MA-1, which is projected to receive gas landfalls from offshore Subareas C-3 and E-1. The projected gas pipeline in coastal Subarea MA-1 is expected to result in the construction of a gas processing plant (Table IV-14).

The utilized capacity of existing gas plants is projected to decline and may result in closures as total offshore gas production declines. As an operating assumption in this document, plants are expected to close when the utilized capacity of an OCS-related gas plant falls to less than 25 percent. This percentage was chosen because it was the minimum capacity at which a gas plant was operating in 1990. Using this assumption, 14 plants will close during the next 35 years, beginning during the first decade of the next century.

Proposed Action Scenario: No new pipeline landfalls are expected as a result of the proposed actions. Consequently, no new gas plant construction is expected. Under the Base and High Case Scenarios, respectively, 3 percent and 6 percent of the utilized capacity of existing facilities is expected to be associated with the proposed actions.

(c) Separation Facilities

Separation facilities remove impurities from crude oil or gas. These facilities are often located with oil terminals and/or gas processing plants. 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. About 6 ha (15 ac) of land are required for each 100,000 hbl of oil equivalents processed. There are 63 existing separation facilities located in the Texas and Louisiana coastal area (Table IV-17) with most (50) located in Louisiana.

OCS Program Scenario: One new separation facility is projected for coastal Subarea MA-1 in association with a gas processing plant, and one in TX-1 in association with a new oil pipeline landfall and an associated terminal. Because of recent regulations developed by the State of Louisiana, three separation facilities closed in 1991, and an additional nine will be closed when the fields generating the produced waters are abandoned. In addition to the nine projected closures, other separation facility closures will occur at terminals and gas plants that will shut down during the 35-year analysis period. In all, it is estimated that 20 of the existing separation facilities will close during the 35-year analysis period.

Proposed Action Scenario: No new pipeline landfalls are projected under the Base and High Case Scenarios, thus no new separation facilities are projected to be constructed. It is assumed that 3 percent and 6 percent of the separation facility utilization will be associated with the Base and High Case Scenarios, respectively.

(d) Terminals

Terminals are the receiving stations for liquid hydrocarbons transported from offshore platforms to shore by barge, pipeline, or tanker. Most terminals are at the landfall site of a pipeline, where a metering station is located and where storage facilities are expected to be found. Terminals can also occur at a gas processing plant if liquid hydrocarbons are being extracted from the gas stream. Most of the existing 94 terminals in the Gulf (Table IV-17) receive oil by pipeline; only a few (8) receive oil by barge. Most of the land required for a new terminal is for storage tanks. Space requirements are expected to range from 2 to 24 ha (5-60 ac).

OCS Program Scenario: Four new terminals are projected during the life of the proposed actions. Three will occur in Texas (2 in TX-1 and 1 in TX-2) in association with projected oil pipeline landfalls, and 1 in MA-1. It is also estimated that 8 terminals in Louisiana will close during the same time period. Closures are expected to occur at terminals associated with short pipeline segments that serve coastal oil fields that are nearing depletion. Five of these terminals are located in LA-1, and three in LA-2.

Proposed Action Scenario: No new landfalls are projected under the Base and High Case Scenarios, thus no new terminals are projected to be constructed. It is assumed that 3 percent and 6 percent of the existing terminal utilized capacity will be associated with the Base and High Case Scenarios, respectively.

(e) Disposal Sites for Offshore Waste

Offshore wastes not discharged offshore are either piped ashore or loaded on supply boats or barges and transported ashore to industry shorebases. At shorefront facilities the wastes are then loaded onto other barges to reach commercial waste disposal facilities located farther inland. Onshore disposal occurs at a licensed commercial oil-field waste site (NOW site) where the wastes are usually landfarmed, buried in abandoned wells, or injected into specially designated wells or salt domes. In Texas, wastes can also be taken to commercial landfills. Another option is chemical treatment of the waste to create a product that is contaminant free and can be recycled as solid material for road fill. State regulations in Louisiana require that oil-field wastes be disposed of at State permitted and designated commercial oil-field wastes facilities. Although common practice in other areas of the United States, oil-field wastes are not brought to hazardous waste sites along the Gulf because of higher costs for use of these sites compared to other disposal methods.

The following lists major disposal facility operators who receive or are projected to receive OCS-generated wastes. There are other sites that could process OCS wastes but do not currently do so. These sites include two Louisiana facilities located in Bossier Parish (a 20-ac operating landfarm and a 152-ac permitted landfarm owned by Campbell Wells) and five smaller facilities located inland of the Texas coast (EcoMud Disposal; Iley, Inc.; MOVAC Services; D&M Vacuum Services; and SR Services). All of these smaller sites only process a small portion of the wastes shipped from offshore sites. None of these sites can be reached by barge.

Capacities of Disposal Facilities in Gulf of Mexico Region

Operator	Total Acres Permitted	Current Capacity (MMbbl/yr)	Future Capacity (MMbbl/Yr)	1989 Wastes Receipts (MMbbl)
Campbell Wells, Inc. - includes Mermentau, Bourg, and Bateman, La. landfarms - operates 5 transfer stations in La.	319.8	2.3	3.84	1.802
Fidelity Environ, La. - in construction	31.2		0.37	0.000
Delta Environ, La. - permitted but legal matters have stopped construction			0.36 (not included in totals)	0.000
NewPark Environ, La. Venice, La. - facility no longer in operation				0.340
Guillory, Inc. La. permit suspended				0.040
MAR, Inc. La. permit suspended				0.006
NewPark Environ, Tex. processing facility in Texas: 10 transfer stations--5 in La., 4 in Tex., 1 in Ala.		2.4	2.4	no data for 1989 (0.667 in 1991)
Butler Services, Miss. - in process of obtaining permit	160.0		1.9	0.000
TOTALS	511.0	4.7	8.51	2.855

The MMS completed an evaluation of the capacity of these solid-waste disposal facilities to receive future OCS-generated wastes. Section IV.B.2.c. provides estimates of the quantities and types of offshore wastes expected to be brought onshore for disposal. The MMS analysis shows that there is ample capacity to dispose of all future wastes generated offshore and requiring onshore disposal. The one exception is the onshore disposal of NORM-contaminated wastes. This issue is discussed separately after the Scenario information given below.

Municipal Landfills

In addition to drilling and production wastes, trash and debris from the offshore oil industry are shipped onshore for disposal. These wastes include mud bags, drums, crates, and a variety of domestic wastes.

Trash and debris are not allowed to be disposed of at NOW sites, according to State of Louisiana regulations. These wastes are disposed of at municipal landfills largely located in the coastal zone. There are no estimates of the total volumes of trash and debris generated offshore and brought onshore for disposal. Section IV.B.1.a.(3)(e) provides some estimates of trash and debris wastes generated during the drilling of a typical well. Based on these quantities alone, it appears that levels of trash and debris generated by the offshore industry can be very high. Considering that there is a growing problem with inadequate landfill capacities, it is assumed that the expected levels of trash and debris transported from future OCS operations will result in the need for one additional landfill.

OCS Program Scenario: It is assumed that the 10 transfer stations and 6 oil-field waste disposal sites (4 in Louisiana, 1 in Mississippi, and 1 in Texas) will continue to operate and will use all currently permitted acreage. Furthermore, it is assumed that there will be sufficient capacity to dispose of all projected future waste generated by the OCS Program and requiring onshore disposal at these six sites. No new sites will be constructed. One new landfill will be established in Louisiana to receive OCS-generated trash and debris. This landfill will not be located in wetlands.

Proposed Action Scenario: It is assumed that the 10 transfer stations and 6 oil-field waste disposal sites (4 in Louisiana, 1 in Mississippi, and 1 in Texas) will continue to operate and will use all currently permitted acreage. Furthermore, it is assumed that there will be sufficient capacity to dispose of all projected future waste generated by the proposed actions and requiring onshore disposal at these six sites. No new sites will be constructed.

Naturally Occurring Radioactive Material (NORM) Disposal

The primary operational wastes disposed of onshore and contaminated with NORM are production solids and equipment. One of the most pressing regulatory concerns involves finding ways to safely dispose of the rapidly accumulating volume of stored NORM-contaminated wastes generated during the oil and gas extraction process.

Prior to 1989, production solids were disposed of at commercial oil-field waste sites. Used equipment was discarded or recycled at pipe yards. In 1989 the State of Louisiana, Department of Environmental Quality, adopted NORM regulations (modified on June 20, 1992) that established strict disposal requirements for all NORM materials emitting radiation greater than 25 microREMS per hour. The State of Texas has recently developed regulations for the possession, use, recycling, storage, and transfer of NORM. On August 30, 1993, the State of Texas, Texas Railroad Commission, received jurisdiction to develop regulations for the disposal of NORM oil-field wastes. These regulations are due January 1, 1995. Operators of NOW sites located in Louisiana have interpreted the State of Louisiana's regulations to apply to receipt of oil-field operational solid wastes and are not, in general, accepting any solid material with radioactivity greater than 25 microREMS per hour. Rejection by NOW site operators has left very few available disposal options for NORM-contaminated materials by the Gulf of Mexico area oil industry. At present, the majority of operators are storing NORM-contaminated material in approved waste disposal drums and stockpiling the material at shorebases and centralized storage locations until suitable disposal methods that avoid future liabilities are found. There are only two waste disposal sites in this country that will accept diffuse radium waste; these sites are located in Utah and Washington State. Transporting NORM-contaminated materials across State lines is difficult because of regulatory concerns. Both industry and the State of Louisiana are gathering data on the number and

location of drums containing NORM-contaminated oil-field wastes and contaminated pipe stockpiles, but no statistics are currently available.

Proposed offshore disposal options being approved 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 stored in drums onshore. These materials are mixed with mud prior to transport offshore for reinjection.

Existing pipe yards projected to be used for future OCS operations are known to be contaminated with NORM. Louisiana has recorded over 600 sites (estimates are up to 2,000 sites) contaminated by previously, improperly disposed of NORM wastes (Zaloudek, personal communication, 1992). Although many of these sites are well operators, sites include many of the pipe yards used by the OCS oil industry. Future land-use options for the land now used by such pipe yards will be restricted.

There is also a growing public concern about the 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 that lack radiation monitoring or solids being taken to municipal landfills or dumped in rivers have been recorded (Raloff, 1991).

b. Coastal Oil and Gas Transportation

(1) Pipelines

At present, a total of 166 OCS-related pipeline landfalls occur in the CPA and WPA for the purposes of transporting both produced oil and gas. The term "landfall" refers to the site at which a pipeline comes ashore from the Gulf of Mexico. Of that total, 16 landfalls occur in the WPA, and the remaining 150 landfalls occur in the CPA. The number of landfalls in each coastal area is provided in Table IV-17. Tables IV-15 and IV-16 indicate that some OCS resources produced in the WPA are piped ashore in Louisiana.

Approximately 4,450 km (2,760 mi) of OCS-related pipelines are operating in Louisiana and Mississippi. The length of OCS-related pipelines operating in Texas is unknown. The cumulative length of OCS-related pipelines operating onshore in each onshore subarea is depicted in Table IV-17.

OCS Program Scenario: The volumes of oil anticipated to be transported from the CPA and WPA by pipeline over the next 35 years are provided in Tables IV-14, IV-16, and IV-17. It has been estimated that six new pipeline landfalls will be constructed to help carry produced products for the OCS Program. Four pipelines are anticipated to carry oil to Calhoun County, Texas; Nueces County, Texas; Madagorda Peninsula, Texas; and Jackson County, Mississippi. Two are anticipated to carry gas to Jackson County, Mississippi; and Vermillion Parish, Louisiana.

For every landfall constructed in TX-1, TX-2, and LA-1, it has been estimated that 40 km (25 mi) of onshore pipeline will be constructed and that 16 km (10 mi) of onshore pipeline will be constructed for every landfall constructed in LA-2, LA-3, and MA-1. Consequently, construction of 192 km (120 mi) of pipelines are anticipated as a result of the OCS Program. The lengths of pipelines to be constructed in each coastal subarea are found in Tables IV-14, IV-16, and IV-17.

Proposed Action Scenario: Due to the surplus capacity of the existing pipeline system and proposed OCS pipelines, the proposed actions are not anticipated to directly cause the construction of a new pipeline landfall or onshore pipeline segment. The volumes of oil projected to be transported into coastal subareas by pipeline over the next 35 years as a result of the proposed actions are provided in Tables IV-13 and IV-15.

(2) Oil Barges

A general discussion of barging operations from offshore platforms to onshore terminals is found in Section IV.A.2.b.(2). Six terminals located in Louisiana (Lake Charles, Gibbstown, Weeks Island, Gibson, Cocodrie, and Empire) are presently receiving OCS barged oil and are expected to continue to receive barged oil from platforms located in both the WPA and the CPA. Three Texas terminals, all located in Subarea W-2 (Texas City, Galveston, and Port Arthur), will receive primarily WPA barged oil (4,418 trips). The Houston Ship

Channel, Sabine Pass Ship Channel, and the Calcasieu Ship Channel will be used by the barge traffic carrying WPA oil to the above terminals.

The projected number of barge trips carrying OCS oil only includes barging from OCS production facilities to terminals along the Louisiana and Texas coasts. It does not include barge traffic transporting 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, or along the coast. An analysis of 8 years of oil transport in the Gulf showed that about 18 percent of all oil (21% of crude oil) moved by barges along the coast is from OCS production (Rainey, 1992). This is based on the assumption that all oil brought into the Gulf Coast has an equal chance of being loaded back onto barges from secondary movement.

OCS Program Scenario: Projected barge trips for future OCS operations transporting crude oil from offshore platforms to onshore terminals for offloading are given for each coastal subarea in Tables IV-14, IV-16 and IV-17. Subarea LA-1 will receive the majority of barged oil. Table IV-19 breaks down these barge trips by used waterways and by specific terminals where the offloading is projected to occur. Additionally, about 21 percent of crude oil moved by barges along the Gulf Coast (coastwise movement) will be from OCS production. The total volume of OCS crude to be barged coastwise is estimated to be about 40 MMbbl annually.

Proposed Action Scenario: Projected barge trips related to the proposed actions are given for each coastal subarea in Tables IV-13 and IV-15. The projected barge trips include only the transport of crude oil from offshore platforms to onshore terminals for offloading. Subarea LA-1 will receive the majority of barged oil from operations in the CPA (99 trips); and Subarea TX-2 will receive the majority of the trips from the WPA platforms (6 trips). Table IV-18 breaks down these barge trips by used waterways and by specific terminals where the offloading is projected to occur. Less than 1 percent of crude oil moved by barges along the Gulf Coast will be a result of the proposed actions.

(3) Shuttle Tankers

A general discussion of the movement of oil from offshore platforms to major port terminals is provided in Section IV.A.2.b.(3). Major port systems receiving tankered oil include Corpus Christi (TX-1), Freeport (TX-2), Houston/Galveston (TX-2), Port Arthur (TX-2), Lake Charles (LA-1), and the Mississippi River Port system (LA-3). Terminals locations along the Mississippi River include the Ports of Baton Rouge, Good Hope, Gramercy, New Orleans, and St. Rose, Louisiana. The Louisiana Offshore Oil Port (LOOP) facility is not expected to receive domestically produced oil because the tankers projected to carry the oil to shore are too small to use the facilities. No oil is expected to be reloaded back on shuttle tankers and moved coastwise to other terminals.

OCS Program Scenario: For OCS Program operations in the WPA, there are 955 tanker trips projected to shore terminals: 432 to Corpus Christi, 125 to Freeport, 244 to Houston, 66 to Port Arthur, 66 to Lake Charles, and 22 to Mississippi River terminals (Table IV-16). For OCS Program operations in the CPA, there are 46 trips projected, all going to Mississippi River terminals for offloading operations (Table IV-14). There are also 45 tanker trips projected to come from EPA operations to offloading areas in the Mississippi River area (Table IV-17). Table IV-19 identifies the navigation channels and port areas used for the shuttle tanker offloadings.

Proposed Action Scenario: Projected shuttle tanker trips from offshore floating production systems (FPS's) located in the WPA to onshore terminals located in major port areas occurring in support of the proposed action are given for each coastal subarea in Table IV-15. Table IV-18 shows the navigational channels and major port areas expected to be used by these tankers. For the Base Case of Sale 150, there are 53 shuttle tanker trips to shore projected: 5 of these going to Lake Charles, Louisiana, in LA-1; 19 trips to the Corpus Christi area; 11 trips to Freeport; 13 trips to the Houston area; and 5 trips to Port Arthur.

There are no shuttle tanker operations projected for activities resulting from Sale 147 in the CPA.

(4) Navigation Channels

Twenty-three channels are used by the OCS Program activities in the WPA and CPA. Table IV-18 lists the channels and their locations. Among those channels, approximately 139 km (86 mi) and 811 km (504 mi)

of canals, rivers, and bayous are found onshore in the WPA and CPA, respectively (derived from Turner and Cahoon, 1988; Wicker et al., 1989).

On average, the existing OCS Program accounts for approximately 12 percent of traffic on these navigational channels. The OCS Program represents as much as 69 percent of channel traffic on some channels such as the Vermillion Bay/Bayou Teche system.

The existing number of channels is believed to be adequate to accommodate traffic generated by the OCS Program. More deep-water leases are anticipated in the future; therefore, it is assumed that the navigation channels to Corpus Christi, Texas, and Pass Fourchon, Louisiana, will be deepened to 7 m (22 ft).

OCS Program Scenario: Future OCS use of the navigational channels is expected to continue to be 12 percent. Two channels will be deepened entirely as a result of the OCS Program. Traffic percentages on each of the 23 channels attributed to the OCS Program are described in Table IV-19 (Turner and Cahoon, 1988).

Proposed Action Scenario: High and Base Case uses of navigation channels are assumed to be 3 percent and 6 percent of the total OCS Program, respectively.

2. Onshore Disturbances

a. Physical Disturbances

(1) Maintenance of Existing Pipeline and Navigation Corridors

Pipeline maintenance activities that disturb onshore habitats are very infrequent, and for the purposes of the OCS Program and proposed action will be considered insignificant.

Surveys to determine the need for maintenance dredging of navigation channels are typically scheduled every two years. Maintenance dredging is then performed on an as needed basis. Dredged materials are primarily disposed of on existing spoilbanks and in spoil disposal areas. Additional spoil disposal areas are developed as needed and must be permitted prior to construction. Historical data describing volumes of material dredged from these channels is being compiled from U.S. Army, Corps of Engineers' records and is not available for this Draft EIS.

When pipelines and navigational channels are permitted for construction through sensitive wetland habitats, measures are required to mitigate unavoidable adverse environmental impacts. Structures constructed to mitigate adverse hydrodynamic impacts and accelerated erosion are dams, weirs, bulkheads, rip-rap, shell/gravel mats, and gobi mats. Typically, little or no maintenance is performed on these structures. The number of related mitigation structures constructed on navigation and pipeline channels is unknown.

OCS Program Scenario: Twelve percent of impacts caused by lack of maintenance and maintenance activities associated with navigational canals is attributed to the OCS Program. One hundred percent of impacts caused by lack of maintenance and maintenance activities associated with OCS pipelines are attributed to the OCS Program.

Proposed Action Scenario: The Base and High Cases of the proposed actions respectively, represents 3 percent and 6 percent of the impacts caused by the OCS Program.

(2) Vessel Usage of Channels

Vessel wakes cause canals to widen at rates of 0.95-2.54 m/yr (3.1-8.3 ft/yr) (Johnson and Gosselink, 1981). Based on this information, it is assumed that each OCS-related navigation channel listed in Table IV-18 will widen at a rate of 1.5 m/yr (4.9 ft/yr). Approximately 139 km (86 m) and 811 km (504 mi) of canals are found in the onshore in the WPA and CPA, respectively.

OCS Program Scenario: Twelve percent of impacts caused by navigational traffic in OCS-related navigational canals is attributed to the OCS Program.

Proposed Action Scenario: The Base and High Cases of the proposed actions, respectively, represents 3 percent and 6 percent of the impacts caused by the OCS Program.

(3) *New Construction and Modifications*

The term "landfall" refers to the site at which a pipeline comes ashore. Landfalls are anticipated to occur on beaches with a good sand supply in their longshore currents for re-establishing the beach if the beach is dredged. If, under the closer scrutiny of permitting processes, it is shown that the sediment supply is not adequate to repair a dredged landfall beach, the pipeline landfall may be accomplished by another method, perhaps directional boring, which will not disturb the beach. Hence, no significant or long-term disturbance of beaches are expected.

Since 1970, backfilling of pipeline canals has been required by permitting agencies. In the WPA and in coastal Subareas LA-1 and MA-1 of the CPA, 0.68 ha of wetlands are disturbed per km of pipeline installed (Turner and Cahoun, 1988). After being backfilled, the right-of-way may re-vegetate or remain as shallow open water (Wicker et al., 1989), a result of the ditching and use of marsh buggies. This remaining impact is estimated to be a water channel 1.5 m (4.9 ft) wide and extending 50 percent of the proposed pipeline route.

Dredged material from the deepening of two waterways will be placed in spoil disposal areas and upland sites. It is assumed that dredged material will be used to produce approximately 182 and 162 ha (450 and 400 ac) of wetlands in association with the Fourchon and Corpus Christi area projects, respectively, over a 35-year period.

b. Discharges from Onshore Operations

(1) *Facilities*

The operation of onshore facilities used in support of OCS operations is expected to result in some pollution to the surrounding environment due to accidental spills, and to both point- and nonpoint-source discharges.

The facility's presence, along with the associated access routes, alters the natural hydrology and geography of the area over time, resulting in increased runoff from the land. Saltwater intrusion may occur if the facility is built near wetlands. If existing vegetation is modified, greater erosion and land loss around the facility may take place. Increases of nonpoint-source pollution due to runoff at support facilities may contribute particulate matter, heavy metals, oil and grease, fecal coliform, high nutrient loadings, and radionuclides (particularly from pipe yards) to local streams, estuaries, and bays, causing elevations of the contaminants in the surrounding waters, low dissolved oxygen levels and high turbidity.

At present, estimates of sites exhibiting NORM contamination in surface soils around some pipe yards and service bases vary, but range from 600 to 2,000 contaminated sites.

Supporting onshore infrastructure also contributes routine and accidental point-source discharges to the surrounding bodies of water. Service bases and marine terminals contribute contaminants through their use of anti-fouling marine paints, through chronic spills, through discharge of domestic wastewaters, 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, anti-fouling 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 portion (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 on-site 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 chemicals are added during crude-oil desalting, steam distillation, steam stripping, etc. Process water discharged from refining 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.

OCS Program Scenario: The apportionment of surrounding water contamination from routine discharges and runoff from existing infrastructure is based on the utilization capacity for each type of facility described in the sections for each facility type (Section IV.B.1.a.). In general, about 70-90 percent of the discharge contamination is attributed to the use of these facilities to support future OCS operation.

Proposed Action Scenario: The apportionment of surrounding water contamination from routine discharges and runoff from existing infrastructure is based on the percent usage of these facilities in support of proposed action activities, as described in the sections for each facility type (Section IV.B.1.a.). In general, about 3 percent (Base Case) and 6 percent (High Case) of the discharge contamination is attributed to the use of these facilities to support operations resulting from the proposed actions.

(2) Vessels

Operational discharges from vessels include bilge and ballast waters and fuel oil release. New regulations promulgated under the international protocols provided by MARPOL 73/78 (33 CFR 157) have significantly limited operational discharges from oil tankers and other large vessels. These regulations now require that terminal areas maintain onshore receptacles to receive these waste waters. 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 in coastal waters may still discharge oily bilge waters into the water but their treatment process must severely limit the oil content in this water, dependent on their distance from shore. Bilge water discharges from service vessels while enroute on navigation channels would be widespread. It is assumed that these discharges occur throughout the 4-hr trip projected for service vessels in coastal waters.

Based on an NERBC (1976) analysis of bilge water generation from vessels of various deadweight tonnage and on the information on size and tonnage of work boats described in Section IV.A.2.c.(1), 32 percent of the vessels average 60 dwt and would discharge 55 liters/hr; and 68 percent of the vessels average 100 dwt and would discharge 90 liters/hr.

OCS Program Scenario: Total volumes of bilge water discharged in navigation channels from service vessels supporting OCS Program operations during the 35-year analysis period and discharge volumes for each coastal subarea can be found in Tables IV-14, IV-16, and IV-17. The total amount discharged are 185,000,000 liters and 51,030,000 liters as a result of activities in the CPA and WPA, respectively.

Proposed Action Scenario: Total volumes of bilge water discharged in navigation channels from service supporting operations resulting from the proposed actions and discharge volumes for each coastal subarea can be found in Tables IV-13 and IV-15. The amounts discharged as a result of activities in the CPA and WPA are 2,648,000 liters and 350,000 liters, respectively, under the Base Case.

c. Offshore Wastes Disposed of Onshore

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 USEPA effluent limitation guidelines (Section I.B.3.d.(3)(e) describes the regulations) will greatly increase the amount of both drilling and production wastes brought onshore.

Section IV.A.3.d. provides general information on specific types of OCS offshore operational wastes and their contaminants. Section IV.B.1.a.(3)(e) provides information on disposal sites for these wastes when they are brought onshore. The following provides estimates of the quantities brought onshore and assumptions regarding their disposal.

Produced Waters

OCS Program Scenario: About 20 percent of OCS produced water generated in the CPA as a result of future OCS production will continue to be piped onshore to Louisiana for disposal. No produced waters are shipped into Texas waters. Table IV-17 indicates that about 1.7 Bbbl of produced water will be piped to shore facilities during the 35-year life of the analysis period.

Disposal methods will be very different from past practices. There are 13 coastal processing facilities in Louisiana that are expected to continue receiving OCS-generated wastes. Two of the sites, the Grand Isle and Sabine Pass separation facilities, will inject produced water after treatment into surface wells. The Pass Fourchon facility services multiple fields and will continue to operate, shipping the separated, treated produced waters back out to the OCS for discharge into the Gulf. It is unknown how the other facilities will phase out their surface water discharges. Except for the facilities described above at Grand Isle, Pass Fourchon, Sabine Pass, and one other near the Mississippi River, the others are projected to only receive future produced waters from existing leases and are not expected to continue operating once production ceases.

Proposed Action Scenario: It is estimated that about 11 percent of produced waters generated as a result of Sale 147 (Base and High Cases) will be brought to Louisiana for disposal in Subareas LA-3 and LA-1. Table IV-17 provides total estimates at 59 MMbbl. Water generated as a result of Sale 150 is not expected to be shipped onshore for disposal.

Treatment will occur at four separation facilities that receive produced water from a number of fields and which have recently been upgraded to potentially receive produced water from deep-water tracts. These facilities, located at Grand Isle, Pass Fourchon, and Sabine Pass, and near the Mississippi River, will receive produced waters from future leases associated with Sale 147 and dispose of the treated waters by surface well injection or shipment back out to the OCS for discharge.

Drilling Muds and Cuttings

Projections of the quantities of muds and cuttings brought onshore are based on the following assumptions: (1) oil-based drilling muds will be used when drilling wells beyond 3,048 m (10,000 ft) in depth; (2) exploration and delineation wells will be drilled to an average of 4,115 m (13,500 ft); (3) all oil-based muds will be shipped onshore; (4) 5 percent of the fluids are assumed to go with the drill cuttings after muds/cuttings separation; and (5) the USEPA effluent limitation guidelines are made final and will be adhered to by industry. Estimates of the quantities of muds and cuttings brought onshore are: 1,595 bbl of mud and 386 bbl of cuttings per exploratory well drilled; and 444 bbl of mud and 108 bbl of cuttings per development well drilled.

OCS Program Scenario: Total quantities of drilling muds and cuttings generated from OCS Program operations and disposed of onshore are provided in Table IV-17.

Proposed Action Scenario: Total quantities of drilling muds and cuttings generated from the proposed actions and disposed of onshore are provided in Table IV-13 for the CPA (379,000 bbl) and Table IV-15 for the WPA (293,000 bbl).

Production Solids

Based on USEPA's effluent limitation for produced sands of zero offshore discharge, that 100 percent of production solids (sands and vessel sludges) will be disposed of onshore, based on USEPA's effluent limitation for produced sands. Estimates of total produced sand expected from a typical platform are from 25 to 250 bbl per day according to the USEPA (1993), or 0.05 percent of the oil produced (USEPA, 1976). About 17 percent of produced solids are expected to be contaminated with NORM and will not be disposed of at commercial oil-field disposal sites.

No projections of quantities of oil-field pipe brought onshore are made. Historically, after production ceased, oil-field pipe was routinely pulled and brought to pipe yards to be stacked and reamed out for later reuse. To avoid worker exposure to dust particles containing elevated levels of radionuclides during pipe cleaning, it is assumed that pipe will remain in place in the future.

OCS Program Scenario: Estimates of the quantities of production solids generated from OCS operations in the next 35 years and brought onshore for disposal are found in Tables IV-14, IV-16, and IV-17. About 2.6 MMbbl of produced sand will be shipped onshore from CPA operations and about 585,000 bbl from WPA operations.

Proposed Action Scenario: Estimates of the total quantities of production solids generated from the proposed actions during the average 20-year production life of a platform and brought onshore for disposal are found in Tables IV-13 and IV-15. About 60,000 bbl of produced sand will be shipped onshore from CPA operations and about 20,000 bbl from WPA operations during the time period 1996-2027.

d. Accidents

(1) Onshore/Coastal Oil Spills

Spills can occur at onshore storage, processing, or transport facilities as part of OCS oil and gas industry operations. In particular, spills have occurred from the barging of OCS crude, during fuel and crude oil transfer operations, from storage tank leaks, from onshore pipeline breaks, and from refinery spills. Information on spill incidents in Louisiana (Oil Spill Intelligence Report, 1992) shows that since 1974 there have been 67 spills over 10,000 gallons (238 bbl): 42 pipeline spills, 22 storage tank or transfer spills, and 3 spills from refineries. The average size of the pipeline spills was 500 bbl. Determining if these spills were due to OCS industry operations versus state oil and gas or import oil operations is difficult. The MMS does not regulate such activities, and the MMS spill database contains only spill incidents that occur in Federal waters. The U.S. Coast Guard data on spills, collected as part of the Emergency Response Notification System and published in several U.S. Coast Guard reports (USDOT, Coast Guard, 1989), for the years 1983 to 1987 were examined. Based on this data and an MMS analysis of oil spill risk from transport operations (Rainey, 1992) the following observations about spill occurrences are made: the majority of spill incidents occur in river channels; 35 percent of all spills are crude oil; the source of 18 percent of oil processed in the Gulf area is OCS operations (21% is crude oil); marine vessels and terminals spill the largest volumes averaged over a year; nontransportation facilities (such as bulk storage and refineries) have the greatest number of mishaps; there are about 8 spills per 1,000 transfers; the vast majority of spills are less than 50 bbl, most averaging about 2 bbl; and 15 percent of Gulf Coast pipelines carry OCS oil (based on a proportion of length of pipelines). The U.S. Coast Guard data showed that in the Gulf area there are about 1,500 spills occurring every year. It is assumed that the majority of spills less than 50 bbl occurring at onshore facilities are captured by the levees required for these facilities.

In order to complete an analysis of spill impacts, assumptions regarding the size and fate of onshore spills were made about the following: the time period it takes for the major sheen to dissipate; the time period it takes for contaminant levels to reach background levels; and the area of potential contact. In open water, the area of potential contact is the maximum area if oil remained together and spread out to 1 mm in thickness. In the marsh, the area of potential contact is the area that the oil will cover after final spreading. The area of potential contact in a marsh is projected to be larger than that projected for open due to the smearing of the oil from tidal movement over time. The time projected for sheen dissipation in a marsh assumes no burial of oil or pooling of small amounts of oil into very low energy spots. The following assumptions were used in the analysis:

- Spills of 1 bbl or less
 - concern about these size spills are usually related to frequency of occurrence
 - very temporary residence time; sheen will dissipate within 6 weeks
- Spills of greater than 1 bbl and less than 50 bbl (Size 1)
 - size: 50 bbl (we assume a conservative size (the maximum) for these small spills since impact increases significantly with size)
 - sheen will dissipate from surface within 6 weeks
 - contaminant levels will reach background level within 6 months
 - area of potential contact:
 - open water: 8,000 m² (0.8 ha)
 - marsh: 2.7 ha
- Spills of greater than 50 bbl and less than 1,000 (Size 2)
 - size: 500 bbl (based on analysis of historical pipeline spills in Louisiana)
 - sheen will dissipate from surface within 6 months
 - contaminant levels will reach background level:
 - low energy (marsh): 5 years
 - open bay: 1 year
 - area of potential contact:
 - open bay: 80,000 m² (8 ha)
 - marsh: 27 ha
- Spills of greater than or equal to 1,000 bbl (Size 3)
 - size: 6,500 bbl (based on OSRA statistics for this size class)
 - open bay
 - sheen will dissipate from surface within 6 weeks
 - contaminant levels will reach background level within 2 years
 - area of potential contact:
 - 1 million m² (103 ha)
 - marsh (low energy)
 - sheen will dissipate from surface level within 1 year
 - contaminant levels will reach background level within 10 years
 - area of potential contact: 350 ha

The following assumptions were made regarding shoreline spill cleanup of onshore spills:

- *Employment:* Based upon recent experience involving shoreline cleanup operations of oiled coastline, it is assumed that 100 temporary/contract personnel would be required per kilometer of shoreline for the cleanup of somewhat inaccessible beach and marsh areas that are slightly oiled with numerous scattered pockets of extensive oiling.
- *Time Frame:* Cleanup would take 4-6 weeks.
- *Perched Shell Beach Shoreline Cleanup:* Cleanup options will be limited since access and erosion problems will be encountered. After the oiling of a perched shell beach with a light oil (34.5° API) cleanup options if erosion and access problems are encountered include (a) no action and (b) bioremediation (either nutrient enrichment or bacterial enrichment). Cleanup techniques that will be used if access and erosion is not a problem include (a)

manual debris removal, (b) manual sediment removal, (c) cold-water deluge flushing, and (d) vacuum.

- *Barrier Island/Fine Sand Beaches Cleanup:* In the event of a landfall, mechanical cleanup will not be used if heavy equipment could disrupt bird habitats. After the oiling of a barrier island/fine sand beach with a light oil (34.5° API), cleanup options if access and erosion are primary concerns include (a) no action, particularly if the beach is an area used by nesting birds; (b) manual debris removal; (c) manual sorbent application; and (d) manual scraping. Heavy equipment (e.g., motor grader/elevating scrapper, motor grader/front end loader, backhoe, beach cleaner, dragline/clamshell, cold water deluge flooding, or low-pressure, cold-water washing), as well as other cleanup options, will be used only if access and erosion are not considered a problem based upon the location of the oiled area. Methods that would keep sediment loss to a minimum would be selected.
- *Salt Marsh Cleanup:* Offshore spills of less than 50 bbl that impact the edge of marsh areas would not be cleaned due to the minimal impact expected to these areas when weighed against the greater impact that manual cleanup would have on the area. After the oiling of a salt marsh with a light oil (34.5° API) cleanup options include (a) no action, (b) manual debris removal, (c) manual sorbent application, (d) cold-water deluge flooding, (e) low-pressure washing, (f) nutrient enrichment, and (g) vacuum pumps from boats. Cleanup options that avoid causing additional damage to the marshes will be selected. No burning or cutting of the marsh will occur. Natural recovery will be an option when only a small amount of marsh is affected and/or only a small amount of oil impacts the edge of the marsh.

OCS Program Scenario: The total number of spills projected to occur over the 35-year life analysis period can be found in Tables IV-14, IV-16, and IV-17. The following table provides estimates of the expected annual frequency of spill occurrences divided into two spill categories--crude oil and other types of oil:

Crude Oil

<u>Spill Size</u>	<u>Total</u>	<u>CPA</u>	<u>WPA</u>
≤1 bbl	20/yr	16/yr	4/yr
Size 1	7/yr	6/yr	1/yr
Size 2	1/yr	1/yr	0
Size 3	0.12/yr (1/9 yr)	0.1/yr (1/10 yr)	1/35 yr

Other Oil Types

<u>Spill Size</u>	<u>Total</u>	<u>CPA</u>	<u>WPA</u>
≤1 bbl	22/yr	18/yr	4/yr
Size 1	6/yr	5/yr	1/yr
Size 2	0.62/yr (1/1.6 yr)	1/yr	0
Size 3	0.09/yr (1/11.6 yr)	0.07/yr (1/15)	1/35 yr

Proposed Action Scenario: The total number of spills projected to occur over the 35-year life of the proposed actions can be found in Tables IV-13 and IV-15. The following table provides estimates of the expected annual frequency of spill occurrences divided into two categories: crude oil and other types of oil. Spill frequencies are only provided for the Base Case; the High Case is assumed to be twice the frequency of the Base Case.

Crude Oil

<u>Spill Size</u>	<u>Total</u>	<u>CPA</u>	<u>WPA</u>
≤ 1 bbl	0.59/yr (1.7 yr)	0.5/yr (1/2 yr)	0.11/yr (1/9 yr)
Size 1	0.2/yr (1/5 yr)	0.17/yr (1/16)	1/35 yr
Size 2	1/35 yr	1/35 yr	0
Size 3	0	0	0

Other Oil Types

<u>Spill Size</u>	<u>Total</u>	<u>CPA</u>	<u>WPA</u>
≤ 1 bbl	0.67/yr (1/1.5 yr)	0.55/yr (1/1.8)	0.11/yr (1/9 hr)
Size 1	0.17/yr (1/6 yr)	0.14/yr (1/7 yr)	1.35/yr
Size 2	1/35 yr	1/35 yr	0
Size 3	0	0	0

(2) Beached Trash and Debris

Human trash loads exceeding several thousand pounds per mile continue to be reported from coastal cleanups along Texas and Louisiana beaches. Items such as 55-gallon drums, 5-gallon buckets, 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 will contribute solid wastes to the Gulf of Mexico. The latest opinions cited by government and industry have estimated oil and gas operations in the Gulf contribute from 5-10 percent of the cumulative trash loads currently effecting coastal beaches in the CPA and WPA. That percentage should decline over the life of the proposed actions with declining offshore operations and better waste handling and waste management practices currently being implemented by offshore oil and gas operators.

e. Noise

Coastal noise emissions resulting from OCS oil and gas development are associated with helicopter and service-vessel traffic. Noise generated from these activities can be transmitted through both air and water, and is transient in nature. The intensity level and frequency of the emissions are highly variable, both between and among the various sources. Coastal noise emissions from proposed OCS activities may affect resources proximate to the activities.

Helicopters, while flying onshore, generally adhere to corporate policy regarding minimum operational altitude. Service altitudes over land are generally above 308 m (1,000 ft) in environmentally non-sensitive or uninhabited areas and 616 m (2,000 ft) in sensitive areas, which include National Parks and Wildlife Refuges (Osborne, personal communication, 1992). This document assumes that 90 percent of the helicopter flights over coastal areas will adhere to these flight patterns.

Service vessels transmit noise through both air and water. The source of vessel noise is mechanical, from propulsion and generator machinery and from hull noise generated during transit. Speed restrictions on vessels operating within coastal waterways significantly reduce noise emissions in environmentally sensitive and populated areas.

OCS Program Scenario: Information relating to the estimated number of helicopter trips and service-vessel trips (including shuttle tankers, barges, and other service vessels) can be found in Table IV-14 for the CPA and Table IV-16 for the WPA.

Proposed Action Scenario: Information relating to the estimated number of helicopter trips and service-vessel trips (including shuttle tankers, barges, and other service vessels) can be found in Table IV-13 for the CPA and Table IV-15 for the WPA.

C. OTHER CUMULATIVE ACTIVITIES SCENARIO

The CEQ regulations require a cumulative impact analysis to be completed as part of an EIS on a particular proposed action. Cumulative actions are past, present, and reasonably foreseeable future actions, both Federal and nonfederal (40 CFR 1508.7), that when added with activities resulting from the proposed actions result in an incremental impact to the resources of concern. The time period over which these future impacts are examined is limited to the timeframe of the proposed actions (1994-2028), and the resources analyzed are those identified as potentially being impacted from the proposed actions. This Cumulative Scenario provides characteristics and assumptions about potentially impact-producing activities that could result from State oil and gas activities; other major offshore activities such as military operations, sulfur production, and marine transportation; coastal activities such as river modification projects, municipal impacts, and natural subsidence of wetlands; and loss of habitat and predation pressure outside of the Gulf of Mexico area on migratory species. While OCS activities that result from previous and future leasing are also included in the Cumulative Scenario, these activities have been described in Sections IV.A. and B. and will not be covered here.

1. State Oil and Gas Activities

a. Leasing, Production, and Associated Infrastructure

In Texas State offshore waters, annual oil production peaked in 1977 at 2.6 MMbbl and annual gas production peaked in 1980 at 254 Bcf. As of October 16, 1992, some 272 rigs were operating within the State; 4 were located in offshore waters and 1 was located in inland waters (Oil and Gas Journal, 1992a). Approximately 1.83 MMbbl/day of crude oil and lease condensate were produced within the State (Oil and Gas Journal, 1992b).

In Louisiana State offshore waters, annual oil production peaked at 72.1 MMbbl. Annual gas production reached a peak of 604 Bcf in 1972 and thereafter steadily declined. The Louisiana Mineral Board conducts lease sales monthly. As of October 16, 1992, some 77 rigs were operating within the State; 41 were located in offshore waters and 6 were located in State inland waters (Oil and Gas Journal, 1992a). Approximately 1 MMbbl/day of crude oil and lease condensate are produced within the State (Oil and Gas Journal, 1992b).

The State of Mississippi has experienced a limited amount of offshore activity. As of October 16, 1992, only three land-based rigs were operating in the State, with no active leases in Mississippi State waters (Oil and Gas Journal, 1992a). Approximately 68,000 bbl/day (BPD) of crude oil and lease condensate are produced within the State (Oil and Gas Journal, 1992b).

Oil and gas activity in the State of Alabama's offshore waters has increased over the past few years. Since 1979, several discoveries have been made, and the commercial potential of natural gas in Mobile Bay has been confirmed. There are two producing fields in Alabama State waters. As of October 16, 1992, only seven rigs were operating within the State (Oil and Gas Journal, 1992a). Approximately 51,000 BPD of crude oil and lease condensate are produced within the State (Oil and Gas Journal, 1992b).

The State of Florida has experienced very limited drilling in coastal waters. There is currently a moratorium on drilling activity in Florida State waters, and the State has no plans for lease sales in the future. As of October 16, 1992, no rigs were operating within the State (Oil and Gas Journal, 1992a). Approximately 14,000 BPD of crude oil and lease condensate are produced within the State (Oil and Gas Journal, 1992b).

b. Related Concerns

(1) Drilling-Related Wastes

In 1989, the Louisiana Department of Natural Resources estimated that approximately 13,000 oil-field waste pits existed in the State. Other projections have been as high as 20,000. Problems associated with these pits result from contaminated 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). The OCS operations no longer dispose of wastes in field waste pits.

On-site pits are often used to handle oil and gas wastes other than produced water, including drilling muds and associated on-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 waters 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, 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. Recent concern involving oil-field waste pits was brought about by a U.S. Fish and Wildlife Service 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). A 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 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 Vermillion 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 percent were located in the parish.

Improper storage or disposal of drums containing solvents, corrosion inhibitors, and biocides used in the 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 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." By far the greatest volume of these waters were discharged into the Galveston Trinity estuarine system. Within this estuary, there were 208 discharge points that delivered an estimated 4000,000 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.

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 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 400 m (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 surrounding storage and cleaning sites, scrap-yards, and metal reclamation yards. Interior surfaces of production tubing, holding tanks, separators, heater treaters, and other like equipment may be contaminated with mineral deposits called scale. 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 naturally occurring radioactive material (NORM) contaminated oil-field wastes are largely unknown at this time. A growing awareness of this problem began when reports surfaced of contaminated pipe being used to construct bleachers and 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.

2. 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. 1414b. The designated ocean areas in which wastes may be disposed are listed in 40 CFR 228. Further, USEPA publishes 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 (transfer to smaller vessels). 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. Nonenergy Minerals Programs in the Gulf of Mexico

Sulphur Program in the Gulf of Mexico

At present, sulphur is produced from two offshore mines (the Caminada mine and the Main Pass mine), both on leases in Federal waters off Louisiana. Also, exploration drilling is planned in the near future on several leases acquired in the 1988 Federal offshore sulphur lease sale.

The Caminada Mine is on Grand Isle Blocks 16, 17, 22, and 23. Production was initiated in March 1979, and is projected to continue until approximately 1999. The produced sulphur is transported by barge to Grand Isle shore base.

The Main Pass sulphur mine lies in Main Pass Block 299. Exploratory drilling began in December 1988. Main Pass Block 299 is one of the world's largest sulphur discoveries. Estimated recoverable reserves are 67 million long tons, more than all of the other remaining U.S. sulphur reserves combined. The Main Pass sulphur mine should produce for 30 years or more. The produced sulphur is transported by barge to Port Sulphur Terminal.

Sulphur is mined using a hot-water-extraction method. This technique involves drilling wells using standard rotary drilling technology followed by injection of hot (approximately 325°F) seawater into the mineral-bearing formation to melt the elemental sulphur in-situ. Compressed air is pumped down the well and the molten sulphur is "air-lifted" to the platform where it is contained in vessels known as sulphur "pans," then pumped to liquid sulphur storage tanks. It is later transferred to barges for transport to onshore processing facilities.

Other Mineral Programs

At present, no other mineral programs are active in the Gulf of Mexico OCS. A Task Force established in 1986 to study the occurrence, location, and economic feasibility of developing non-energy mineral resources in the Gulf of Mexico has identified several minerals that are potentially commercially exploitable, including phosphate, sulphur, salt, oyster-shell, limestone, sand and gravel, and magnesia. The most prominent offshore hard minerals identified were sand and shell. Offshore sand deposits may be a possible sand source for coastal restoration and protection against accelerating rates of wetland loss.

d. Marine Transportation

Vessels operating offshore often use the network 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 has 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 collisions involving other vessels or fixed structures such as platforms and rigs. Section IV.C.5. 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 involving OCS platforms 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. 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 (i.e., an OCS service vessel hitting an OCS platform), 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 noncontact 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.

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.C.2.b.).

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 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), 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 CPA. The portions of the Eglin Water Test Areas comprise another 4 million acres, or 7.3 percent, of the Central Gulf.

Warning AreasDefense 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 WPA. The proposed action excludes a 337-block polygon (about 1.8 million acres) in the Western Naval Operations Area near Corpus Christi, Texas. This carrier operations area was deferred for Sales 141 and 143 through agreements between MMS and the Department of Navy.

Warning AreasDefense Operations Conducted

W-228	Carrier operations, air-to-air gunnery, rocket firing, aircraft operations, submarine operations
W-602	High-altitude training

3. 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. 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 tributaries and on other rivers have contributed to wetland loss in the Gulf because levees eliminate regular episodes of overbank flooding and prevent the distribution of alluvial sediments across deltas and flood plains. Prior to channelization, the flow of rivers was distributed among several distributary channels that delivered sediment to wetlands over a broad area during high river stages. Today, sediment from the Mississippi River is discharged through the main channel directly to the deep waters of the continental slope and through the Atchafalaya system.

As an example of this effect, Bayou Lafourche, in coastal Subarea LA-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 introduced 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 has trapped much of the sediment load of the rivers. 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).

Sediment deprivation will continue as a major impacting factor in Louisiana. 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.

Hydrologic alterations of river basins in the WPA have also been implicated as factors affecting coastal erosion in Texas.

b. Submergence and Natural Subsidence of Wetlands

Submergence of coastal wetlands in the Gulf of Mexico region contributes to 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 waterlogging and ultimate conversion of the marsh to open water. The submergence rate that is critical for the survival of wetland plants and maintenance of wetlands varies for different parts of the Gulf, and critical submergence rates have 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 downwarping, compaction, dewatering, and horizontal movement and oxidation of recent sediments. Human activities, such as fluid withdrawal 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 withdrawal greater than 10 cm is about 400 km² (Turner and Cahoon, 1987).

Submergence of wetlands is also considered a factor in the erosion of wetlands (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 withdrawal (Ratzlaff, 1980) and natural compactional subsidence (Swanson and Thurlow, 1973).

c. Dredging

An analysis of the amount of dredging activity for oil and gas projects that occurred in coastal Louisiana during 1988 was done to determine the magnitude of dredging impacts expected under the Cumulative Scenario. The data for this analysis came from U.S. Army Corps of Engineers (COE), New Orleans District permit applications. Dredging projects for oil and gas activities included maintenance dredging of existing rig access canals and drill slips and the dredging of new canals and slips. A total of 129,471 m (424,794 ft) of canals were maintenance dredged through wetland areas. The typical maintenance depth of a channel was 2.4 m (8 ft). This activity generated a total of 4,455,644 m³ (5,827,418 yd³) of dredged material, 82 percent of which was disposed of onto existing continuous spoil banks. Despite concerns about the impacts of continuous spoil banks on adjacent marsh areas, only 3 percent of the projects planned to provide gaps in the spoil banks to improve surface drainage off marsh surfaces. Only 2 percent of the projects proposed to place the spoil in a wetland area to encourage vertical accretion of the wetland surface.

An additional 52,833 m (173,345 ft) of maintenance dredging was done through open water coastal areas, generating 1,313,184 m³ (1,717,479 yd³) of dredged material. This material was disposed of into surrounding waters.

In 1988, 11,344 m (37,220 ft) of new channels and drill slips were dredged in wetland areas. These projects generated 580,451 m³ (759,157 yd³) of material. In open water coastal areas, 53,380 m (175,140 ft) of new dredging occurred, generating 3,324,933 m³ (4,349,012 yd³) of material. In the wetland areas, 30.5 ha (75.4 ac) of wetlands were lost as a result of dredging. Nearly half of these impacts occurred in brackish marshes. In 63 percent of the projects, the spoil was to be disposed of on continuous spoil banks. Only 7 percent of the projects proposed gapped spoil banks, and only 3 percent proposed disposal of the spoil onto wetland surfaces to encourage vertical wetland accretion.

Dredging for pipeline installations included 61 proposed projects in wetland areas totalling 123 km (76 mi) in length and 29 projects in open water coastal areas totalling 42 km (26 mi). The pipeline canals dredged in wetland areas would have been backfilled after installing the pipe.

On the basis of the above data, this document assumes that under the Cumulative Scenario, 9-10 million m^3 (12-13 million yd^3) of dredged material will be generated and disposed of during the peak year in Louisiana as a result of oil and gas operations. Nearly all of this dredging will be for onshore oil and gas development. In addition, 80 pipeline installation projects will occur in wetland and estuarine areas involving about 165 km (103 mi) of pipe. The peak year is assumed to occur during the first few years of the proposed action. Tidelands oil and gas activity levels are expected to decline in subsequent years at an unknown rate. All pipeline projects are assumed to be backfilled. Similar information has not been compiled yet for Texas, Mississippi, or Alabama. These estimates are based on COE permit applications and not on dredging projects actually implemented. Therefore, these estimates represent maximum estimates because not all permit applications may have been implemented.

Data on maintenance dredging in major Gulf waterways for general navigation purposes are being compiled, but will not be available for this EIS. In general, it is assumed that major Gulf waterways will be maintenance dredged every one or two years. Some idea of the scale of these projects can be obtained from proposed dredging projects in the Atchafalaya River and Bayous Chene, Boeuf, and Black (coastal Subarea LA-2) where 76,460 m^3 (100,000 yd^3) of material will be removed from the channels annually.

4. 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, which have been listed as endangered species under the Endangered Species Act, are migratory birds found along the north-central and western Gulf of Mexico coastal areas. Their migratory patterns are generally north-south, and thus they do not range over into other OCS Regions. Ongoing habitat alteration and destruction have been listed as primary concerns for these species. Accidental and intentional shootings are recorded for both whooping cranes and peregrine falcons.

Nonendangered and Nonthreatened Species

Many coastal and marine birds that inhabit the Gulf of Mexico and its contiguous bays, estuaries, and wetlands are seasonal migrants. These species are either winter residents or staging transients gathering energy reserves for migrational leaps (Terborgh, 1989). Migrating birds follow a complex series of corridors or pathways which vary according to species. The most common depiction of these migrational pathways are the four parallel north-south "flyways" across the North American continent which are used to describe waterfowl distributions. The central and western Gulf of Mexico coastline serves as the southern terminus of the Mississippi Flyway (Alabama, Mississippi, and Louisiana) and the Central Flyway (Texas), respectively. Migrating birds spend the majority of summer months in areas as far north as the coastal tundra of Canada and Alaska. Some species only pass through the Gulf area and overwinter in a variety of habitats in the Caribbean Sea, Central America, and South America. Generally the migrational trend within the Gulf region is north-south.

All migrating birds found within the Gulf region are subject to impacts from outside the planning areas that are detrimental to existing population levels. Long-term declines in duck populations are thought to be due, in part, to the systematic alteration and destruction of critical summer habitat utilized for breeding grounds. This habitat, known as the prairie pothole region, is situated in a broad belt across the Northern Plains States of the United States (Terborgh, 1989). Alteration and destruction of this habitat has grown steadily worse since settlement of that region. Other factors impacting waterfowl populations include hunting pressure, degradation of water quality throughout their respective ranges, ingestion of chlorinated hydrocarbons and petroleum, and incidental ingestion of lead shot. Migrating shorebirds are also thought to be affected by the destruction of northern (and southern) hemisphere wetland habitats which serve as staging areas during

their migrational circuit. Destruction and modification of these coastal wetland habitats has affected the populations of both migratory and resident species of coastal and marine birds.

b. Marine Turtles

Marine turtles are vulnerable to harm from human activities throughout their migratory ranges, particularly because of their wide-ranging movements in coastal waters. The major activities outside of the planning areas that affect marine turtles include commercial fishing, hopper dredging, pollutant discharge, ingestion of or entanglement in debris, nearshore boat traffic, human consumption, and contact with foreign, inshore, or processed oil (reviewed in NRC, 1990).

Capture and drowning in commercial fishing gear, particularly shrimp trawls, is the largest source of mortality for sea turtles in the United States (NRC, 1990). The use of Turtle Excluder Devices on shrimp trawls 7.6 m (25 ft) or longer and seasonal restrictions for selected fisheries is legislatively mandated to decrease turtle mortalities, but incidental catch may still occur in shrimping activities excluded from regulation (Crouse, 1992). Turtles also drown in association with driftnet, longline, and set-net fisheries, but these sources of mortality are neither fully documented nor regulated (NRC, 1990). Collisions with boats may also disable or kill sea turtles and are typically associated with about 8% of sea strandings identified by the U.S. sea turtle stranding network (Teas and Martinez, 1992).

Dredge and fill activities occur in many of the nearshore seasonal habitats of marine turtles in the southeastern United States and other areas. Operations range in scope from propeller dredging by recreational boats to large-scale navigation dredging and fill for land reclamation. Hopper dredging has caused turtle mortalities in coastal areas including Cape Canaveral Ship Channel, Florida, and the King's Bay Submarine Channel in Georgia (Slay and Richardson, 1988).

Sea turtles frequent coastal areas such as algae and seagrass beds to seek food and shelter (Carr and Caldwell, 1956; Hendrickson, 1980). These submerged vegetated areas may be lost or damaged by activities that alter salinity, increase turbidity, or disturb natural tidal and sediment exchange. Natural catastrophes, including storms, floods, droughts, and hurricanes, can also substantially damage sea turtle habitats and nesting beaches (Agardy, 1990).

Construction, vehicle traffic, beachfront erosion, and artificial lighting are activities that may disturb marine turtles or their nesting beaches (Raymond, 1984; Garber, 1985). Human consumption of turtle eggs, meat, or byproducts occurs worldwide and depletes turtle stocks (Mack and Duplaix, 1979; Cato et al., 1978). Human take is estimated to be substantial, but the often illegal nature of the activity render estimates unreliable.

Marine debris is a well-documented source of mortality and debilitation for marine turtles (NRC, 1990). In addition to the incremental amount of trash and debris generated by the OCS Program, marine debris is carried into the Gulf and Atlantic via oceanic currents from South and Central America, Europe, and North Africa (Plotkin and Amos, 1988; Hutchinson and Simmonds, 1992). The volume of nonbiodegradable materials contributed by these sources is unknown. Turtles that consume or become entangled in debris may die or become debilitated (O'Hara, 1989; USDOC, NMFS, 1989a; Heneman and the Center for Environmental Education, 1988). Plastics and other materials may remain in the gut for at least six months and interfere with digestion (Lutz and Alfaro-Shulman, 1992).

Chronic pollution, including industrial and agricultural wastes and urban runoff, may pose a threat to sea turtles world-wide (Frazier, 1980; Hutchinson and Simmonds, 1991). Some turtle species have lifespans greater than 50 years (Congdon, 1989; Frazer et al., 1989), creating the potential for bioaccumulation of heavy metals (Hillestad et al., 1974; Stoneburner et al., 1980; Davenport et al., 1990), pesticides (Thompson et al., 1974; Clark and Krynskiy, 1980; Davenport et al., 1990), and other toxins (Lutz and Lutcavage, 1989).

Fibropapillomas, debilitating tumors occurring primarily in green turtles, also threaten sea turtles in populated coastal areas (Teas, 1991). Fibropapillomas may be accompanied by trematode and leech infestations and severe anaemia (Norton et al., 1990). The disease was documented in the 1930's (Smith and Coates, 1938), but its incidence has increased in the last century, especially from 1985-1990, in Florida, Hawaii, and Puerto Rico turtles (Teas, 1991). The origin of marine turtle fibropapilloma disease is unknown, but viral and toxicological causes are among those under investigation (Jacobson, 1991).

c. Cetaceans

The sperm whale and five species of baleen whales (blue whale, fin whale, humpback whale, sei whale, and northern right whale) are currently listed as endangered species under the Endangered Species Act. With the possible exception of the sperm whale, all of these whales are highly migratory and may frequent the Gulf of Mexico only on a seasonal or irregular basis. Other large whales and several species of smaller cetaceans are also found within both coastal and offshore waters of the Gulf, as either resident or transient populations. They are thus subject to adverse impacts across their entire respective ranges, which encompass high arctic waters to the Caribbean Sea and tropical waters of the Atlantic Ocean.

Oil and gas activity in the western Atlantic Ocean is minimal and is not expected to increase significantly.

Commercial fishing, maritime commerce, bioaccumulation of toxins, acute poisoning from plankton bloom phenomena, and detrimental effects from whale watching vessels 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, though quota limitations and seasonal hunting suggest that the impact is low. Maritime commerce can cause a variety of impacts, including collisions, noise and general disturbance, and degradation of water quality from spills and discharge. Conflicts are most likely at the convergences of shipping lanes and marine mammal migration routes, such as the Yucatan and Florida Straits and along certain segments of the eastern coast of the United States. Bioaccumulation of toxins through the food chain has been found in marine mammals. These toxins include hydrocarbon and heavy metal compounds from a multitude of worldwide sources such as oil spills, ocean dumping, industrial and municipal effluents, and agricultural runoff. This phenomenon appears to be on the increase worldwide. Whale-watching excursion vessels can disturb, frighten, or collide with whales during close approach or pursuit endeavors (Freeman, 1991). These activities are seasonally popular in areas along the Eastern Seaboard and Atlantic Canada. Recent guidelines proposed by the National Marine Fisheries Service (*Federal Register*, 1992), for whale-watch excursion operations should minimize impacts from this activity. These proposed regulations were withdrawn recently by the NMFS.

d. Fish Resources

Those nonestuarine-dependent species of fish that are commercially important, such as mackerel, cobia, and crevalle, are called coastal pelagics. Coastal pelagics could be affected by activities outside the planning areas. These species are distributed and spawn over a large geographic area and depth range within the coastal area of the southeastern United States; they range throughout the Gulf of Mexico and move seasonally (Gulf of Mexico Fishery Management Council, 1985). Mackerel move up the east coast of Florida as far as the Carolinas. This movement is not considered oceanic migration, as is the case with salmon. The movements of these pelagic species outside the planning areas are related to reproductive activity, seasonal changes in water temperature, or other oceanographic conditions.

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; Horst, 1992b).

Coastal pelagics harvested from the Atlantic of the southeastern United States and from the Gulf of Mexico are believed to be in decline due to several factors, including overfishing and degradation of nearshore water quality (Angelovic, written communication, 1989; USDOC, NOAA, 1991b). Oil spills that occur 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 pollution from foreign and domestic oil tankering throughout their range may adversely affect coastal pelagic species.

5. 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 being 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 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 illegally discharged operational discharges from tankers while at sea, natural seepage, and coastal, municipal, and industrial discharges and runoff. Recent MARPOL regulations have significantly reduced the levels of operational discharges associated with vessel operations. Terminals are now required to maintain onshore disposal facilities for receipt of this waste.

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. The examination also 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 an 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 (USDOL, MMS, 1991) 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, condensate, 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, Coast Guard, 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 bbl from worldwide tanker operations. These databases were supported often by personal communications 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 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 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 are 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 communication, 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 is less than 50 bbl (Oil Spill Intelligence Report, 1988; Westcott, personal communication, 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, almost all of the spills will occur in Louisiana's coastal zone. These spills are inclusive of spill events associated with OCS operations.

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, 0.47. 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. Tables IV-10 and IV-11 in Section IV.A. provide 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 (Rainey, 1992).
- 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)

<u>Port</u>	<u>Mean No. of Spills</u>	<u>Probability of One or More Spills</u>
Corpus Christi, Tex.	2.00	0.86
Freeport, Tex.	0.50	0.39
Galveston/Houston, Tex.	4.60	0.99
Port Arthur, Tex./ Lake Charles, La.	3.43	0.97
Miss. River Ports, La.	3.12	0.96
LOOP	4.07	0.98
Pascagoula, Miss.	1.55	0.79
Mobile, Ala.	0.12	0.11

Other Types of Barge and Tanker Spills

Figure IV-3 shows the distribution of the 82 tanker and barge spills greater than 1,000 bbl that have occurred in the Gulf region since 1974 (Rainey, 1992). 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.

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. Both of these projections are based on steady-state conditions.

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

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, 1993). The projected amount of OCS produced water discharged (Tables IV-14 and IV-16) 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 Mississippi River reflect petroleum contamination from the River's discharge (Southwest Research Institute, 1981; Brooks and Giammona, 1988). The National Academy of Sciences (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

Figure IV-3. 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 (USDOl, MMS, 1990, unpublished information).

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 estimated in 1990 that 8.3 MMbbl (approximately 1.2 Mta) of used motor oil is generated annually in the U.S. by do-it-yourselfers (Automotive Information Council News, 1990). 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 3.1×10^6 Mta). Using a discharge rate for U.S. refineries of 0.0005 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 number 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.

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