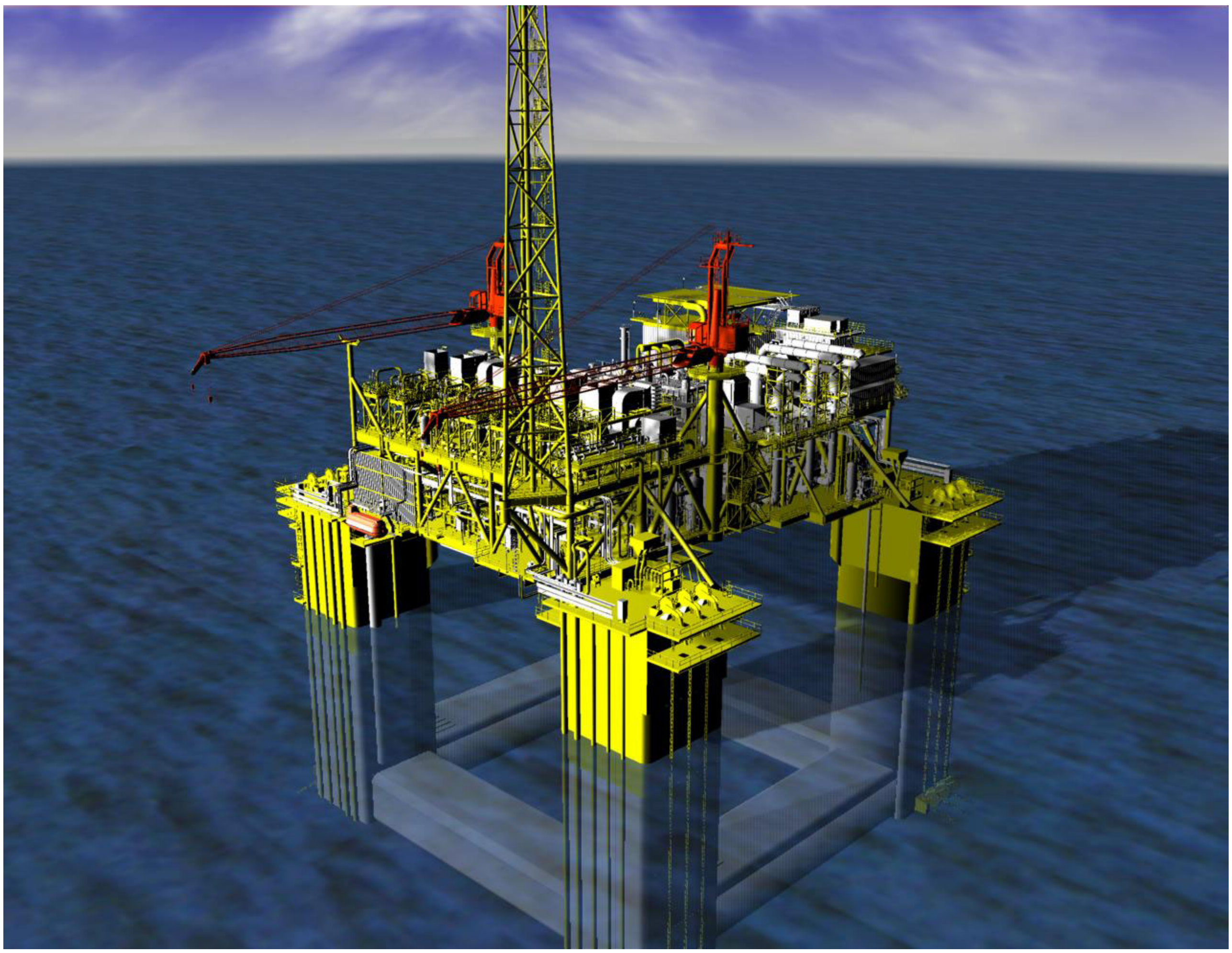
OCS EIS/EA
MMS 2005-064

Environmental Assessment for Independence Hub

Surface Facilities and Subsea Development Project

Eastern and Central Planning Areas, Gulf of Mexico



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

OCS EIS/EA
MMS 2005-064

Environmental Assessment for Independence Hub

Surface Facilities and Subsea Development Project

Eastern and Central Planning Areas, Gulf of Mexico

Author

Minerals Management Service
Gulf of Mexico OCS Region

Published by

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

New Orleans
November 2005

SITE-SPECIFIC ENVIRONMENTAL ASSESSMENT FOR ANADARKO'S INDEPENDENCE HUB PROJECT FINDING OF NO SIGNIFICANT IMPACT

Anadarko Petroleum Corporation (APC) and partners have submitted Initial Unit Development Operations Coordination Documents (DOCD) and pipeline right-of-way (ROW) applications proposing to (1) install a floating production facility in Mississippi Canyon Block 920, (2) complete 21 smart-wells for subsea production, (3) install gathering flowlines to the production facility, and (4) install an export trunk line to a junction platform in West Delta Block 68 in order to produce nine gas fields in the Central and Eastern Planning Areas. This site-specific environmental assessment (SEA) of the proposed action is complete and results in a Finding of No Significant Impact. Based on this SEA, we have concluded that the proposed action will not significantly affect the quality of the marine and human environment (40 CFR §1508.27). Preparation of an environmental impact statement is not required. During this evaluation MMS identified mitigations for this proposed action; these mitigations are listed below.

Mitigations for ROW Pipelines

1. Mitigation 3.04 (Post-Approval Submittal)—Magnetic Anomalies and/or Sidescan—Sonar Targets—Multiple Features. Our review indicates that the proposed pipeline route is in the vicinity of the unidentified sidescan-sonar targets listed in the enclosure, features that may represent significant archaeological resources. In accordance with 30 CFR 250.194(b), you will either (1) conduct an underwater archaeological investigation prior to commencing construction activities to determine whether these features represent archaeological resources or (2) ensure that all seafloor disturbing actions avoid the unidentified features by a distance greater than that listed in the enclosure. Submit lay barge anchor position plats at a scale of 1 in = 1,000 ft with dynamic global positioning system accuracy, with your pipeline construction report required by 30 CFR 250.1008(b) that demonstrate that the features were not physically impacted by the construction activities. (Applicable to P-15099 and P-15100)
2. Mitigation 3.04 (Post-Approval Submittal)—Magnetic Anomalies and/or Sidescan—Sonar Targets—Multiple Features. Our review indicates that the proposed pipeline route is in the vicinity of the unidentified magnetic anomalies and sidescan-sonar targets listed in the enclosure, features that may represent significant archaeological resources. In accordance with 30 CFR 250.194(b), you will either (1) conduct an underwater archaeological investigation prior to commencing construction activities to determine whether these features represent archaeological resources or (2) ensure that all seafloor disturbing actions avoid the unidentified features by a distance greater than that listed in the enclosure. Submit lay barge anchor position plats, at a scale of 1 in = 1,000 ft with dynamic global positioning system accuracy, with your pipeline construction report required by 30 CFR 250.1008(b) that demonstrate that the features were not physically impacted by the construction activities. (Applicable to P-15153)
3. Mitigation 3.05 (Post-Approval Submittal)—Magnetic Anomalies and/or Sidescan—Sonar Targets—Single Feature. Our review indicates that the proposed pipeline route is in the vicinity of the unidentified sidescan-sonar target listed in the enclosure, a feature that may represent significant archaeological resources. In accordance with 30 CFR 250.194(b), you will either (1) conduct an underwater archaeological investigation prior to commencing construction activities to determine whether these features represent archaeological resources or (2) ensure that all seafloor disturbing actions avoid the unidentified features by a distance greater than that listed in the enclosure. Submit lay barge anchor position plats, at a scale of 1 in = 1,000 ft with dynamic global positioning system accuracy, with your pipeline construction report required by 30 CFR 250.1008(b) that demonstrate that the feature was not physically

impacted by the construction activities. (Applicable to P-15149, P-15152, and P-15166)

4. Mitigation 4.01 (Notification)—Artificial Reef Notification. Your proposed operations are located within 500 ft of an artificial reef site or an artificial reef permit area established by the State of Louisiana. Prior to conducting operations (including the use of anchors, anchor chains, and wire ropes) that could disturb the seafloor within 500 ft of an artificial reef site or an artificial reef permit area, contact the Louisiana Artificial Reef Coordinator (Rick Kasprzack at (225)765-2375) to ensure that your operations do not damage reefal material. (Applicable to P-15153)

Mitigations for DOCD's

5. Mitigation 6.05 (Condition of Approval)—Coastal Zone Concurrence—Florida. Drilling permits cannot be issued for the proposed wells until concurrence with your coastal zone management consistency certification has been received by this office from the Florida Department of Environmental Protection or until concurrence with the certification has been conclusively presumed. (Applicable to N-8402, N-8411, N-8415, N-8419, and N-8430).

7. Mitigation 19.03—ROV Survey Not Required. In accordance with NTL No. 2001-G04, the MMS has determined that you will not need to conduct the two ROV surveys you proposed in your plan. (Applicable to N-8385, N-8407, N-8415, and N-8458)

Dennis Chew
Dennis Chew
Chief, Environmental Assessment Section
Leasing and Environment, GOM OCS Region

11/9/05
Date

[signature]
Joseph Christopher
Regional Supervisor
Leasing and Environment, GOM OCS Region

11/9/05
Date

TABLE OF CONTENTS

Page

FIGURES

TABLES

ABBREVIATIONS AND ACRONYMS

AAC	air armament center
AFB	air force base
A&M	agricultural and machinists
APC	Anadarko Petroleum Corporation
bbl	barrel(s)
BOD	biochemical oxygen demand
B.P.	before present
BTU	British thermal unit
CFR	Code of Federal Regulations
CH_4	methane
cm	centimeter
CPA	Central Planning Area
CSA	Continental Shelf Associates
CZM	Coastal Zone Management
DGPS	dynamic global positioning system
DOCD	Development Operations Coordination Document
DOI	Department of the Interior (also: USDOI)
DP	dynamically positioned
EA	environmental assessment
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
EIS	environmental impact statement
EPA	Eastern Planning Area
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FAD	fish attracting device
Final EIS	final environmental impact statement
FMC	Fishery Management Council
FONSI	Finding of No Significant Impact
FR	*Federal Register*
ft	foot
FWS	Fish and Wildlife Service
g	grams
gal	gallon
GOM	Gulf of Mexico
GulfCet	Gulf Cetacean
H_2S	hydrogen sulfide
in	inch
kg	kilogram
km	kilometer
kph	kilometers per hour
lb	pounds
LCA	Louisiana Coastal Area
LDWF	Louisiana Dept. of Wildlife and Fisheries
LLC	limited liability corporation
MARPOL	International Convention for the Prevention of Pollution from Ships
mi	mile
mph	miles per hour
MMcf	million cubic feet
MMS	Minerals Management Service
MSA	Metropolitan Statistical Area
MWA	military warning area
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NERBC	New England River Basins Commission
NGMCS	Northern Gulf of Mexico Continental Slope Study
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NOW	nonhazardous oil-field waste
NPDES	National Pollutant and Discharge Elimination System
NRC	National Research Council
NTL	Notice to Lessees and Operators
NYMEX	New York Mercantile Exchange
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OSRA	Oil Spill Risk Analysis
PAH	polynuclear aromatic hydrocarbons
PCB	polychlorinated biphenyl
PEA	programmatic environmental assessment
ppt	parts per thousand
PSD	Prevention of Significant Deterioration
ROV	remotely operated vehicle
ROW	right-of-way
SIC	Standardized Industry Code
SOV	spill occurrence variable
TCW	treatment, completion, and workover
TSS	total solids in suspension
TV	transport variable
USCG	U.S. Coast Guard
USCOE	U.S. Corps of Engineers
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
WPA	Western Planning Area

INTRODUCTION

The Independence Hub is a development project arising from discoveries made from 2002 through 2004 in the current Eastern Planning Area (EPA) sale area since renewed leasing began in December 2001 with Lease Sale 181. The Independence Hub is designed to be an integrated development of nine gas fields in the EPA and Central Planning Area (CPA). The development consists of a central Hub facility, subsea production infrastructure, connecting flowlines, and a new export trunk line terminating at a junction platform that ties in to the Tennessee Gas pipeline in Plaquemines Parish, Louisiana. The proposed action involves several Initial Development and Coordination Documents (DOCD) and related pipeline right-of-way (ROW) applications that are evaluated as an integrated project.

There are recent and comprehensive National Environmental Policy Act (NEPA) evaluations in final environmental impact statements (EIS) that have considered the deepwater CPA and EPA. The Independence Hub Site-Specific Environmental Assessment (SEA) tiers from existing NEPA documentation and thereby minimizes duplication of these evaluations by referencing them where appropriate as provided in NEPA implementing regulations (40 CFR §1502.20). This SEA tiers from the CPA/Western Planning Area (WPA) Multisale Final EIS (USDOI, MMS, 2002) and two EIS's for the EPA, the EPA Multisale Final EIS (USDOI, MMS, 2003a) and the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a). A programmatic environmental assessment for exploration in the EPA sale area (USDOI, MMS, 2003b) also contains relevant analyses for this ultra-deepwater setting.

1. THE PROPOSED ACTION

1.1. Purpose of the Proposed Action

The proposed action to install and operate the Independence Hub is designed to produce gas and condensate from nine fields operated by different companies in the CPA and EPA of the Gulf of Mexico (GOM) by using a semisubmersible production structure. Production of hydrocarbon resources would help satisfy the Nation's need for energy supplies. 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 oversees the OCS oil and gas program and MMS is the agency charged with this oversight. The Secretary is required to balance orderly resource development with protection of the human, marine, and coastal environments while ensuring that the U.S. public receives an equitable economic return for resources discovered and produced on public lands.

1.2. Need for the Proposed Action

The need for the proposed action lies in the need for orderly development of OCS resources. As the designated operator of Mississippi Canyon Block 920, Anadarko Petroleum Corporation (APC) has filed a DOCD with MMS consistent with its requirement to file such a plan before production activity commences. Reasons that APC has submitted this proposal to MMS include

- commercial quantities of hydrocarbons have been discovered on a valid lease;
- leaseholders have a legal right to produce hydrocarbon resources; and
- leaseholders are obligated via lease terms to diligently develop resources.

1.3. Description of the Proposed Action

Five independent exploration and production companies and a midstream energy company have come together to facilitate the development of nine ultra-deepwater discoveries of natural gas in the EPA and the adjacent CPA of the GOM. The MMS is evaluating the Independence Hub project as an integrated system based on the DOCD's submitted by the operators of each gas field, the corresponding ROW pipelines that carry product to the Hub, and the export trunk line to shore.

The named gas discoveries in the EPA and CPA of the GOM are shown Table 1-1. Table 1-2 shows the MMS control numbers for DOCD's and pipeline ROW applications that are part of the Independence Hub project. Independence Hub LLC will own the Hub and the Independence Trail export trunk line, while APC will operate the Hub and seven of the nine gas fields. The Independence Trail trunk line will be operated by GulfTerra Field Services. The remaining gas fields will be operated by Dominion Exploration & Production, Inc. (San Jacinto field) and Kerr-McGee Oil & Gas Corporation (Merganser field).

Independence Hub LLC is an affiliate of Enterprise Products Partners L.P. and the Atwater Valley Producers Group, which includes APC, Dominion Exploration & Production, Inc., Kerr-McGee Oil & Gas Corporation, Spinnaker Exploration Company, BHP Billiton, and Devon Energy Corporation. These companies have executed agreements for the gathering and processing of natural gas and condensate from nine fields discovered over the last three years in the Atwater Valley, DeSoto Canyon, and Lloyd Ridge areas of the GOM. A summary of trade news taken from published sources follows for each of the prospects that are to comprise the Independence Hub project.

- Anadarko discovered gas at Spiderman prospect in November 2003 in 8,200 ft (2,499 m) of water, reporting 140 ft (42.5 m) of pay.
- Anadarko discovered gas at Atlas prospect in June 2003 in 9,000 ft (2,743 m) of water, reporting 180 ft (55 m) of pay.

- Anadarko discovered gas at Atlas Northwest prospect in January 2004 in 9,850 ft (3,002 m) of water, reporting 50 ft (15 m) of pay.

- BHP discovered gas at Vortex prospect in December 2002 in 8,340 ft (2,582 m) of water, reporting 75 ft (23 m) of pay. The APC has taken over as operator of this prospect.
- Murphy Oil Corporation discovered gas at South Dachshund prospect in December 2004 in 8,400 ft (2,560 m) of water, reporting 70 ft (21 m) of pay. The APC has taken over as operator of this prospect and renamed it Mondo Northwest.
- Dominion Exploration and Production Inc. discovered gas at San Jacinto prospect in April 2004 in 8,200 ft (2,500 m) of water, reporting 100 ft (30.5 m) of pay.
- Anadarko Petroleum Corporation discovered gas at Jubilee prospect in April 2003 in 8,800 ft (2,682 m) of water, reporting 83 ft (25.3 m) of pay.
- Kerr-McGee Oil and Gas Corporation discovered gas at Merganser prospect in 2001 in 7,900 ft (2,408 m) of water, reporting 4 reservoir sands.
- Shell Exploration and Production discovered gas at Cheyenne prospect in 2004 in 9,000 ft (2,743 m) of water (no additional data). The APC has taken over as operator of this prospect.

Without this consortium of operators working together, each of these fields would not be economical to develop alone. Independence Hub LLC anticipates future production from a number of unexplored blocks in the area.

Table 1-1

Prospect, Lease Acquisition Sale Number,
MMS Initial EP Control Number, and Wells Intended for Production

Prospect	Sale #	Initial EP #	Exploratory Wells Intended for Completion and Production
Atlas Northwest	181	N-7533	LL 5 #1
Atlas	181	N-7533	LL 50 #1 Sidetrack #1
Spiderman	181	N-7686	DC 620 #1, DC 621 #1 Sidetrack #1
Cheyenne	181	N-7698	LL 399 #1, LL 399 #1, #2, #3 and #4
San Jacinto	181	N-7928	DC 618 #1, DC 618 #2, DC 618 #3
Mondo Northwest	116	N-8098	LL 1 #1
Merganser	175	N-7225	AT 37 #1, AT 37 #3
Vortex	157	N-7502	AT 261 #1 Sidetrack #1, AT 261 #2
Jubilee	166	N-7545	AT 349 #2, AT 349 #3, AT 349 #4, AT305 #1, AT 305 #2

Note: AT = Atwater Valley; DC = DeSoto Canyon; LL = Lloyd Ridge; EP = Exploration Plan

Table 1-2

Prospects Served by the Proposed Independence Hub, Corresponding MMS Initial DOCD or Pipeline ROW Application Control Numbers, Affected OCS Lease, and Planning Area, Protraction Area, and Block Number(s).

Prospect	DOCD Number	Pipeline ROW Application*	Produced Lease or RUE Location	Planning Area, Protraction Area, and Block Number(s)
Atlas Northwest	N-8411	P-15146	G-23450	EPA LL 5
Atlas	N-8411	P-15146	G-23458	EPA LL 50
Spiderman	N-8402	P-15099 P-15100	G-23528, G-23529	EPA DC 620, 621
Cheyenne	N-8419	P-15149 P-15152	G-23480	EPA LL 399
San Jacinto	N-8430	P-15166	G-23526	EPA DC 618
Mondo Northwest+	N-8415	P-15146	G-10486, G-10487	EPA LL 1, 2
Merganser	N-8407	P-15199	G-21826	CPA AT 37
Vortex	N-8458	P-15149 P-15152	G-16890	CPA AT 261
Jubilee	N-8385	P-15149 P-15152	G-18556, G-18577	CPA AT 305, 349
Independence Trail Trunk Line	N/A	P-15153	N/A	CPA
Independence Hub Topsides	N-8385	N/A	G-23648	CPA MC 876, 919, 920, 921,964

Notes: AT = Atwater Valley; DC = DeSoto Canyon; LL = Lloyd Ridge; MC = Mississippi Canyon
EPA = Eastern Planning Area; CPA = Central Planning Area; N/A = Not Applicable; DOCD = Development Operations Coordination Document; RUE = Right of Use and Easement
+ Anadarko assumed operatorship for G-10486 and G-10487 and renamed the prospect Mondo Northwest
* Indicates control numbers for flowlines only

All of the 21 wells intended for production would have been drilled under initial or revised Exploration Plans (EP). Eighteen of 21 wells will be completed using a dynamically-positioned (DP) drillship, the *Deepwater Millennium*, or an equivalent drillship. Dominion plans to complete the three wells in their San Jacinto field in DeSoto Canyon Block 618 using a moored semisubmersible drilling unit, the *Noble Amos Runner*, or an equivalent unit. The well completion procedure would install (1) production tubing and gravel packs, (2) horizontal wet trees that use smart-well technology, (3) production equipment on the sea bottom that includes manifolds for flow control and routing, and (4) connecting flowlines and umbilicals from the nine anchor fields to the Hub. A 24-in diameter (61 cm) gas export trunk line would be installed by GulfTerra to pipe gas from the Hub to shore for processing. The Hub will be located in Mississippi Canyon Block 920, in water depth of 7,920 ft (2,414 m), based on favorable seafloor conditions and proximity to the identified anchor fields. First production is expected in the first quarter of 2007. A 20-year minimum production lifetime for the Independence Hub is expected. A schematic of the Independence Hub development is shown in Figure 1-1.

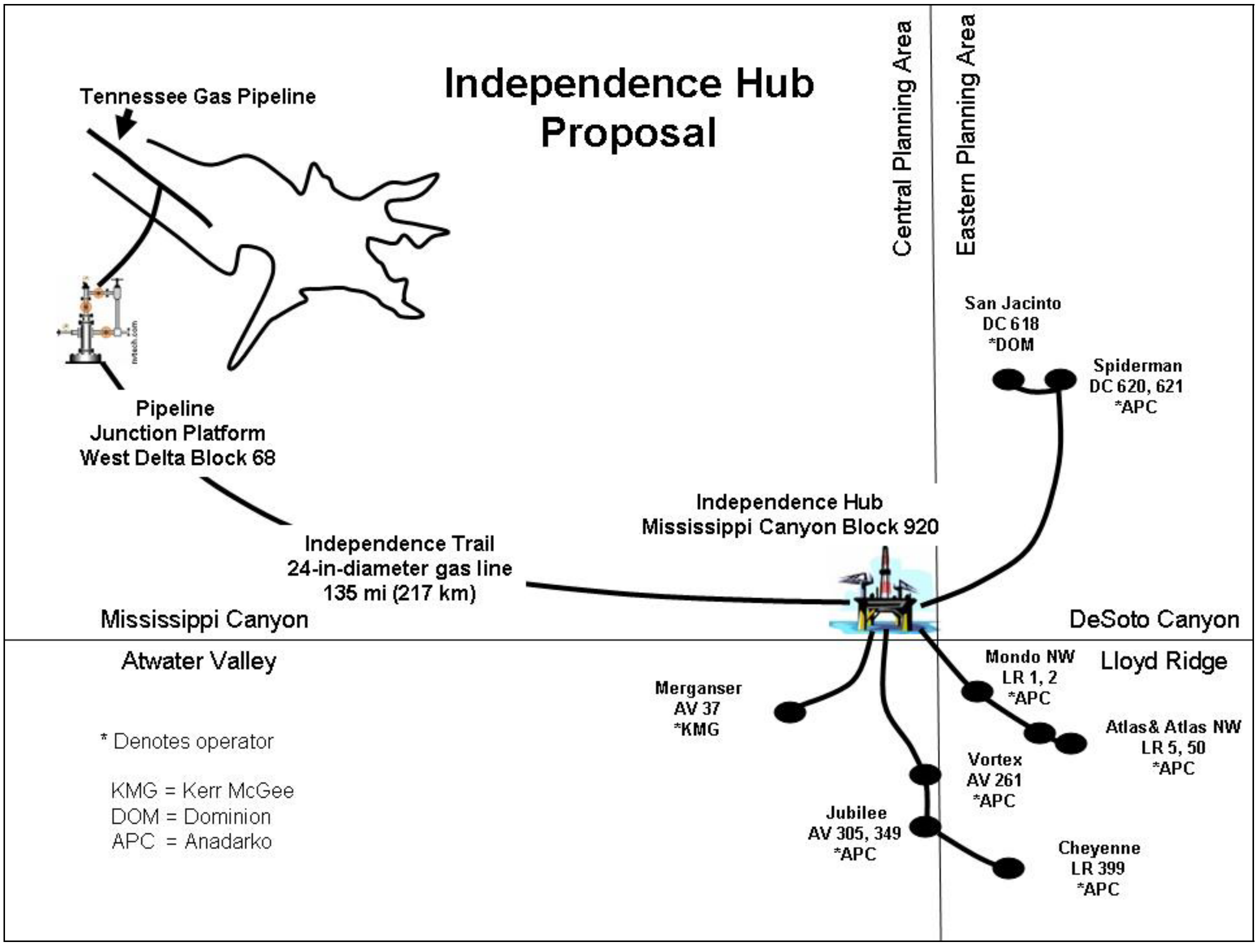


Figure 1-1. Planimetric Schematic View of the Independence Hub in Mississippi Canyon Block 920, Subsea Tiebacks to Nine Anchor Gas Fields in the EPA and CPA, and Independence Trail Export Trunk Line to Junction Platform and to Shore.

The MMS assigns control numbers to track required reviews that pipeline applications and DOCD's must receive as part of the permitting process, part of which includes an evaluation under NEPA. This SEA examines an integrated collection of plans and pipelines that comprise the Independence Hub project. The MMS plan control numbers that are part of this NEPA evaluation include the DOCD's identified in Table 1-2 and the following pipeline right-of-way applications.

- P-15099—8-in diameter flowline from Spiderman to Hub
- P-15100—10-in diameter flowline from Spiderman to Hub
- P-15101—6-in diameter umbilical from Spiderman to Hub
- P-15146—8-in diameter flowline from Atlas to Atlas NW to Mondo NW to Hub
- P-15147—6-in diameter umbilical from Atlas to Atlas NW to Mondo NW to Hub
- P-15148—6-in diameter umbilical from Atlas to Atlas NW to Mondo NW to Hub
- P-15149—10-in diameter flowline from Cheyenne to Jubilee to Vortex to Hub
- P-15150—6-in diameter umbilical from Cheyenne to Jubilee to Vortex to Hub
- P-15152—8 5/8-in diameter flowline from Cheyenne to Jubilee to Vortex to Hub
- P-15153—24-in diameter Independence Trail GulfTerra trunk line

- P-15166—8-in diameter flowline from San Jacinto to Spiderman
- P-15167—6-in diameter umbilical San Jacinto to Spiderman
- P-15199—8 5/8-in diameter flowline from Merganser to Hub
- P-15200—6-in diameter umbilical from Merganser to Hub

1.3.1. Schedule of Activities

The scheduled activities for Independence Hub are concurrent in some cases (Table 1-3). The well completion and hub and pipeline installation is expected to take approximately 16 months.

Table 1-3

Milestone Dates for the Proposed Independence Hub Project

Activity	Estimated Start Date	Estimated Complete Date
Install lease-term pipelines, complete wells, install Independence Hub	4/01/2006	12/31/2006
Field hook-ups, flow testing	12/31/2006	6/30/2007
First gas	7/01/2007	6/30/2022

1.3.2. Surface Hub and Subsea Production Equipment

Independence Hub LLC will design, construct, install, and own Independence Hub, a 105-ft (38 m) deep-draft, column-legged, semisubmersible platform with a displacement of 50,000 tons (see cover for image of the Hub). The Hub would be moored in water 7,920 ft (2,414 m) deep (Figure 1-2). Topside facilities have a surface area of approximately 1.2 ac (0.5 ha), a two-level production deck, and a crew of 40 people. A steel catenary production riser would carry gas from flowlines to the Hub. The Hub topsides would be anchored to the sea bottom by means of 12 polyester mooring lines connected to suction pilings. Design basis peak production levels for the Independence Hub are 850 million cubic feet (MMcf) of gas per day, 4,250 bbl of condensate per day, and 3,000 bbl of water per day. One to two bbl of condensate would be produced for every MMcf of gas. The platform, which is estimated to cost approximately $385 million, will be operated by APC. The Hub is being designed with excess capacity to tie-back as many as 10 additional fields.

The project will require completing 21 existing exploratory wells by installing production tubing and downhole equipment and subsea production hardware. Eighteen of the 21 wells would be completed with a dynamically positioned (DP) drillship, the *Deepwater Millennium,* or an equivalent. The three wells in DeSoto Canyon Block 618 that are the San Jacinto development would be completed using a moored semisubmersible drilling unit such as the *Noble Amos Runner.* Exploratory wells were drilled under approved initial or revised EP's and are now temporarily plugged and abandoned or are in the process of being drilled. Subsequent stages involve the placement on the sea bottom of production structures and facilities to produce each well. This hardware includes horizontal subsea production trees, subsea umbilical termination assemblies, in-line termination sleds, pipeline end terminations (commonly called manifolds), umbilical lines, flowlines, and connecting jumpers. Umbilicals are 6-in diameter (15 cm) jacketed cable containing a composite of electrical lines, hydraulic lines, and tubing that can carry and deliver special chemicals to the wellheads and manifolds to ensure unimpeded flow of product through the gathering flowlines. Subsea production equipment is described in Regg et al. (2000). Production structures are made predominantly of stainless steel to resist corrosion and the tremendous pressures at depths >8,000 ft (2,438 m). Subsea production hardware is mounted on a metal platform with legs or pilings that stabilize the equipment on the sea bottom.

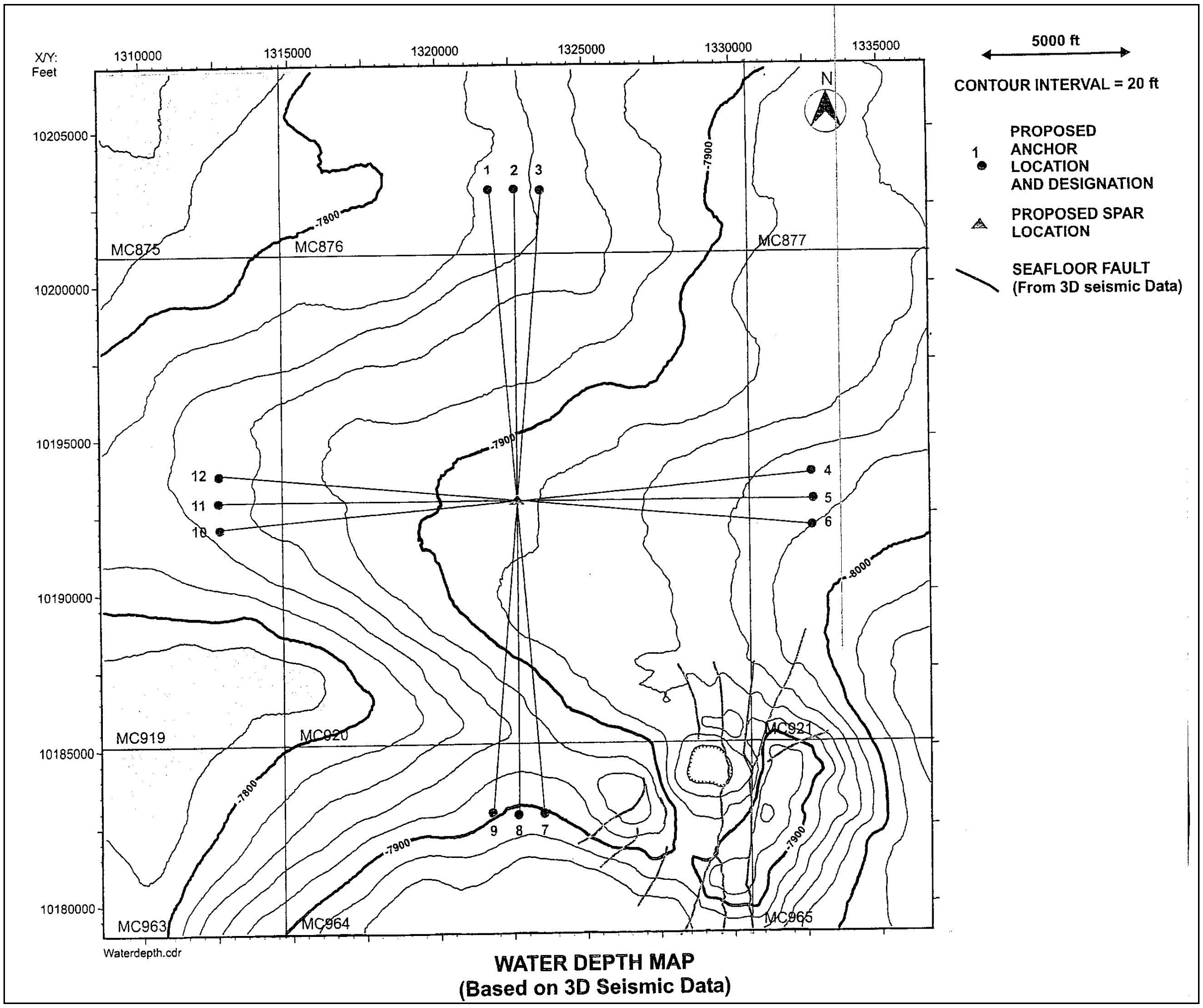


Figure 1-2. Bathymetric Map of Mississippi Canyon Block 920 Showing the Location of Independence Hub Topsides with Suction Pile and Mooring Line Locations.

The completion rig would mount a horizontal subsea tree to each wellhead that controls the production flow rate from each well and that prevents blowouts. Horizontal refers to the configuration of the valves inside of the tree. These subsea trees weigh approximately 85,000 lb (39 metric tons) and have a bottom footprint of 225 ft^2 (20 m^2). The horizontal trees would deploy "smart well" technology and have the ability to produce from multiple subsurface horizons. Pipelines that carry product from each field to the production structure are called flowlines. Each field would be tied back to the Hub through operator-owned, subsea flowline systems. Approximately 121 mi (195 km) of 8-in diameter (20 cm) flowlines, 55 mi (89 km) of 10-in diameter (55 cm) flowlines, and 105 mi (169 km) of 6-in diameter (15 cm) umbilicals tie the 21 wells to the Hub structure in Mississippi Canyon Block 920.

Manifolds are used to control flow routing from single fields produced by multiple wells or between fields that are part of an integrated production system. These are the largest pieces of equipment in a subsea production system. Typical manifolds occupy a sea-bottom area of approximately 6,400 ft^2 (595 m^2 or 0.15 ac). Four manifolds would be emplaced on the sea bottom as part of this project. Manifolds would be located at the following fields: (1) DeSoto Canyon Block 621 to regulate flow from six wells at San Jacinto and Spiderman fields; (2) Atwater Valley Block 349 to regulate flow from six wells at Cheyenne and Jubilee fields; (3) Atwater Valley Block 261 to regulate flow from two wells at Vortex field; and (4) Atwater Valley Block 37 to regulate flow from two wells at Merganser field.

Additional subsea production equipment includes flowline termination sleds and umbilical termination assemblies. The project has 31 in-line termination sleds that serve to anchor the ends of flowlines. Sleds are connected to the well tree by a 6- to 8-in diameter (15-20 cm) flexible connection called a jumper. Each sled has a bottom footprint of approximately 700 ft^2 (65 m^2). Seventeen subsea umbilical termination assemblies house the hydraulic and electrical systems of the umbilical system. Umbilical termination assemblies are relay stations for the umbilical system that remotely control production from each well. Umbilicals hold electrical wiring and tubing that contains various chemical agents and amendments for the well and flowlines; for example, agents to reduce formation of gas hydrates in flowlines. Each termination assembly has a bottom footprint of approximately 700 ft^2 (65 m^2).

1.3.3. Pipelines

Independence Hub LLC will design, construct, install, and own Independence Trail, a new 24-in-diameter (61 cm) export trunk line from the Hub to a junction platform in West Delta Block 68. Pipelines are the primary method used to transport liquid and gaseous hydrocarbon products between OCS production sites and onshore facilities. Hydrocarbon products include unprocessed mixtures of oil, gas, and condensate; processed oil, gas, and condensate; produced water; methanol or ethylene glycol (antifreeze); and a variety of chemicals used by the OCS industry offshore for flow assurance. The approximately 176 mi (281 km) of 8- to 10-in diameter (20-25 cm) lines are gathering flowlines that connect subsea wellheads from the nine gas fields to the Hub facility.

The Independence Trail pipeline would be installed by GulfTerra Field Services from the Hub to a manned, 4-pile valve junction platform in West Delta Block 68 (Platform A). The approximately 135 mi (217 km) long, 24-in diameter (61 cm) export trunk line would route from the Hub in water 7,920 ft (2,414 m) deep to Platform A in water 114 ft (35 m) deep and carry both gas and condensate. No gas processing would take place on Platform A. From the junction platform Tennessee Gas would install two ROW pipelines to transport combined gas and condensate to shore. Pipeline segment No. 15033 is a short 24-in diameter (61 cm) pipeline segment that terminates at a tie-in point in Grand Isle Block 32 and from there goes to an existing valve platform in Louisiana State waters. The second segment (No. 15034) is a 24-in diameter (61 cm) pipeline that would cross the OCS boundary in West Delta Block 16 and continue to the valve platform in Louisiana State waters. At the valve platform the gas and condensate mixture routes through a single pipeline to Tennessee's central compression and separation facility located at Port Sulfur, Louisiana.

Regulatory processes and jurisdictional authority concerning pipelines on the OCS and in coastal areas are shared by Federal agencies. The MMS is responsible for regulatory oversight of the design, installation, and maintenance of OCS producer-operated oil and gas pipelines. The U.S. Dept. of Transportation (DOT) is responsible for establishing and enforcing design, construction, operation, and maintenance regulations, and for investigating accidents for all OCS transportation pipelines beginning downstream of the point at which operating responsibility transfers from a producing operator to a transporting operator. The MMS is responsible upstream of the transfer point.

For the Independence Hub, DOT is responsible for the Independence Trail export trunk line, whereas MMS is responsible for the gathering system of flowlines to carry the product from the wellheads to the Hub. The MMS evaluates the routes for potential seafloor or subsea geologic hazards and other natural or manmade seafloor or subsurface features or conditions (including other pipelines) that could have an adverse impact on the pipeline or that could be adversely impacted by the proposed operations. Routes are also evaluated for potential impacts on archaeological resources and biological communities. The design of the proposed pipeline is evaluated for (1) appropriate cathodic protection to inhibit corrosion, (2) external pipeline coating system to prolong service, (3) submersibility of the pipeline to ensure the pipeline remains on the seafloor irrespective of the product in it, (4) internal operating pressures, and (5) adequate provisions to protect pipelines at crossover points with other pipelines. Deepwater pipelines are emplaced in harsh conditions and endure high hydrostatic pressure, cold temperatures, and varying substrate consistencies. Conditions of low visibility and strong bottom currents can lead to difficulty during installation and maintenance.

Pipelines installed in water deeper than 200 ft (61 m) have no burial requirement, as would all of the gathering lines and most of the Independence Trail export trunk line. The method for installing deepwater trunk lines and gathering flowlines to the Hub is the J-lay method. Using a dynamically-positioned lay barge, lengths of pipe are joined to each other by welding or other means while supported in a vertical or near-vertical position by a tower. As more pipe lengths are added to the string, the string is lowered to the ocean floor. The configuration resembles a "J" in profile.

Pipelines installed in water depths less than 200 ft (61 m) are required to be buried to a depth of at least 3 ft (1 m) (30 CFR §250.1003). Pipeline burial reduces pipeline movement by high currents and storms, protects the pipeline from external damage from anchors and fishing gear, and reduces the chance of entanglement and equipment loss.

Twenty miles (32 km) of the Independence Trail from West Delta Block 91 to Platform A in West Delta Block 68 would be buried because water depth would be <200 ft (61 m). Use of a jetting sled is the typical method used to bury pipelines. Jetting sleds are mounted with high-pressure water jets and pulled along the seafloor behind the pipelaying barge. The water jets are directed downward to excavate a trench and the sled guides the pipeline into the trench. Jetting of sediment resuspends and disperses sediments over the otherwise undisturbed water bottom that flanks the jetted trench. The area covered by settled sediment and the thickness of the settled sediment depends upon variations in bottom topography, sediment density, and currents.

Pipeline decommissioning in deep water involves abandonment in place and requires an MMS review and approval process. Decommissioning plans are evaluated to ensure they will render the pipeline inert by plugging the ends to minimize the potential for the pipeline becoming a source of pollution and to minimize the likelihood that the decommissioned line will become an obstruction to other users of the OCS by filling it with water and burying the ends. An overview of OCS pipelines is provided in Cranswick (2001).

1.3.4. Well Completions and Workovers

The 21 wells expected to be put into production for the Independence Hub are being completed under initial or revised EP's. A DP drillship such as the *Deepwater Millennium* or equivalent would be deployed to complete 18 of the 21 wells. The three wells at the San Jacinto Field in DeSoto Canyon Block 618 could be completed with a moored semisubmersible drilling unit, the *Noble Amos Runner.*

A workover is a generic term for reentering an existing wellbore for a variety of purposes. These purposes include (1) completing a well to put it into first production, maintain production, or restore the productivity of the well; (2) evaluating a geologic formation or reservoir; or (3) plugging and abandoning a well. There are no new development wells to be drilled as part of this proposed action. There are 21 existing exploratory wells among the nine anchor gas fields. Temporary abandonment involves sealing the well by placing a 100-ft (30 m) plug of cement within the deepest casing string and another 100-ft (30 m) plug within 200 ft (61 m) of the mudline. Temporary abandonment most often occurs while waiting on design, construction, and installation of production equipment and facilities.

Well completion is the process of installing downhole equipment to allow production of oil or gas from hydrocarbon-bearing formations. Examples of completion activities include setting and cementing casing, perforating casing and surrounding cement, installing production tubing and packers, and gravel-packing the well. To complete each well the temporary cement plugs will have to be drilled through resulting in a small quantity of cement cuttings (15-50 bbl per well) on the seafloor.

Workovers subsequent to completing the well can be performed to stimulate or restore production and can include acidizing the perforated interval in the casing, setting plugs in the wellbore, resetting the gravel packs, or flooding the produced zone with liquid nitrogen. Workovers on subsea completions require that a rig be moved on location and can take from a few days to several months to complete, with an average of about 5-15 days. Historical data suggest that each producing well averages one workover operation about every 4 years (USEPA, 1993a and b). The final workover is permanent abandonment when equipment is removed from the well and specific intervals in the well are plugged with cement to prevent communication between downhole fluids and shallower layers or the sea bottom. Including workovers for initial completion and permanent plugging and abandonment, each of the 21 wells to be produced by the Independence Hub is expected to receive three additional workovers over the 20-year lifetime of the Hub, for a total of 105 workovers for the project.

1.3.5. Onshore Support Facilities and Transportation

The onshore support base at Port Fourchon, Louisiana, will serve as the port of debarkation for equipment, supplies, and crews for well completion operations. Port Fourchon lies approximately 150 mi (241 km) northwest of Mississippi Canyon Block 920. The designated backup onshore support base at Venice, Louisiana, lies 160 mi (257 km) northwest of Block 920 (Figure 1-3). Both bases are capable of providing the services necessary for the proposed activity. Each base has 24-hour service; a radio tower and phone patch; dock space; indoor and outdoor equipment and supply storage space; forklift, crane, and docking services; tractor trailer parking; and drinking water supplies. Either base can serve as a loading point for the tools, equipment, machinery, completion chemicals, and crews needed for well completions and Hub infrastructure installation and operation. Venice, located in Plaquemines Parish, Louisiana, experienced significant damage August 29, 2005, from Hurricane Katrina. The extent of this damage will likely exclude Venice as a support base during construction of the Hub.

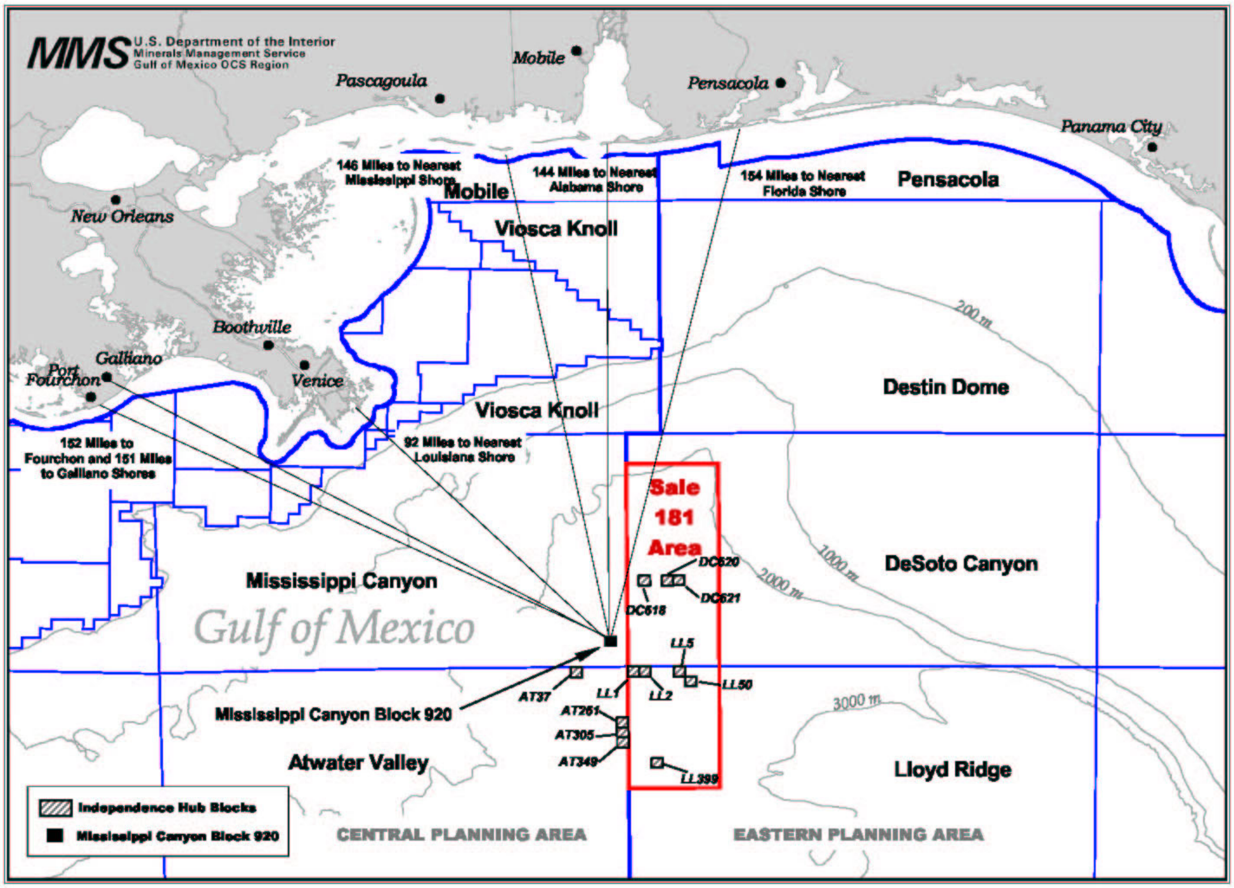


Figure 1-3. Distances from Independence Hub in Mississippi Canyon Block 920 to the Primary Shore Base at Port Fourchon and to the Nearest Shorelines. Block numbers for the nine anchor fields that will be produced by the Hub are shown (see also Figure 1-1).

The Hub pontoon structure was manufactured in Singapore; however, the topside facilities are being fabricated at the Kiewit Offshore Services yard in Ingleside, Texas. Approximately 400 people will be engaged between November 2004 and April 2006 building the superstructure for the Hub, including piping pump rooms, compressors, separators, and living quarters.

Personal vehicles will be the main means of transportation to carry rig personnel from various locations to Ingleside and either Port Fourchon or Venice. Crews working offshore will then be transported to the drilling rig by the crewboat, and a supply boat will transport large or bulk supplies. Each boat will use the most practical and direct route to and from the Independence Hub permitted by weather and vessel traffic conditions. A helicopter will be used periodically to transport small supplies and personnel. The most practical and direct air route from the shore base permitted by the weather and traffic conditions will be used. About 30 people are estimated to have a direct or supporting role in crewing each of the following: (1) one supply boat; (2) one crewboat; (3) one Hub installation rig; or (4) one pipeline lay barge. Vessel crews will live on their respective vessels while working and will return to their temporary or permanent residences upon completion of each tour of duty.

Table 1-4 summarizes support-vessel travel frequency per week during the 16 months of well completion, Hub installation, subsea equipment installation, flowline tie backs, and testing, and during the subsequent 20 years of production.

Table 1-4

Support Vessel Travel Frequency for Stages of the Proposed Independence Hub Project

Vessel	Trips/Week (16 months hub installation, well completion, and pipeline installation)	Trips/Week (20 years production)
Crewboat	3	1
Supply boat	2	1
Helicopter	7	3

1.3.6. New or Unusual Technology

The APC identified two new and unusual technologies for use in the Independence Hub: (1) the use of 12 synthetic mooring lines to anchor the Hub production facility; and (2) the use of carbon rod technology in the dynamic section of the umbilicals. The MMS performed a review for deployment of new and unusual technologies (NUT).

The use of synthetic mooring lines has been reviewed in earlier NUT evaluations. For example, they are used on the largest producing operation currently in the GOM—British Petroleum's Thunderhorse platform. Polyester mooring lines or connections are no longer considered new or unusual by MMS. The MMS determined that their use does not affect the environment any differently than the steel mooring lines that they were designed to replace. The main advantage of the synthetic mooring lines is their lighter weight compared to that of steel lines. The MMS has required periodic testing of the synthetic lines to ensure their performance would not deteriorate over time as compared to the performance of steel mooring lines on development facilities.

The use of carbon rods in the dynamic section of umbilicals is a new deployment of this technology. The APC is proposing the use of carbon rods in lieu of steel rods in the cross-section of the umbilicals. Traditionally, steel rods have been used to provide additional strength to the umbilicals. The length of the umbilicals is the driving factor for proposing the use of carbon rods because of the water depth for all of the Hub's anchor gas fields. Tensions on the umbilicals will be high for the project. Steel rods have a weight-to-strength ratio that is a disadvantage when compared to carbon rods with similar strength. The carbon rods will augment the axial strength of the umbilicals without adding significant weight compared to the use of steel rods. The use of carbon rods to provide weight savings and to add axial strength to the dynamic portions of the umbilicals is not expected to affect the environment any differently than the use of traditional steel rods. The carbon rods will be contained within the 6-in (15 cm) cross-section of the umbilicals and they would not interact with the environment during their normal operation.

During decommissioning operations, that portion of the umbilicals above the seafloor would be required to be removed. The buried portion of the umbilicals would be removed or properly abandoned. If the subbottom portion of the umbilicals is abandoned "in place," its ends would have to be buried and covered to minimize interference with other uses of the OCS. These procedures are similar to those required for pipeline abandonment.

1.3.7. Decommissioning and Removal

The Independence Hub is expected to have a minimum production life of 20 years. When the Hub is no longer economically viable to operate, it will have to be decommissioned; the bottom moorings will be severed and removed along with the subsea production equipment installed on the sea bottom.

Under MMS operating regulations (30 CFR §250.1700) and lease agreements, all lessees must remove objects and obstructions from the seafloor upon termination of a lease. The MMS's NTL 2002-G08 (*Structure Removal Applications*) gives lessees directions on explosive and nonexplosive severing and removal of all obstructions (i.e., wellheads, casing stubs, platforms, mooring devices, etc.) to a depth at least 15 ft (4.5 m) below the seafloor. Additional requirements for clearing a platform or well site of potentially obstructing debris, and verification of clearance, are contained in NTL 98-26 (*Minimum Interim Requirements for Site Clearance (and Verification) of Abandoned Oil and Gas Structures in the Gulf of Mexico*) depending upon water depth and structure type. The NTL limits the operator to conducting stationary or towed, high-frequency (500 kHz) sonar verifications over a 300-ft (92 m) radius search area centered over the well site, and a 1,320-ft (707 m) radius centered on the platform geometric center (a fixed platform rather than a bottom-founded semisubmersible). The MMS requires lessees to submit a procedural plan for site clearance with a subsequent report on the results of their site clearance activities within 30 days of removal.

Coupled with the growing number of deepwater tension leg platforms and spars, operators have to contend with new demands for quick-disconnect and line-severing tools that may be necessary for emergencies or decommissioning operations. Some of the mooring systems used in deepwater operations have quick-disconnect technology built into their designs, using several varieties of exploding bolts, electromechanical couplings, and/or hydraulic-actuated connections; these release mechanisms are controlled from the surface. In situations where the mooring system disconnects are not used or become disabled, severing contractors have several mechanical and explosive cutting tools at their disposal for shearing cables, lines, and chains from their moorings.

For a nonexplosive severing, lessees/operators must notify the MMS at least 30 days prior to removal with a Sundry Notice detailing removal operations and well characteristics. If a well is to be removed with explosives, an application for a structure-removal permit must be submitted to the GOM Region, providing information that includes the following: (1) complete identification of the structure; (2) size of the structure (number and size of pilings); (3) removal technique to be employed (if explosives are to be used, (4) the amount and type of explosive per charge; and (5) the number and size of well conductors to be removed. The MMS would prepare a site-specific EA that analyzes impact of the decommissioning activities on physical, environmental, and socioeconomic resources.

The regulations for explosive removal of deepwater infrastructure are currently in flux. Because wells and bottom-founded production equipment is moving into deep and ultra-deepwater, there was a need to revisit technological changes and the potential impacts of the last analysis MMS performed in the late 1980's for removals at depths on the continental shelf (≤600 ft (183 m)). The MMS recently completed a programmatic EA for structural removal of OCS structures (USDOI, MMS, 2005a) and has used it as a basis to request NOAA Fisheries for a rulemaking for incidental take of protected marine mammals and sea turtles. By the time the Independence Hub is ready for decommissioning and removal, there will likely be new requirements in place to govern these activities.

Because all water depths are >2,625 ft (800 m) in Mississippi Canyon Block 920 as well as in all blocks where subsurface production hardware would be installed, OCS regulations offer operators the option to seek an "alternative removal depth request." The alternative is to avoid jetting (30 CFR §250.1716(b)(3)) sediment around bottom-founded structures to depths of 15 ft (4.5 m) and using explosives for severing (30 CFR §250.1728(b)(3)). Cuts above the mudline can be allowed with minor reporting requirements to MMS on the remnant's description and height above the seafloor. Industry representatives have indicated their intent to use the alternate removal depth option for removals >2,625 ft. (>800 m) depth and by use of quick-disconnect equipment (i.e., detachable risers, mooring disconnect systems, etc.) to fully abandon-in-place wellheads, casings, and other subsea equipment without the need to sever and remove the equipment. Expensive pieces of equipment, such as manifolds, may be recovered.

1.3.8. Potential Geological Hazards and H_2S Determination

The Independence Hub project does not require drilling of new wells. Existing wells were drilled under EP's for which MMS conducted a geological and geophysical review of the well sites and for which MMS made an H_2S determination in the approval process. No potential shallow geological hazards to drilling are therefore expected. The blocks encompassing the gas fields to be developed by the Independence Hub have all been cleared of H_2S by MMS in letters as shown in Table 1-5.

Table 1-5

Blocks Cleared of H_2S by MMS

Prospect	Current Operator	Protraction Area & Block #	MMS H_2S Finding	Date of Action
Atlas NW	Anadarko	Lloyd Ridge 5	Absent	November 11, 2002
Atlas	Anadarko	Lloyd Ridge 50	Absent	November 11, 2002
Spiderman	Anadarko	DeSoto Canyon 620, 621	Absent	May 9, 2003 & June 12, 2003
Cheyenne	Anadarko	Lloyd Ridge 399	Absent	April 28, 2005
San Jacinto	Dominion	DeSoto Canyon 618	Absent	July 28, 2004
Mondo NW	Anadarko	Lloyd Ridge 1, 2	Absent	No letter cited by date
Merganser	Kerr McGee	Atwater Valley 37	Absent	No letter cited by date
Vortex	Anadarko	Atwater Valley 261	Absent	September 9, 2002
Jubilee	Anadarko	Atwater Valley 305, 349	Absent	October 21, 2002

1.3.9. Offshore Discharges and Waste Disposal

The discharge of wastes into offshore waters is regulated by the U.S. Environmental Protection Agency (USEPA) under the authority of the Clean Water Act. No wastes generated during oil and gas operations can be discharged overboard unless they meet the requirements of the National Pollution Discharge Elimination System (NPDES) permit. All of the waste types generated from the proposed installation, production, and decommissioning of the Independence Hub will be either (1) discharged overboard in compliance with the NPDES requirements or (2) transported to shore for disposal in permitted or licensed commercial facilities or for recycling. The wastes for overboard discharge and transport to shore for recycling or disposal are summarized in Tables 1-6 and 1-7.

During the 16-month period of Hub installation, well completion, subsea equipment, and flowline installation, the wastes generated would consist of (1) small amounts of cement cuttings from overdrilling temporary plugs; (2) cement; (3) small amounts of drilling mud and well treatment, completion, and/or workover fluids (TCW) often with caustic soda additives; (4) chemically treated seawater or freshwater; (5) sanitary and domestic wastes; (6) deck drainage; (7) uncontaminated seawater used for cooling, desalinization, and ballast; and (8) solid trash and debris. Treating chemicals are typically used to stimulate well production, to assist product flow assurance, or to treat or prevent operational problems that may occur in the production process. Treating chemicals can generally be classified into three categories: production-treating chemicals, gas-processing chemicals, and stimulation and workover chemicals. Specialized TCW fluids are discharged overboard or recycled by the supplier and solid waste is transported to shore for disposal in licensed landfills.

During the 20-year production operation, volumetrically large overboard discharges would include (1) sanitary and domestic wastes; (2) deck drainage; (3) uncontaminated seawater used for cooling, desalinization, and ballast; and (4) produced water. Solid wastes taken to shore for disposal include trash and produced sand. Produced sand is entrained in the gas and condensate flow from the produced formations and would be transported to shore for land spreading.

Table 1-6

Wastes for Discharge Overboard from the Proposed Independence Hub During the Well Completion, Hub Installation, and 20-Year Production Phases

Type of Waste	Amount to be Discharged*	Maximum Discharge Rate	Treatment, Transport, and Disposal Method
Drilling mud	600 bbl/well	As produced	Discharge at seafloor
Cement cuttings	15 bbl/well	As produced	Discharge at seafloor
Seawater and caustic soda	8,000 bbl/well	As produced	Discharge at seafloor
Produced water	1,000 bbl/day	3,000 bbl/day	Treat and discharge Overboard
Sanitary wastes	20 gal/person/day	As produced	Chlorinate and discharge overboard
Domestic wastes	30 gal/person/day	As produced	Grind, remove floating solids and discharge overboard
Desalinization unit water	360 bbl/day	360 bbl/day	Discharge overboard
Uncontaminated fresh or seawater	1,190 bbl/day	As produced	Discharge overboard
Deck drainage**	90 bbl/day	As produced	Discharge overboard

* Expressed as a volume per well or rate.
** Daily average, peaks determined by precipitation

Table 1-7

Wastes for Transport to Shore from the Proposed Independence Hub During the Well Completion, Hub Installation, and 20-Year Production Phases

Type of Waste—Approximate Composition	Amount*	Name/Location of Disposal Facility	Treatment and/or Storage, Transport, and Disposal Method
Produced Sand	200 bbl/yr	New Park Transfer Station (Venice, LA)	Land spreading
Chemically Treated Seawater/ Freshwater—water to which chemical agents have been added	20 bbl/well	U.S. Liquids, Fourchon, LA, or Newpark Environmental Services, Fourchon, LA	Transport to shore base for pickup
Non-RCRA Exempt Solid Wastes—plastic, paper, aluminum, food refuse **	5 m^3/month	Galliano Waste Disposal, Galliano, LA, or Waste Management, Raceland, LA	Transport to shore base for pickup by municipal operations

* Expressed as a volume per well or rate.
** 1 m^3 = 6.3 bbl

Produced water from well testing and from the 20-year production period constitutes the largest single discharge from this proposed development. APC estimates approximately 1,000 bbl of produced water would be generated per day. As a general trend, the volume of produced water increases as oil fields age. Produced water (also known as production water or produced brine) is the total water evolved as a by-product of gas extraction. It is comprised of formation water, injection water, and small quantities of various dissolved chemicals and hydrocarbons. Produced water is mostly formation water (also called fossil or connate water) that exists in permeable rock formations in their natural state and that is brought to the surface commingled with oil and gas.

Produced waters can have high total solids in suspension (TSS), salinities, levels of organic carbon, metal content, and can be very low in dissolved oxygen. Because these waters are closely intermingled with liquid petroleum, they contain variable concentrations of dissolved and dispersed petroleum hydrocarbons and other soluble organic compounds particularly phenols and carboxylic organic acids (Neff, 1997) that are separated from hydrocarbon on the production platform. Predominantly dry gas production is anticipated from the Independence Hub project, and the amount of produced water is expected to be minimal until these fields begin to age. A variety of metals including toxic metals such as arsenic, cadmium, and copper have been found in some produced-water discharges. Table IV-8 in the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a) provides typical chemical concentrations that have been measured in GOM produced waters.

Produced water is disposed of by either overboard discharge or reinjection into geologic formations near the drilling site. The APC identifies overboard discharge as the disposal method for produced water. The USEPA's NPDES permit establishes limits for free oil in produced water as determined by the visual sheen test. Oil and grease is limited to <42 mg/l daily and 29 mg/l monthly average (USDOI, MMS, 2001a; Table IV-9).

Routine sanitary and domestic wastes necessarily arise from people working offshore on drilling rigs, production platforms, and support vessels. The MMS estimated that 20 gal/person/day of sanitary waste and 30 gal/person/day of domestic waste would be discharged from the Hub. Estimates of the amounts of sanitary and domestic wastes discharged from associated service-vessel operations were not provided by APC but are generally estimated to be 60 gal/person/day (NERBC, 1976).

Deck drainage effluent is primarily rainwater containing residual oil and grease from equipment washwater and rainwater. Overboard discharge of deck drainage is governed by the NPDES permit requirement for no visible oil sheen. Water-based drilling mud would be used to complete the wells when the temporary cement plugs would be drilled through. The TCW fluids such as caustic soda are typically used to initially stimulate the wells for production.

1.4. REGULATORY FRAMEWORK

Federal laws mandate the OCS leasing program and the environmental reviews for the actions proposed by operators that seek to explore and produce hydrocarbons from Federal waters. An explanation of applicable statutes and regulations that comprise the regulatory framework for OCS activity, and this proposed action is contained in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 1.3), or the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 1.3) and is incorporated into this SEA by reference.

1.4.1. Military Warning Areas

The airspace over the Eastern Gulf has been divided up into military warning areas to accommodate operations at Eglin Air Force Base (AFB) in Florida (USDOI, MMS, 2003a; Figure 2-1)(USDOI, MMS, 2003b; Figure 2-1). Three mitigation measures to help reduce potential conflicts between military and OCS oil and gas activities are included in the proposed action in the form of lease stipulations. Mitigation measures in the form of stipulations are added to the lease terms and are therefore enforceable as part of the lease. The three stipulations were evaluated in the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a), and are summarized below.

The mitigation measures included in the proposed action were developed as a result of scoping efforts over a number of years for the continuing OCS Program in the GOM and from specific consultation and coordination with the Department of Defense (DOD) for Lease Sale 181, the first opportunity for leasing in the EPA for many years. It is expected that these measures will serve to eliminate dangerous conflicts between oil and gas operations and military operations in the EPA, thus allowing multiple uses of the OCS for activities of great importance to the national interest to take place without risk to either.

The Independence Hub in Mississippi Canyon Block 920 is on the western edge but within EWTA-3. The blocks to be produced from among the nine anchor gas fields are within either ETWA-1 or EWTA-3 with the exception of Atwater Valley Block 37 (Merganser). Although there will be no permanent surface facilities associated with any produced blocks, a completion rig will be on station in each block at times between April 2006 and July 2007 while wells are completed, subsea production equipment installed, and connecting flowlines emplaced. Table 1-8 shows OCS protraction areas, blocks, and associated military warning areas.

Table 1-8

OCS Protraction Areas, Blocks, and Associated Military Warning Areas

Gas Field	OCS Protraction Area and Block	Eglin Water Test Area
Atlas Northwest	Lloyd Ridge 5	EWTA-3
Atlas	Lloyd Ridge 50	EWTA-3
Spiderman	DeSoto Canyon 620 and 621	EWTA-1
Cheyenne	Lloyd Ridge 399	EWTA-3
San Jacinto	DeSoto Canyon 618	EWTA-1
Mondo Northwest	Lloyd Ridge 1and 2	EWTA-3
Vortex	Atwater Valley 261	EWTA-3
Jubilee	Atwater Valley 305 and 349	EWTA-3

1.4.1.1. Hold and Save Harmless, Electromagnetic Emissions, and Operational Restrictions

A standard military warning area stipulation has been applied to all blocks leased in military areas in the GOM since 1977. This stipulation for the EPA is applied to all blocks leased within a warning or water test area. The stipulation was applied to blocks in warning areas in past lease sales in the EPA and is considered by the DOI and DOD to be an effective method of mitigating potential multiple-use conflicts. The text of the stipulation is provided on page II-25 of the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a) or on page 2-19 of the EPA Multisale Final EIS (USDOI, MMS, 2003a).

1.4.1.2. Evacuation Stipulation for the Eglin Water Test Areas

This stipulation, restricting oil and gas activities in the Eglin Water Test Areas (EWTA) (USDOI, MMS, 2003a; Figure 2-1), was developed in close coordination with Air Armament Center (AAC) personnel at Eglin AFB. The stipulation is designed to prevent space-use conflicts between the oil and gas industry and DOD operations in the Eastern Gulf. Air Force operations staged from Eglin AFB and Tyndall AFB in Florida make extensive use of the airspace over the Eastern Gulf. These uses include equipment and weapons testing, which results in debris of varying size that fall into the Gulf. Falling debris can range in size and weigh from several kilograms to several tons. Shipping is warned of such tests and is cleared from the Gulf, and commercial and private air traffic is routed away from the testing areas. In addition, mishaps can occur during routine training missions, resulting in debris hitting the water. The text of the stipulation is provided on pages II-27 and II-28 of the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a) or on page 2-20 of the EPA Multisale Final EIS (USDOI, MMS, 2003a).

1.4.1.3. Coordination and Consultation Stipulation for Exploration Activities in Eglin Water Test Areas

This stipulation, requiring close coordination between DOD and MMS for oil and gas activities in the EWTA's, was developed by MMS and AAC personnel at Eglin AFB. This stipulation would be applied to any lease resulting from Sale 181 that also receives the Evacuation Stipulation. The text of the stipulation is provided on pages II-28 and II-29 of the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a) or on page 2-21 of the EPA Multisale Final EIS (USDOI, MMS, 2003a).

1.4.2. Notices to Lessees

Notices to Lessees and Operators (NTL) 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 communicate administrative information. The most current versions of NTL's can be accessed from the MMS website (USDOI, MMS, 2005b). The NTL's that pertain to this proposed action are itemized here and their relevance is explained in subsequent sections.

The NTL 2005-G07 (*Archaeological Resource Surveys and Reports)* was effective July 1, 2005. The purpose of this NTL is to establish the need for, and requirements of, sea-bottom archaeological resource surveys and reports

The NTL 2005-G10 (*Revisions to the List of OCS Lease Blocks Requiring Archaeological Resource Surveys and Reports*) effective July 1, 2005. This NTL requires an archaeological survey and assessment for all lease blocks in the Mississippi Canyon Area of the Central Gulf.

The NTL 2004-G02 (*Military Warning and Water Test Areas*) was effective January 27, 2004. This NTL provides the most current website links to the addresses and telephone numbers of the individual command headquarters for GOM military warning and water test areas.

The NTL 2003-G17 (*Guidance for Submitting Exploration Plans and Development Operations Coordination Documents*) was effective August 27, 2003. The purpose of this NTL is to provide guidance on preparing EP's and DOCD's that are required by 30 CFR §250, Subpart B. The format and content requirements for these plans are established.

The NTL 2000-G20 (*Deepwater Chemosynthetic Communities*) was effective December 6, 2000. The purpose of this NTL is to provide a consistent and comprehensive approach to protecting high-density chemosynthetic communities from damage caused by oil and gas activities. Setback distances for known or suspected chemosynthetic communities and drill cuttings discharge outfalls or sea-bottom disturbances are established.

The NTL 2002-G15 (*Coastal Zone Management Program Requirements for OCS ROW Pipeline Applications*) was effective December 20, 2002. The purpose of this NTL is to implement Subpart D of 15 CFR 930 that sets forth specific requirements for Federal consistency provisions of the CZMA for activities requiring Federal licenses and permits and defines the responsibilities of applicants, MMS, and affected States

The NTL 2002-G09 (*Regional and Subregional Oil Spill Response Plans*) was effective October 1, 2002. The purpose of this NTL is to provide for subregional Oil Spill Response Plans (OSRP's) in the Eastern Planning Area of the GOM and their content.

The NTL 2003-G03 (*Remotely Operated Vehicle Surveys in Deepwater*) was effective January 23, 2003. The purpose of this NTL is to require remotely operated vehicle (ROV) surveys in the sale area of the EPA and reports when activities are planned in deepwater areas greater than 400 m depth that may have localized impacts on benthic communities.

The NTL 2003-G06 (*Marine Trash and Debris Awareness and Elimination*) was effective February 15, 2003. The purpose of this NTL is to help mitigate the potential threat that trash and debris pose to marine mammals, fish, sea turtles, and other marine animals.

The NTL 2003-G07 (*Vessel Strike Avoidance and Injured/Dead Protected Species Reporting*) was effective February 15, 2003. The purpose of this NTL is to establish the requirements of the marine observer program to help avoid collisions between vessels and marine mammals.

The NTL 2001-G08 (*Structure Removal Applications*) was effective October 9, 2001. The purpose of this NTL is to amend MMS policy for the explosive removal of well casings and casing stubs, production platforms, well jackets, single-well caissons, and pipeline accessory platforms based on recent Federal requirements for protecting endangered and threatened species or marine mammals and sea turtles.

The NTL 98-26 (*Minimum Interim Requirements for Site Clearance (and Verification) of Abandoned Oil and Gas Structures in the Gulf of Mexico*) was effective November 30, 1998. The purpose of this NTL is to establish parameters for removal of property on termination of leases and for clearance of bottom debris so as not to conflict with other uses of the OCS.

1.5. SUMMARY OF IMPACTS

Impacts on physical, biological, socioeconomic, and human resources for completion of 21 existing exploration wells and installation, operation, and decommissioning of (1) the Independence Hub, (2) all subsea production equipment, (3) approximately 281 mi (452 km) of gathering flowlines and umbilicals, and (4) approximately 135 mi (217 km) of Independence Trail export trunk line and junction platform are expected to be minimal to insignificant.

Insignificant impacts on air quality are expected. The Independence Hub would be located >125 mi (200 km) from the Breton National Wilderness Area, a Prevention of Significant Deterioration (PSD) Class I area. Hub emissions are too far from shore to affect air quality onshore to any measurable degree and all coastal counties are currently in attainment for ozone concentration.

Insignificant impacts on water quality are expected. The Hub would be located in water approximately 8,000 ft (2,438 m) deep and no closer than 92 mi (148 km) to the nearest land in Plaquemines Parish, Louisiana. Waste streams and overboard discharges are expected to be continuous but within permit limits. Dilution factors at this depth and distance from shore are tremendous. No accidental hydrocarbon spills are expected because the hydrocarbon produced is predominantly natural gas, with minor condensate. A spill of diesel fuel or gas treating chemicals from the Hub or from service vessel transfers is possible. If a spill occurred at all it would be expected at quantities within the historical norms for rigs and service vessels at sea (10-100 bbl).

Insignificant impacts are expected on coastal and offshore biological resources such as beaches, seagrass communities, wetlands, marine mammals, sea turtles, coastal and marine birds, fish, and essential fish habitat. No takes of species listed under the Endangered Species Act (ESA) among these groups are expected or would be within NOAA Fisheries incidental take limits.

Adverse but insignificant impacts on soft-bottom benthic communities are expected. Bottom disturbances would be caused by emplacement of Hub anchor pilings and mooring lines, the Independence Trail 24-in diameter export trunk line, subsea production templates, manifolds, horizontal wellheads, umbilicals and umbilical termination assemblies, and flowlines and line termination sleds. Bottom disturbance would range from crushing or burial of infauna and epifauna by bottom-founded infrastructure to minor bottom perturbations and sediment resuspension that would temporarily impact bottom habitats. The extent of bottom impacts will depend on the type of bottom-mooring system chosen by Dominion Exploration and Production Inc. to complete the three wells at the San Jacinto development in DeSoto Canyon Block 618. Vast undisturbed and ecologically equivalent benthic habitats are available in adjacent areas and would serve as potential recruitment sites for fauna migrating to impacted areas.

No impacts on chemosynthetic faunas are expected because no geophysical signatures of chemosynthetic communities or hard-ground substrates are present. The well sites were cleared in the surveys made during MMS approvals for the operator's EP's. Shallow-bottom surveys have not detected these features along pipeline routes for the gathering flowlines and umbilicals between wellheads and the Hub or along the Independence Trail trunk line route.

No significant impacts are expected on socioeconomic and human resources such as commercial or recreational fishing, archaeological resources, coastal infrastructure, navigation and port usage, recreational resources, area demographics, employment levels or economic activity, and existing equities of environmental justice. Approximately 800 people will be employed by the total Hub project during the peak construction years of 2005 through early 2007. Four hundred people would be employed at the Kiewit Offshore Services yard at Ingleside, Texas, building the Hub topside facilities over 18 months. The direct expenditures of the building activity and the indirect expenditures by full-time employees on the project payroll and their dependents involved in this construction would cause a relatively minor and temporary stimulation of economic activity and temporary and permanent housing demand in the Corpus Christi area in proximity to the Kiewit yard. Coastal infrastructure and port activity in Louisiana would experience greater use. The direct and indirect economic impacts from materials purchases and employment of a 40-person crew for the Hub facility and the people needed to crew supply and crewboats, completion rigs, and pipeline lay barges are expected to be relatively small and would stimulate the local economies where these activities are based to a very slight degree.

2. ALTERNATIVES TO THE PROPOSED ACTION

2.1. NONAPPROVAL OF THE PROPOSAL

The APC would not be allowed to complete the Independence Hub development and produce from the nine gas fields in the CPA and EPA as proposed. This alternative would result in no impacts from the proposed action because no action would take place, but could preclude the development of much needed hydrocarbon resources from a known discovery, and thereby result in a loss of royalty income for the U.S. and energy for American citizens. In addition, it is entirely likely that if these gas fields are not produced as part of a string of discoveries they may individually be abandoned because the cost of producing any single discovery would be uneconomic for the operator. Considering these aspects and the fact that MMS anticipates minor environmental and human impacts resulting from the proposed action, this alternative was not selected for further analysis.

2.2. APPROVAL OF THE PROPOSAL WITH EXISTING AND/OR ADDED MITIGATION

The MMS's lease stipulations, OCS Operating Regulations, Notices to Lessees and Operators, and other regulations and laws were identified throughout this environmental assessment as existing mitigation to minimize potential environmental effects associated with the proposed action. Additional mitigations are described below. This alternative was selected for evaluation in this PEA.

2.2.1. Mitigations

2.2.1.1. Mitigation 3.04—Multiple Sidescan-Sonar Targets

Our review indicates that the proposed pipeline route is in the vicinity of the unidentified sidescan-sonar targets listed in an enclosure, features that may represent significant archaeological resources. In accordance with 30 CFR 250.194(b), you will either (1) conduct an underwater archaeological investigation prior to commencing construction activities to determine whether these features represent archaeological resources or (2) ensure that all seafloor disturbing actions avoid the unidentified features by a distance greater than that listed in the enclosure. Submit lay barge anchor position plats, at a scale of 1 in = 1,000 ft with dynamic global positioning system (DGPS) accuracy, with your pipeline construction report required by 30 CFR 250.1008(b) that demonstrate that the features were not physically impacted by the construction activities. (Applicable to P-15099 and P-15100)

2.2.1.2. Mitigation 3.04—Multiple Magnetic Anomalies and Sidescan-Sonar Targets

Our review indicates that the proposed pipeline route is in the vicinity of the unidentified magnetic anomalies and sidescan-sonar targets listed in an enclosure, features that may represent significant archaeological resources. In accordance with 30 CFR 250.194(b), you will either (1) conduct an underwater archaeological investigation prior to commencing construction activities to determine whether these features represent archaeological resources or (2) ensure that all seafloor disturbing actions avoid the unidentified features by a distance greater than that listed in the enclosure. Submit lay barge anchor position plats, at a scale of 1 in = 1,000 ft with dynamic global positioning system (DGPS) accuracy, with your pipeline construction report required by 30 CFR 250.1008(b) that demonstrate that the features were not physically impacted by the construction activities. (Applicable to P-15153)

2.2.1.3. Mitigation 3.05—Single Sidescan-Sonar Target

Our review of your application indicates that the proposed pipeline route is in the vicinity of the unidentified sidescan-sonar target listed in an enclosure, a feature that may represent a significant archaeological resource. In accordance with 30 CFR 250.194(b), you will either (1) conduct an underwater archaeological investigation prior to commencing construction activities to determine whether this feature represents an archaeological resource or (2) ensure that all seafloor disturbing actions required by pipeline construction avoid the unidentified feature by a distance greater than that listed in the Enclosure. Submit lay barge anchor position plats, at a scale of 1 in = 1,000 ft with DGPS accuracy, with your pipeline construction report required by 30 CFR 250.1008(b) that demonstrate that the feature was not physically impacted by the construction activities. (Applicable to P-15149, P-15152, and P-15166)

2.2.1.4. Mitigation 4.01—Artificial Reef Notification—Louisiana

Your proposed operations are located within 500 ft (152 m) of an artificial reef site or an artificial reef permit area established by the State of Louisiana. Prior to conducting operations (including the use of anchors, anchor chains, and wire ropes) that could disturb the seafloor within 500 ft (152 m) of an artificial reef site or an artificial reef permit area, contact the Louisiana Artificial Reef Coordinator (Rick Kasprzack at (225)765-2375) to ensure that your operations do not damage reefal material. (Applicable to P-15153)

2.2.1.5. Mitigation 6.05—Coastal Zone Concurrence—Florida

Drilling permits cannot be issued for the proposed wells until concurrence with your coastal zone management consistency certification has been received by this office from the Florida Department of Environmental Protection or until concurrence with the certification has been conclusively presumed. (Applicable to N-8385, N-8407, N-8415, and N-8458)

3. DESCRIPTION OF THE AFFECTED RESOURCES

Chapter 3 describes the physical, biological, socioeconomic, and human resources that could be potentially affected by installation, production, and decommissioning activities for the proposed Independence Hub project. The descriptions present environmental resources as they are now, thus providing baseline information for the analyses in Chapter 4 where potential impacts from the Hub project in Mississippi Canyon Block 920 are examined.

3.1. PHYSICAL RESOURCES

Descriptions of the (1) geologic and geographic setting; (2) physical oceanography; (3) meteorological conditions; and (4) existing OCS-related infrastructure are contained in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Appendix 9.1), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Appendix A), the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Appendix A), and the PEA for exploration in the EPA (USDOI, MMS, 2003b; Appendix A).

These sources are incorporated into this SEA by reference where appropriate. Summaries of affected physical resources follow and include water quality and air quality.

3.1.1. Water Quality

Water quality is discussed in this SEA as either coastal or offshore. Coastal waters extend seaward from shore approximately 3 mi (4.8 km) corresponding to the boundary between State waters and the Federal OCS. The continental shelf is generally recognized to extend seaward to a depth of ≤600 ft (183 m). Offshore includes the continental shelf, slope, deepwater (≥1,000 ft (305 m)), and ultra-deepwater (≥5,000 ft (1,525 m)).

3.1.1.1. Coastal Waters

Coastal water quality along Louisiana is relevant to the Independence Hub insofar as service vessels will traverse these waters to and from support bases and this project in ultra-deepwater. The bays, estuaries, and nearshore coastal waters of the north-central Gulf are highly important to coastal ecosystems in that they provide important feeding, breeding, and/or nursery habitat for many commercially important invertebrates and fishes, as well as sea turtles, birds, and marine mammals. Water quality governs the suitability of these waters for animal as well as human use. Furthermore, the egg, larval, and juvenile stages of marine biota dependent upon these coastal areas are typically more sensitive to degraded water quality than adult stages.

A comprehensive assessment of water quality in the coastal and estuarine areas of the GOM is contained in the USEPA's estuarine report (USEPA, 1999a). Estuaries were classified primarily by aquatic life support, fish consumption, or recreation and whether or not they are fully, partially, or not supportive of these uses. Of the 78 percent of Gulf estuaries that were surveyed, 35 percent of the surveyed estuaries were designated as impaired in their ability to support one or more of these uses. Impairment factors include pathogen indicators (e.g., fecal coliform) and eutrophication indicators (e.g., nutrients, organic enrichment, and low dissolved oxygen). The first USEPA National Coastal Condition Report summarized coastal conditions with data collected from 1990-1996 (USEPA, 2001a). The USEPA has updated this information in a second report (USEPA, 2004). The GOM coastal area was rated fair to poor in the first report. The primary reasons for this rating were the areal extent of contaminated sediments, wetland losses, poor benthic conditions, and the high expression of eutrophic condition. The ranking method was changed between reports, so comparisons are difficult.

The second report ranked the water quality index and the overall condition fair. The ranking used (1) dissolved oxygen, (2) dissolved inorganic nitrogen, (3) dissolved inorganic phosphorus, (4) chlorophyll *a*, and (5) water clarity. Estuaries with a poor water-quality rating comprised 9 percent of the Gulf Coast estuaries while those ranked fair to poor comprised 51 percent. In Texas and Louisiana, the estuaries that received a poor water-quality rating in the report had low water clarity and high dissolved inorganic phosphorus levels in comparison to those expected for that region. The factors that contributed to a poor water-quality rating in Florida and Mississippi estuaries were low water clarity and high chlorophyll relative to expected levels. Chlorophyll is one of several symptoms of eutrophic conditions. Dissolved oxygen levels in Gulf Coast estuaries are good, and less than 1 percent of bottom waters exhibit hypoxia (dissolved oxygen level below 2 milligrams per liter (mg/L)).

A large area of the nation contributes to coastal water quality conditions in the Gulf because drainage from more than 55 percent of the conterminous U.S. enters the GOM primarily from the Mississippi River. Urban storm-water runoff is the leading source of contaminants that impair coastal water quality. The runoff flows across paved or impervious surfaces and is more likely to transport contaminants including suspended solids, heavy metals and pesticides, oil and grease, and nutrients (U.S. Commission on Ocean Policy, 2004). Other contaminant sources include (1) agricultural runoff, (2) municipal point sources, (3) land fill leachate, (4) hydromodification, (5) petrochemical plants and refineries, (6) power plants, (7) pulp and paper mills, (8) fish or livestock processors, (9) nonrefinery industrial discharge, and (10) shipping. Hydromodification includes dredging and spoil disposal; channelization (channel straightening); dam, levee, or floodgate construction; and river bank and shoreline modifications that change river flow patterns or sediment load.

The National Research Council (NRC) (2003; Table I-4) estimated that 942 metric tons of oil/yr (about 6,600 bbl/yr) entered Gulf waters from petrochemical and oil refinery industries in Louisiana. Further, the NRC (2003) calculated an estimate for oil and grease loads from all land-based sources per unit of urban land area for rivers entering the sea. The Mississippi River introduced approximately 525,600 metric tons of oil/yr (3.7 million bbl/yr) into the waters of the Gulf (NRC, 2003; Table I-9).

Vessels from the shipping and fishing industries, as well as recreational boaters, add contaminants to coastal water in the form of bilge water, liquid and solid waste, spills, and chemicals leached from antifouling paints. Many millions of cubic feet of sediments are moved each year in coastal areas as a result of channelization, dredging, spoil disposal, and other hydromodifications. Water quality may be affected by these activities because they can lead to saltwater intrusion, increased turbidity, and release of contaminants.

Nonpoint sources of contamination from urban and agricultural runoff are difficult to control and to regulate. Inland cities, farms, ranches, forests, and various industries drain into waterways that empty into the Gulf. About 80 percent of U.S. croplands lie upstream of the Gulf. Nutrient enrichment of river water from nitrogen and phosphorus fertilizers and compounds is another major contributing factor to water quality problems. It can lead to noxious algal blooms, reduced seagrasses, fish kills, and oxygen depletion. The Gulf coastal area alone used 10 million pounds of pesticides in 1987 (USDOC, NOAA, 1992).

Water quality in coastal waters of the northern GOM is highly influenced by season. For example, salinity in open water near the coast may vary between 29 and 32 parts per thousand (ppt) during fall and winter but decline to 20 ppt during spring and summer due to increased runoff (USDOI, MMS, 2000; page III-9). Oxygen and nutrient concentrations also vary seasonally. Sediment contamination in U.S. coastal waters is related to proximity to large industrialized cities. High levels of certain contaminants have been reported for all Gulf State waters (O'Connor and Beliaeff, 1995). Cadmium, copper, and zinc increases have been noted in mollusks at eight sites between Pascagoula Bay, Mississippi, and the Mississippi River.

Coastal water quality is further characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.1.2.1), in the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 3.1.2.1), in the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Chapter III-B.2.a), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 3.2.2.1). These discussions are incorporated into this SEA by reference.

3.1.1.2. Offshore Waters

The water offshore of the Louisiana coast can be divided into two regions: the continental shelf and the slope west of the Mississippi River (<1,000 ft (305 m) deep) and deep water (>305 m). The continental shelf off the modern Mississippi River Delta is narrow because the birdfoot delta platform has built out across the shelf. To the west of the river the shelf broadens and is about 100 mi (160 km) wide in western Louisiana. Waters on the continental shelf and slope are heavily influenced by the Mississippi and Atchafalaya Rivers, the primary sources of freshwater, sediment, and pollutants from a huge drainage basin (Murray, 1998). Lower salinities are characteristic on the continental shelf and inshore where freshwater from these rivers mixes with Gulf waters. While the average discharge from the Mississippi River exceeds the input of all other rivers along the Texas-Louisiana coast by a factor of 10; during low-flow periods the Mississippi River can have a flow less than all these rivers combined (Nowlin et al., 1998).

A seasonal zone of hypoxia on the Louisiana-Texas shelf is one of the largest areas of low oxygen in the world's coastal waters (Murray, 1998). Hypoxic conditions are caused by a seasonally stratified water column. Stratification occurs during the summer months when Mississippi River discharge tends to be lower. The less dense, generally warmer, and low-salinity water from the river "floats" on top of denser, more saline water on the shelf and creates a stratified water column. High nutrient loads in the river water enhance algae and plankton production and increases the amount of decaying organic matter accumulating at the sea bottom. Decay depletes oxygen in bottom waters to the point of hypoxia (<2 mg/l dissolved oxygen) while the oxygen content of near-surface water is at or near to saturation. The hypoxic oxygen levels are low enough to affect the abundance, health, and vitality of soft-bottom invertebrate faunas and bottom-dwelling fish. Under severe or prolonged conditions it can kill off bottom faunas. Hypoxic conditions last until local wind-driven circulation mixes the water column. The hypoxic zone increased from an average size of 8,300 km^2 in 1985-1992 to over 16,000 km^2 in 1993-1997 and reached a record 22,000 km^2 in 2002 (Rabalais, 2005). Increased nutrient loading in the Mississippi and Atchafalaya River systems since the turn of the 19th century correlates with the increased magnitude and frequency of hypoxic events (Eadie et al., 1992) and support the interpretation that hypoxia zones are related to nutrient input into the GOM.

The presence or extent of a nepheloid layer at the sea bottom affects water quality on the shelf and slope. A nepheloid layer is a variably thick layer of suspended clay-sized particles on the ocean bottom that may play a role in transporting fine-grained sediment and contaminants from near shore to offshore waters. The nepheloid layer can be thin and near-bottom, or very thick depending on factors such as water depth, depth of water column mixing, bottom currents, season, and sediment input. Freshwater from the Mississippi/Atchafalaya River systems may carry trace amounts of organic pollutants including polynuclear aromatic hydrocarbons (PAH); herbicides such as atrazine, chlorinated pesticides, and polychlorinated biphenyls (PCB's); and trace inorganic (metals) pollutants.

The concentration of hydrocarbons in slope sediments (except in seep areas) is lower than concentrations reported for shelf and coastal sediments (Gallaway et al., 2003). No consistent decrease with increasing water depth is apparent below 1,000 ft (305 m). In general, the Central Gulf has higher levels of hydrocarbons in sediment, particularly those from terrestrial sources, than the Western and Eastern Gulf (Gallaway and Kennicutt, 1988). Total organic carbon is also highest in the Central Gulf. Hydrocarbons in sediments have been determined to influence biological communities of the Gulf slope, even when present in trace amounts (Gallaway and Kennicutt, 1988).

Hydrocarbon seeps are extensive throughout the continental slope and contribute hydrocarbons to the surface sediments and water column, especially in the Central Gulf (Sassen et al., 1993a and b). Natural hydrocarbon seepage is considered to be a major source of petroleum into Gulf slope waters (Kennicutt et al., 1987; Gallaway et al., 2003), and the NRC (2003) considers seeps to be the predominant source. MacDonald et al. (1993) observed 63 individual seeps using remote-sensing and submarine observations.

The NRC (2003; page 191) reported that estimates of the total volume of seeping oil in the GOM vary widely from 28,000 bbl/yr reported by MacDonald (1998) to a range of between 280,000 and 700,000 bbl/yr (Mitchell et al., 1999). The NRC's best estimate is an annual input of 980,000 bbl/yr for the entire Gulf (NRC, 2003; page 191). This quantity is four times the volume of the *Exxon Valdez* spill per year, which was estimated to have been 260,000 bbl (NRC, 2003; page 14)). Clearly, natural seeps account for a large quantity of oil that enters Gulf waters each year from a phenomena occurring over geologic time scales. Seep oil is a natural component of Gulf water, and oil in the water is called a pollutant or contaminant only when introduced in large quantities in a small area over a short period of time.

In addition to hydrocarbon seeps, other fluids leak from the underlying sediments into the bottom water along the slope, among them: (1) seawater trapped during the settling of sediments; (2) brine from dissolution of underlying salt diapirs; and (3) deep-seated formation waters (Fu and Aharon, 1998; Aharon et al., 2001). The first two fluids are the source of carbonate for hardground deposits while the third is rich in barium and is the source of barite deposits in chimneys.

Produced water (formation water) is the volumetrically largest waste stream from the oil and gas industry that enters Gulf waters. Produced water is commonly treated to separate free oil and either injected back into the reservoir or discharged overboard according to NPDES permit limits (see Chapter 1.3.9). The NRC has estimated the quantity of oil in produced water entering the Gulf per year to be 473,000 bbl (NRC, 2003; Table D-8).

The Independence Hub project is entirely in ultra-deepwater for which limited information is available on water quality. Generally, the water quality in deepwater is considered significantly better than that of the coastal waters (USDOI, MMS, 2002) by virtue of dilution and distance from pollution sources. Water at depths >8,000 ft (2,438 m) is relatively homogeneous with respect to temperature, salinity, and oxygen (Nowlin, 1972; Pequegnat, 1983; Gallaway et al., 1988). Waters offshore Texas, Louisiana, and Alabama show detectable levels of petroleum hydrocarbons, likely from natural seeps (USDOI, MMS, 1997 and 2000). Pequegnat (1983) pointed out the importance of water column mixing and flush time for the GOM. Oxygen in deep water must originate from the surface and be mixed into deep water by some mechanism, but the time for turnover or the mechanism by which oxygen replenishment takes place in the deep GOM is essentially unknown.

Deepwater sediments, with the exception of barium concentrations in the vicinity of previous drilling, have not been documented to show elevated levels of metal contaminants (USDOI, MMS, 1997 and 2000). Total hydrocarbons, including biogenic hydrocarbons (e.g., from plankton and other biological sources) reported in sediments collected from the Gulf slope range from 5 to 86 ng/g (Kennicutt et al., 1987). Petroleum hydrocarbons including aromatic hydrocarbons (<5 ppb) were present at all sites sampled.

Surface ships of all types generate significant waste streams, some of which is permitted for discharge into the sea. Among these ship types are (1) tankers, (2) freighters and container ships, (3) cruise ships, (4) Navy and Coast Guard vessels, (5) commercial fishing boats, (6) recreational power boats, and (7) oil and gas service boats and crewboats. The wastes generated by these vessels are similar to those generated by offshore oil and gas platforms. Among these wastes are (1) uncontaminated sea water used for ship ballast and air conditioning; (2) briny water from desalinization units; (3) bilge water; (4) deck drainage; (5) sewage (blackwater) and domestic waste from galleys, sinks, and showers (graywater); (6) solid trash and debris; and (7) small quantities of machine oil, paints, solvents, and other chemicals.

The crew size of most commercial vessels is small, typically <100 people. In contrast, cruise ships are small floating cities, along with large Naval vessels, and have large sanitary and domestic waste discharges because they carry large passenger and crew loads. On a one-week voyage a 3,000-passenger cruise ship generates about 210,000 gal of sewage, 1,000,000 gal of graywater (Schmidt and Long, 2000), 37,000 gal of oily bilge water (POC, 2003), more than 8 tons of solid waste (Holland America, 2005), and millions of gallons of ballast water. Potentially invasive species (USEPA, 2001b) can reside in ballast water and holding tanks, and toxic wastes can originate from onboard dry cleaning services and photo-processing laboratories.

Offshore water quality is further characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.1.2.2), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 3.1.2.2), the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Chapter III-B.2.b), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 3.2.2.2). These discussions are incorporated into this SEA by reference.

3.1.2. Air Quality

The Independence Hub project is located west of 87.5° W. longitude and hence falls under the MMS's jurisdiction for enforcement of the Clean Air Act. The air over the OCS water is not classified, but it is presumed to be better than the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants. The Independence Hub project in Mississippi Canyon Block 920 is located approximately 92 mi (148 km) southeast of Plaquemines Parish, Louisiana, an area that is in attainment of all of the NAAQS and for Prevention of Significant Deterioration (PSD) purposes is classified as a Class II area.

The Hub's influence on onshore air quality is dependent upon meteorological conditions and air pollution emitted from operational activities. The pertinent meteorological conditions regarding air quality are (1) wind speed and direction, (2) atmospheric stability, and (3) mixing height (which govern the dispersion and transport of emissions). The typical synoptic wind flow for the area is driven by the clockwise circulation around the Bermuda High, resulting in a prevailing southeasterly to southerly flow, which is conducive to transporting emissions toward shore. However, superimposed upon this synoptic circulation are smaller meso-scale wind flow patterns, such as the land/sea breeze phenomenon. In addition, there are other synoptic scale patterns that occur periodically, namely tropical cyclones, and passage of mid-latitude frontal systems. Because of the routine occurrence of all of these various conditions, the winds blow from all directions in the area around the proposed Hub location (Florida A&M University, 1988).

Air quality is further characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.1.1), in the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 3.1.2.2), in the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Chapter III-B.1), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 3.2.1). These discussions are incorporated into this SEA by reference.

3.2. BIOLOGICAL RESOURCES

3.2.1. Coastal Resources

Coastal environmental resources in the Central Gulf are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.2.1). Coastal resources in the Eastern Gulf are characterized in the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Section III.C.1), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 3.2.1), and the PEA for exploration in the EPA (USDOI, MMS, 2003; Chapter 3.3.1). All of these sources are incorporated into this SEA by reference where appropriate. Summaries of affected biological resources follow and include (1) barrier beaches and dunes, (2) wetlands, (3) seagrass communities, and (4) beach mice and salt marsh vole, (5) the Gulf sturgeon, and (6) the smalltooth sawfish.

In 2004, barrier beaches and coastlines along the Alabama and Florida shoreline were severely impacted by the landfall of Hurricane Ivan at 4:00 a.m. on September 16. Ivan was a Category 3 storm with measured wind velocities of 130 mph (209 kph) and tidal surges 10-12 ft (3-3.5 m) high. Considerable destruction of homes and businesses occurred along Gulf Shores, Alabama. The web sites for parks and protected areas along the shoreline of Alabama and Florida (e.g., Gulf Islands National Seashore and Fort Pickens) reported widespread damage to facilities, shoreline modifications, and habitat conversions that were caused by the storm.

In 2005, barrier beaches and coastlines along the Mississippi and Louisiana coasts were severely impacted by the landfall of Hurricane Katrina at 8:00 a.m. on August 29. Katrina made landfall with sustained wind velocities in Slidell, Louisiana, of 176 mph. Tidal surges of 23-26 ft (7-8 m) were reported (City of Slidell, 2005). Complete destruction of homes and businesses from tidal surge and wind along the coastline between Slidell and Biloxi, Mississippi, took place many miles inland. The eye of Katrina passed over the Chandeleur Islands in St. Bernard Parish, Louisiana. The degree to which the Chandeleur barrier system or the barrier islands off the Mississippi coast (e.g., Ship Island) were affected by Katrina's storm surge is yet to be officially documented. The impact is likely to be devastating.

Three weeks after Katrina, Hurricane Rita made landfall near Cameron, Louisiana, near the Texas-Louisiana border. Rita was a Category 3 hurricane at the time of landfall that caused tidal surges of 4-5 ft (1.2-1.5 m) in southeastern Louisiana and additional flooding in levee-damaged parts of New Orleans.

3.2.1.1. Barrier Beaches and Dunes

The coastal barrier beaches and associated dunes that occur along the GOM are typically composed of sandy beaches that are divided into several interrelated environments. Most of southeastern Louisiana's barrier beaches are composed of medium to coarse-grained sand. The Isles Dernieres and Timbalier barrier island arcs originated as delta front sands from the Lafourche delta lobe between 1,000 and 2,000 years ago. These islands lie a few miles off the central Louisiana coastline and protect major bays and estuaries. The Chandeleur Islands of eastern Louisiana are the delta front sands at the terminus of the St. Bernard delta lobe that was active between 3,500 and 2,000 years ago. In 1997, these islands made up 4,769 ac (1,930 ha) of land that was mostly beach and dune complex (USDOI, MMS, 2001a; pageIII-19). Beaches and barrier islands in the Gulf have these features in common: (1) shoreface—underwater seaward slope from the low tide waterline; (2) foreshore—exposed, usually nonvegetated slope from the ocean to the beach berm crest; and (3) backshore—exposed, sparsely vegetated area between the beach berm-crest and dune area, occasionally absent due to storm activity.

Barrier beaches are in a state of constant change and include landforms such as islands, beach face, flood or ebb tidal deltas, tidal inlets, spits, and dunes. They are usually long and narrow in shape having been formed by sediment transported by rivers, waves, currents, storm surges, and winds. Barrier islands protect bays, lagoons, estuaries, salt marshes, seagrass beds, and other wetland environments, some of which may contain threatened or endangered species.

Most barrier shorelines of the Mississippi River Delta in Louisiana are transgressive; the shoreline moves landward as the sea floods and oversteps terrestrial environments. Because the continental shelf is very narrow offshore of the youngest Mississippi River delta lobe (Belize Delta or Birdfoot Delta), the bulk of the coarser-grained bed load is deposited directly onto the edge of the continental shelf into slope and deepwater environments so that sediments are not available for reworking to build and maintain barrier islands and beaches along the coast. Regressive shorelines, where the land oversteps the sea, are atypical. The Chenier Plain of western Louisiana is a typical regressive shoreline formed of parallel sand ridges.

Movement of a barrier shoreline may be caused by any combination of erosion, subsidence, sea-level rise, and storm breaching or washover. Barrier shoreline modification can also be accentuated by manmade structures such as groins, seawalls, rock armoring, jetties, and channelization (channel straightening) that cause sediment to deposition and bypassing. Movement of barrier systems is not a steady incremental process because the passage rates and intensities of cold fronts and tropical storms, as well as the intensity of seasonal changes, are not consistently steady (Williams et al., 1992). Both transgressive and regressive shorelines are important ecologically. Barrier islands, particularly vegetated ones with fresh- and/or saltwater pools, may serve as habitat for a wide variety of animal life, especially birds.

Barrier beaches are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.2.1.1), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 3.2.1.1), the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Chapter III-C.1.a), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 3.3.1.1). These discussions are incorporated into this SEA by reference.

3.2.1.2. Wetlands

According to the U.S. Department of the Interior (Dahl, 1990; Henfer et al., 1994), during the mid-1980's, 4.4 percent of Texas (3,083,860 ha) (Henfer et al., 1994), 28 percent of Louisiana (3,557,520 ha), 14 percent of Mississippi (17,678,730 ha), and 8 percent of Alabama (1,073,655 ha) were considered wetlands. These states' wetland areas decreased by 1.6-5.6 percent since the mid-1970's. Most of coastal Louisiana (90 %) is < 3.3 ft (< 1 m) above sea level. The state contains 25 percent of the Nation's coastal wetlands and 40 percent of all salt marshes in the lower 48 states.

Coastal wetland habitats occur as bands around waterways and as broad expanses of saline, brackish, and freshwater marshes, mud and sand flats, and forested wetlands of cypress-tupelo swamps and bottomland hardwoods. Saline and brackish habitats support sharply delineated, segregated stands of single plant species, while fresh and very low salinity environments support more diverse and mixed communities of plants. High organic productivity and efficient nutrient recycling are characteristic of coastal wetlands. They provide habitats for a great number and wide diversity of resident plants, invertebrates, fishes, reptiles, birds, and mammals. They are important nursery grounds for many economically important fishes and shellfish juveniles. The marsh edge, where marsh and open water meet, is particularly important for its higher productivity and greater concentrations of organisms. Emergent plants produce the bulk of the energy that supports salt-marsh dependent animals. Gulf coastal wetlands also support the largest fur harvest in North America, producing 40-65 percent of the nation's yearly total in Louisiana (Olds, 1984). Gulf coastal wetlands support over two-thirds of the Mississippi Flyway wintering waterfowl population and much of North America's puddle duck population.

Wetlands are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.2.1.2), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 3.2.1.2), the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Chapter III-C.1.b), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 3.3.1.2). These discussions are incorporated into this SEA by reference.

3.2.1.3. Seagrass Communities

Seagrass communities of submerged grasses grow in shallow, relatively clear and protected waters on predominantly sandy bottom substrates. Seagrasses that prefer higher salinities are a more prominent habitat to the west of the Mississippi River Delta, especially in Florida waters. Their distribution depends on an interrelationship among a number of environmental factors that include temperature, water depth, turbidity, salinity, turbulence, and substrate suitability. Seagrass communities are extremely productive, providing essential habitat for wintering waterfowl, as well as spawning and feeding habitat for several commercial and recreational species of fish, shellfish, manatees, and sea turtles.

Three million hectares (7,413,100 ac) of submerged seagrass beds are estimated to exist in exposed, shallow coastal waters of the northern Gulf (USDOI, MMS, 2002 and 2003b; page 24). Approximately 98.5 percent of all coastal seagrass communities in the northern Gulf are located off coastal Florida, primarily due to coarser sediment substrates and higher salinities. The Big Bend Seagrass Aquatic Preserve is a managed habitat of special biological concern with large seagrass communities on the Florida inner continental shelf located approximately 260 mi (418 km) from Mississippi Canyon Block 920.

The soft, organic-rich sediments and turbid waters of Louisiana's estuaries and coastal areas limit widespread distribution of seagrass communities. Only a few areas in offshore Louisiana, mostly in Chandeleur Sound, support seagrass beds. Handley (1995) reported that Louisiana had a large amount of submerged vegetation but only a small area of seagrass habitat (about 13,979 ac (5,657 ha) in 1988). Texas and Louisiana contain approximately 0.5 percent; and Mississippi and Alabama have the remaining 1 percent of known seagrass meadows. Handley (1995) had a much lower estimate for the size of the seagrass resource in the northern Gulf. They estimated a total of 2.52 million ac (1.02 million ha) for all the Gulf States, with Florida containing about 1,712,400 ac (693,000 ha).

Seagrass communities are characterized in the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Chapter III.C.1.c), the EPA Multisale Final EIS (USDOI, MMS, 2003a; 3.2.1.3), the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 3.3.1.3), and the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.2.1.3). These discussions are incorporated into this SEA by reference.

3.2.1.4. Coastal and Marine Birds

The offshore waters, coastal beaches, and contiguous wetlands of the northeastern GOM are populated by both resident and migratory species of coastal and marine birds. This analysis includes (1) seabirds; (2) shorebirds, (3) marsh birds, (4) wading birds, (5) waterfowl, (6) raptors, and (7) diving birds. Many species are mostly pelagic and are rarely sighted near shore. Fidelity to nesting sites varies from year to year along the Gulf Coast (Martin and Lester, 1991). Birds may abandon sites along the northern Gulf Coast because of altered habitat and excessive human disturbance.

Coastal and marine birds are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.2.7), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 3.2.6), the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Chapter III.C.6), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 3.3.5). These discussions are incorporated into this SEA by reference.

Seabirds

Seabirds are a diverse group of birds that spend much of their lives on or over saltwater (Table 3-1). All seabirds feed in marine waters while nesting, and most nest colonially. Overall abundance is highest in the spring and summer and lowest in the fall and winter. Four ecological categories of seabirds have been documented in the deepwater areas of the Gulf: summer migrants (e.g., shearwaters, storm petrels, and boobies), summer residents that breed in the Gulf (e.g., sooty, least, and sandwich tern, and frigate birds), winter residents (e.g., gannets, gulls, and jaegers), and permanent resident species (e.g., laughing gulls and royal and bridled terns) (Hess and Ribic, 2000). Collectively, they live far from land most of the year, roosting on the water surface, except at breeding time when they return to nesting areas along coastlines or remote islands (Terres, 1991). Seabirds typically aggregate in social breeding groups called colonies; the degree of colony formation varies between species (Parnell et al., 1988). They also tend to associate with various oceanic conditions including specific sea-surface temperatures, salinities, areas of high planktonic productivity, tides, or current activity. Seabirds obtain their food from the sea with a variety of behaviors including piracy, scavenging, dipping, plunging, and surface seizing.

Table 3-1

Common Seabirds of the Northern Gulf of Mexico

Common Name	Scientific Name	Occurrence*	Feeding Behavior and Diet
Wilson's storm-petrel	*Oceanites oceanicus*	Summer resident	Picks crustaceans, fish, and squid from the sea surface
Magnificent frigatebird	*Fregata magnificens*	Summer resident	Dives to pluck jellyfish, fish, and crustaceans from the sea surface
Northern gannet	*Morus bassanus*	Wintering resident	Fish and squid
Masked booby	*Sula dactylatra*	Wintering resident	Plunge dives for flying fishes and small squid
Brown booby	*Sula leucogaster*	Wintering resident	Prefers to perch; comes ashore at night to roost
Cory’s shearwater	*Calonectris diomedea*	Summer resident	Feeds at the water surface at night on crustaceans and large squid
Greater shearwater	*Puffinus gravis*	Summer resident	Dives to catch fish
Audubon shearwater	*Puffinus lherminieri*	Summer resident	Dives to catch fish, squid, and other organisms

*All major seabirds are distributed Gulfwide.

Shorebirds

Shorebirds are those members of the order Charadriiformes generally restricted to coastline margins (beaches, mudflats, etc.). GOM 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). An important characteristic of almost all shorebird species is their strongly developed migratory behavior, with some shorebirds migrating from nesting places in the far north to the southern part of South America (Terres, 1991). Both spring and fall migrations take place in a series of “hops” to staging areas where birds spend time feeding heavily to store up fat for the sustained flight to the next staging area; many coastal habitats along the GOM are critical for such purposes. Along the Gulf Coast, observers have recorded 44 species of shorebirds. Six species nest in the area; the remaining species are wintering residents and/or “staging” transients (Pashley, 1991). Although variations occur between species, most shorebirds begin breeding at 1-2 years of age and generally lay 3-4 eggs per year. They feed on plants and a variety of marine and freshwater invertebrates and fish.

Marsh and Wading Birds

"Wading bird" is a collective term referring to birds that have adapted to living in shallow water. These birds have long legs for wading in shallow water, while they use their usually long necks and long bills to probe under water or to make long swift strokes to seize fish, frogs, aquatic insects, crustaceans, and other prey (Terres, 1991) (Table 3-2). These families have representatives in the northern Gulf: Ardeidae (herons, bitterns, and egrets), Ciconiidae (storks), Threskiornithidae (ibises and spoonbills), and Gruidae (cranes).

Seventeen species of wading birds in the Order Ciconiiformes currently nest in the U.S., and all except the wood stork nest in the northern Gulf coastal region (Martin, 1991). Louisiana supports the majority of nesting wading birds. Great egrets are the most widespread nesting species in the Gulf region; they often occupy urban canals (Martin, 1991).

Members of the Rallidae family (rails, moorhens, gallinules, and coots) are elusive "marsh birds," rarely seen within the low vegetation of fresh and saline marshes, swamps, and rice fields (Bent, 1926; National Geographic Society, 1983; Ripley and Beehler, 1985).

Table 3-2

Common Marsh or Wading Birds in the Northern Gulf of Mexico

Common Name	Scientific Name	Occurrence*	Feeding Behavior and Diet
American bittern	*Botaurus lentiginosus*	*	Amphibians, small fish, small snakes, crayfish, small rodents, and water bugs
Least bittern	*Ixobrychus exilus*	Summer resident	NA
Great blue heron	*Ardea herodias*	*	Various aquatic animals
Great egret	*Casmerodias albus*	*	Fish, frogs, snakes, crayfish, and large insects
Snowy egret	*Egretta thula*	*	Arthropods, fish
Little blue heron	*Egretta caerulea*	*	Small vertebrates, crustaceans, and large insects
Tricolored heron	*Egretta tricolor*	*	NA
Reddish egret	*Egretta rufescens*	Pan-Gulf except for central and eastern FL Panhandle	NA
Cattle egret	*Bulbulcus ibis*	*	NA
Green-backed heron	*Butorides striatus*	Permanent resident in central LA and eastward; summer resident in TX and western LA	NA
Black-crowned night heron	*Nycticorax nicticorax*	*	NA
Yellow-crowned night heron	*Nyctanassa biolacea*	Permanent resident TX, eastern LA, MS, AL, and eastern FL Panhandle	Aquatic organisms, especially crustaceans
White ibis	*Eudocimus albus*	*	NA
Glossy ibis	*Plegadis falconellus*	*	Snakes, crayfish, and crabs
White-faced ibis	*Plegadis chini*	Permanent resident in TX and western and central LA; summer resident in eastern LA	NA
Roseate spoonbill	*Ajaia ajaja*	Permanent resident; summer resident in LA	NA

*All wading birds are permanent residents Gulfwide unless otherwise indicated.
NA = Not available.

Waterfowl

Waterfowl belong to the taxonomic order Anseriformes and include swans, geese, and ducks. A total of 27 species are regularly reported along the north-central and western Gulf Coast (Table 3-3). Among these are 1 swan, 4 geese, 7 surface-feeding (dabbling) ducks and teal, 4 diving ducks (pochards), and 11 others (including the wood duck, whistling duck, sea ducks, ruddy duck, and mergansers) (Clapp et al., 1982; National Geographic Society, 1983; Madge and Burn, 1988). Many species usually migrate from wintering grounds along the Gulf Coast to summer nesting grounds in the northern U.S. Waterfowl migration pathways have traditionally been divided into four parallel north-south paths, or "flyways," across the North American continent. The Gulf Coast of Louisiana, Mississippi, and Alabama serves as the southern terminus of the Mississippi flyway. Waterfowl are social and have a diverse array of feeding adaptations related to their habitat (Johnsgard, 1975).

Table 3-3

Common Waterfowl in the Northern Gulf of Mexico

Common Name	Scientific Name	Occurrence*	Feeding Behavior and Diet
Wood duck	*Aix sponsa*	Year-round	Dabbler; eats plants, invertebrates, tadpoles, and salamanders
Canvasback duck	*Aythya valisineria*	Year-round	Diver; feeds on molluscs and aquatic plants
Redhead duck	*Aythya americana*	*	Diver; mostly herbivorous
Ring-necked duck	*Aythya collaris*	*	Diver
Fulvous whistling duck	*Dendrocygna bicolor*	Nests in TX, LA	Feeds nocturnally on land plant seeds
Lesser scaup	*Aythya affinis*	High abundance	Diver; feeds on plants and animals
Greater scaup	*Aythya maarila*	*	Feeds on plants, insects, and invertebrates in nesting season; diet at sea in winter is mostly molluscs and plants
Black scoter	*Melanitta nigra*	Low abundance	Diver; feeds mostly on molluscs
White-winged scoter	*Melanitta fusca*	TX, LA, AL; low abundance	Diver; feeds mostly on shellfish
Surf scoter	*Melanitta perspicilla*	Low abundance	Diver; feeds mostly on molluscs and crustaceans
Common goldeneye	*Bucephala clangula*	*	Diver; needs on molluscs, crustaceans, insects, and aquatic plants
Bufflehead	*Bucephala albeola*	*	Diver; in fresh water, eats aquatic adult and larval insects, snails, small fish, and aquatic plant seeds; in salt water, eats crustaceans, shellfish, and snails
Common merganser	*Mergus merganser*	*	Diver; feeds on molluscs, crustaceans, aquatic insects, and some plants
Red-breasted merganser	*Mergus serrator*	*	Eats mostly fish
Hooded merganser	*Lophodytes cucullatus*	*	Diver; thin serrated bill adapted to taking fish; also feeds on crustaceans and aquatic insects
Tundra swan	*Cygnus columbianus*	Winters on Atlantic Coast, minor presence in Gulf	NA
Greater white-fronted goose	*Answer albifrons*	TX, LA, AL	Feeds on plants and insects
Snow goose	*Chen caerulescens*	TX, LA, MS, AL	Dabbler, grazer, herbivore

Table 3-3

Common Waterfowl in the Northern Gulf of Mexico

Common Name	Scientific Name	Occurrence*	Feeding Behavior and Diet
Canada goose	*Branta canadensis*	*	Dabbler; herbivore
Brant	*Branta bernicla*	FL	Herbivore
Mallard	*Anas platyrhynchos*	*	Dabbler; usually a herbivore; female supplements diet with invertebrate protein source when producing eggs
Mottled duck	*Anas fulvigula*	TX, LA year-round	Dabbler; invertebrates and some plant material
American widgeon	*Anas americana*	*	Dabbler; may feed on widgeon grass
Northern pintail	*Anas acuta*	Abundant in TX	Dabbler; mostly herbivorous
Northern shoveler	*Anas clypeata*	*	Dabbler; strains food through combs of teeth on inside of bill
Blue-winged teal	*Anas discors*	*	Dabbler; mostly herbivorous
Cinnamon teal	*Anas cyanoptera*	TX, west LA	Dabbler; eats invertebrates, plant seeds, and algae; sometimes skims water surface with bill
Gadwall	*Anas strepera*	*	Dabbler; mostly herbivorous
Ruddy duck	*Oxyura jamaicensis*	*	Diver; mostly herbivorous

*All waterfowl are wintering residents Gulfwide unless otherwise indicated.
NA = not available.

Raptors

The American peregrine falcon was removed from the endangered species list on August 20, 1999. The species is still protected under the Migratory Bird Treaty Act. The FWS will continue to monitor the falcon's status for 13 years to ensure that recovery is established.

Diving Birds

There are three main groups of diving birds, cormorants and anhingas, loons, and grebes (Table 3-4). Of the two pelican species in North America, only the brown pelican is listed as endangered under the ESA.

Table 3-4

Common Diving Birds in the Northern Gulf of Mexico

Common Name	Scientific Name	Occurrence*	Feeding Behavior and Diet
Common loon	*Gavia immer*	Wintering resident	Dives from surface for fish, arthropods, snails, leeches, frogs, and salamanders
Horned grebe	*Podiceps auritus*	Wintering resident	Fish and some arthropods
Eared grebe	*Podiceps nigricollis*	TX, LA, MS, AL	Arthropods
Pied-billed grebe	*Podilymbus podiceps*	Permanent resident	Arthropods, small fish
Anhinga	*Anhinga anhinga*	Permanent resident	Swims underwater for fish, frogs, snakes, and leeches
Olivaceous cormorant	*Phalacrocorax olivaceus*	*	NA
Double-crested cormorant	*Phylacrocorax auritus*	Permanent resident	NA

*All of these diving birds are distributed Gulfwide except where otherwise indicated.
NA = Not available.

3.2.2. Coastal Endangered and Threatened Species

3.2.2.1. Beach Mice and Salt Marsh Vole

Sixteen subspecies of field mouse (*Peromyscus polionotus*) are recognized in the northern GOM, eight of which are collectively known as beach mice. The Alabama, Choctawhatchee, St. Andrew, and Perdido Key beach mice and the Florida salt marsh vole are designated as endangered species under the Endangered Species Act of 1973. These mice occupy restricted habitat behind coastal foredunes of Florida and Alabama. Documented beach mouse occurrences are on the Fort Morgan Peninsula in Gulf State Park (Perdido Key Unit); along Gulf Islands National Seashore from Gulfport to Fort Walton, Florida; in Topsail Park just east of Destin, Florida; and on Shell Island, Florida. Beach mice habitats on the Alabama and Florida panhandle coasts experienced severe damage from landfall of Hurricane Ivan on September 16, 2004; a Category 3 hurricane that landed with winds 130 mph (209 kph) and tidal surges from 10-12 ft (3-3.5 m). The Florida salt marsh vole occupies only a single tidal marsh, located on Waccasassa Bay north of Tampa, Florida.

The beach mice and vole are characterized in the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Section III.C.7), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 3.2.5), and the PEA for exploration in the EPA (USDOI, MMS, 2003; Chapter 3.3.1.4). These discussions are incorporated into this SEA by reference.

3.2.2.2. Gulf Sturgeon and Smalltooth Sawfish

The Gulf sturgeon (*Acipenser oxyrhynchus desotoii*) is a threatened fish species in the GOM. Gulf sturgeons are bottom suction feeders that have ventrally located, highly extrusible mouths. Two pairs of barbels are present with taste buds. Fishes that forage by taste are opportunistic feeders because taste is much more discriminating than smell. The Gulf sturgeon occurs in most major riverine and estuarine systems from the Mississippi River to the Suwannee River, Florida, and marine waters of the Central and

Eastern GOM, possibly south to Florida Bay. The decline of the Gulf sturgeon is believed to be due to overfishing, damming of coastal rivers, and degradation of water quality.

The Gulf sturgeon is characterized in the EPA Multisale EIS (USDOI, MMS, 2003a; Chapter 3.2.7.1), the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Chapter III.C.8), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 3.3.6.4) and is incorporated into this SEA by reference.

The smalltooth sawfish (*Pristis pectinata*) was approved for status as an endangered species by NOAA Fisheries in a rulemaking on April 1, 2003. Sawfish are actually modified rays with a shark-like body, and gill slits on their ventral side. Sawfish get their name from their "saws"; long, flat snouts edged with a row of paired teeth used for slashing or rooting. Their diet includes mostly fish but also some crustaceans and they can grow as large as 18 ft (5.5 m) (Clugston, 1991). The lack of smalltooth sawfish records since 1984 from the area west of peninsular Florida is a clear indication of decline of abundance in the northern GOM. Peninsular Florida has been the U.S. region with the largest numbers of capture records of smalltooth sawfish and apparently is the only area that historically hosted the species year-round. Although no longer common, smalltooth sawfish were once characteristic and prominent elements of the inshore Florida fish fauna.

The smalltooth sawfish is characterized in the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 3.2.7.2) and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 3.3.6.5). These discussions are incorporated into this SEA by reference.

3.2.2.3. Listed Coastal and Marine Birds

The following coastal and marine bird species inhabit or frequent the northern GOM coastal areas and are protected under the ESA as either endangered or threatened: piping plover; whooping crane; least tern; bald eagle; and brown pelican.

Piping Plover

The piping plover (*Charadrius melodus*) is a migratory shorebird that is native to North America. The piping plover was designated as threatened in December 1985 over its range in the Gulf Coast states. It breeds on the northern Great Plains (especially in open flats along the Missouri River), in the Great Lakes, and along the Atlantic Coast (Newfoundland to North Carolina). It winters on the Atlantic and Gulf Coasts from North Carolina to Mexico and in the Bahamas West Indies. Hypothetically, in specific wintering habitat plovers may have a preferred prey base and/or the substrate coloration provides protection from aerial predators there due to camouflage by color matching. Such areas include coastal sand flats and mud flats in proximity to large inlets or passes, which may attract the largest concentrations of piping plovers (Nicholls and Baldassarre, 1990). Similarly, nesting habitat in the north includes open sand flats. This species remains in a precarious state given its low population numbers, sparse distribution, and continued threats to habitat throughout its range.

Critical habitat is specially managed or protected only in the case of a Federal action. On July 6, 2000, the FWS proposed critical habitat for the wintering population of piping plover in 146 areas along approximately 2,700 mi of the coast of North Carolina, South Carolina, Georgia, Florida, Alabama, Louisiana, and Texas. Critical habitat identifies specific areas that are essential to the conservation of a listed species and that may require special management consideration or protection. The primary constituent needs for the piping plover are those habitat components that are essential for the primary biological needs of foraging, sheltering, and roosting.

Whooping Crane

The whooping crane (*Grus americana*) is an omnivorous, wading bird that has been endangered since 1970. Whooping cranes are endangered because much of their wetland habitat has been drained for farmland and pasture. The crane's diet consists of blue crabs, clams, frogs, minnows, rodents, small birds, and berries. Whooping cranes 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, 1926). Whooping cranes currently exist in three wild populations and at five captive locations (USDOI, FWS, 1994). The only self-sustaining wild population nests in Canada's

Northwest Territory and adjacent areas of Alberta and winters in coastal marshes and estuarine habitats along the Texas Gulf Coast at Aransas National Wildlife Refuge near Rockport.

Least Tern

The least tern is not considered federally endangered or threatened in coastal areas within 50 mi of the Gulf (Patrick, personal communication, 1997). Only the interior nesting colonies are endangered.

Bald Eagle

In July 1995, the FWS reclassified the bald eagle from endangered to threatened in the lower 48 states (*Federal Register*, 1995). The bald eagle (*Haliaeetus leucocephalus*) is the only species of sea eagle that regularly occurs on the North American continent (USDOI, FWS, 1984). Its range extends from central Alaska and Canada to northern Mexico. The bulk of the bald eagle's diet is fish, though bald eagles will opportunistically take birds, reptiles, and mammals (USDOI, FWS, 1984). The general tendency is for winter breeding in the south with a progressive shift toward spring breeding in northern locations. In the southeast, nesting begins in early September and egg-laying begins as early as late October and peaks in late December. The historical nesting range of the bald eagle within the southeastern U.S. included the entire coastal plain. Nesting habitat was especially on the shores of major rivers and lakes. Certain general elements seem to be consistent among nest site selection. These include (1) the proximity of water (usually within 0.5 mi) and a clear flight path to it, (2) the largest living tree in a span, and (3) an open view of the surrounding area. The proximity of good perching trees may also be a factor in site selection. Bald eagles may not use an otherwise suitable site if there is excessive human activity in the area. The current range is limited, with most breeding pairs occurring in Peninsular Florida and Louisiana, and some in South Carolina, Alabama, and east Texas. Sporadic breeding takes place in the rest of the southeastern states. A total of 120 nests have been found in Louisiana, but only three nests occurred within 5 mi of the coast (Patrick, personal communication, 1997).

Brown Pelican

The brown pelican (*Pelicanus occidentalis*) remains endangered (*Federal Register*, 1985) in Louisiana and Mississippi, where it inhabits the coastal areas. It is not federally listed in Florida, rather it is a State species of special concern. The brown pelican is one of two pelican species in North America. It feeds entirely upon fishes captured by plunge diving in coastal waters. Organochlorine pesticide pollution apparently contributed to the endangerment of the brown pelican. In recent years, there has been a marked increase in brown pelican populations along its entire former range. The population of brown pelicans and their habitat in Alabama, Florida, Georgia, North and South Carolina, and points northward along the Atlantic Coast were removed from the endangered species list in 1985.

The Louisiana Department of Wildlife and Fisheries submitted a request to the FWS in March 1994 to officially remove the brown pelican from the endangered species list in Louisiana (LDWF, 1994). Ten thousand nests and an estimated 25,000 adults were found in a recent Louisiana survey (Patrick, personal communication, 1997).

3.2.3. Offshore Resources

Offshore environmental resources include those on the continental shelf and deepwater. These resources in the Central and Eastern Gulf are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapters 3.2.3 to 3.2.9). Offshore resources in the Eastern Gulf are characterized in the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Section III.C.2), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 3.2.2), and the PEA for exploration in the EPA (USDOI, MMS, 2003; Chapter 3.3.2).

All of these sources are incorporated into this SEA by reference where appropriate. Summaries of affected biological resources follow and include (1) deepwater benthic communities, (2) soft-bottom benthic communities, (3) chemosynthetic communities, (4) coral reefs, (5) marine mammals, (6) sea turtles, (7) coastal and marine birds, and (8) essential fish habitat and fish.

3.2.3.1. Deepwater Benthic Communities

"Deepwater" is a term of convenience referring to vast areas of the Gulf with water depths ≥1,000 ft (305 m) that are typically covered by pelagic clay and silt. The area encompasses a narrow range of habitats in water depths between approximately 8,000 and 9,000 ft (2,438 and 2,743 m) deep. In, on, and directly above these sediments live a wide variety of single-celled organisms, invertebrates, and fish. Their lifestyles are extremely varied as well and can include absorption of dissolved organic material, symbiosis, collection of food through filtering, mucous webs, seizing, or other mechanisms. These organisms can also include chemosynthetic organisms found in association with hydrocarbon seeps that use a carbon source independent of photosynthesis and the sun-dependent photosynthetic food chain that supports all other life on earth.

The continental slope in the GOM extends from the edge of the continental shelf at a water depth of about 600 ft (183 m) to a depth of approximately 3,000 m (9,840 ft) (USDOI, MMS, 2002; page 9.1-6). The Independence Hub lies beyond the continental slope in water depths referred to as abyssal.

3.2.3.2. Soft-Bottom Benthic Communities

The vast majority of the GOM seabed is comprised of soft sediments. Major groups of animals that live in this habitat include (1) bacteria and other microbenthos, (2) meiofauna (0.063-0.3 mm), (3) macrofauna (greater than 0.3 mm), and (4) megafauna (larger organisms such as crabs, sea pens, sea cucumbers, crinoids, and bottom-dwelling (demersal) fish. All of these groups are represented throughout the entire Gulf − from the continental shelf to the deepest abyssal depths (about 3,850 m (12,630 ft)).

The "abyssal" zone (≥1,000 m or 3,281 ft) has the following divisions and characteristic faunal assemblages:

- Upper Abyssal Zone (1,000-2,000 m or 3,281-6,562 ft)—Number of fish species decline while the number of invertebrate species appear to increase; sea cucumbers, *Mesothuria lactea* and *Benthodytes sanguinolenta,* are common; galatheid crabs include 12 species of the deep-sea genera *Munida* and *Munidopsis*, while the shallow brachyuran crabs decline.
- Mesoabyssal Zone (2,300-3,000 m or 7,546-9,843 ft)—Fish species are few and echinoderms continue to dominate the megafauna.
- Lower Abyssal Zone (3,200-3,800 m or 10,499-12,468 ft)—Large asteroid, *Dynaster insignis*, is the most common megafaunal species.

3.2.3.2.1. Megafauna

Animals of a size typically caught in trawls and large enough to be easily visible (e.g., crabs, shrimp, benthic fish, etc.) are called megafauna. In the Gulf, most are crustaceans, echinoderms, or benthic fish. Benthic megafaunal communities in the Central Gulf appear to be typical of most temperate continental slope assemblages found at depths from 300 to 3,000 m (984 to 9,843 ft) (USDOI, MMS, 2001b; page 3-63). Exceptions include the chemosynthetic communities.

Megafaunal invertebrate and benthic fish densities appear to decline with depth between the upper slope and the abyssal plain (Pequegnat 1983; Pequegnat et al., 1990). This phenomenon is generally believed to be related to the low productivity in deep, offshore Gulf waters (USDOI, MMS, 2001b; page 3-60). Megafaunal communities in the offshore Gulf have historically been zoned by depth, which are typified by certain species assemblages (Menzies et al., 1973; Pequegnat, 1983; Gallaway et al., 1988; Gallaway and Kennicutt, 1988; Pequegnat et al., 1990; USDOI, MMS, 2001b; page 3-64).

Carney et al. (1983) postulated a simpler system of zonation having three zones: (1) a distinct shelf fauna in the upper 1,000 m (3,281 ft); (2) an indistinct slope fauna between 1,000 and 2,000 m (3,281-6,562 ft); and (3) a distinct abyssal fauna between 2,000 and 3,000 m (6,562-9,843 ft).

The baseline Northern Gulf of Mexico Continental Slope (NGMCS) Study conducted in the mid- to late 1980's trawled 5,751 individual fish and 33,695 invertebrates, representing 153 and 538 taxa, respectively. That study also collected 56,052 photographic observations, which included 76 fish taxa and 193 non-fish taxa. The photographic observations were dominated by sea cucumbers, bivalves, and sea pens, groups that were not sampled effectively (if at all) by trawling. Decapod crustaceans dominated the trawls and were fourth in abundance in photos. Decapod density generally decreased with depth but abundance peaks were determined at 500 m (1,640 ft) and between 1,100 and 1,200 m (3,609 and 3,937 ft), beyond which numbers diminished. Fish density, while variable, was generally high at depths between 300 and 1,200 m (984 and 3,937 ft); it then declined substantially.

Gallaway et al. (2003) concluded that megafaunal composition changes continually with depth such that a distinct upper slope fauna penetrates to depths of about 1,200 m (3,937 ft) and a distinct deep-slope fauna is present below 2,500 m (8,202 ft). A broad transition zone characterized by low abundance and diversity occurs between depths of 1,200 and 2,500 m (3,937 and 8,203 ft). The proposed Independence Hub development, at a depth of approximately 1,310 m (4,300 ft), lies within this broad transition zone.

3.2.3.2.2. Macrofauna

The benthic macrofaunal component of the NGMCS Study (Gallaway et al., 2003) included sampling in nearby areas at similar depths, both east and west of the Independence Hub project. A transect (the central transect) of 11 baseline stations through Grids 12, 13, and 14 from 305 m (1,000 ft) to nearly the 3,000-m (9,843-ft) contour was sampled in this study. All of these data are relevant to the proposed Independence Hub development because they were taken from the same geographic area and encompass the same depths and substrates.

The study NGMCS examined 69,933 individual macrofauna from over 1,548 taxa; 1,107 species from 46 major groups were identified (Gallaway et al., 2003). Polychaetes (407 species), mostly deposit-feeding forms (196 taxa), dominated in terms of numbers. Carnivorous polychaetes were more diverse, but less numerous than deposit-feeders, omnivores, or scavengers (Pequegnat et al., 1990; Gallaway et al., 2000). Polychaetes were followed in abundance by nematodes, ostracods, harpacticoid copepods, bivalves, tanaidacids, bryozoans, isopods, amphipods, etc. Overall abundance of macrofauna ranged from 518 to 5,369 individuals/m^2 (Gallaway et al., 1988). The central transect (4,938 individuals/m^2) had higher macrofaunal abundance than either the Eastern or Western Gulf transects (4,869 and 3,389 individuals/m^2, respectively) (Gallaway et al., 2003).

In the GOM, macrofaunal density and biomass declines with depth from approximately 5,000 individuals/m^2 on the lower shelf-upper slope to several hundred individuals/m^2 on the abyssal plain (USDOI, MMS, 2001b; page 3-64). This decline in benthos has been attributed to the relatively low productivity of the Gulf offshore open waters (USDOI, MMS, 2001b; page 3-60). Pequegnat et al. (1990) reported mid-depth maxima of macrofauna in the upper slope at some locations with high organic particulate matter, and Gallaway et al. (2003) noted that the decline with depth is not clear cut and is somewhat obscured by sampling artifacts. There is some suggestion that the size of individuals decrease with depth (Gallaway et al., 2003).

3.2.3.2.3. Meiofauna

Meiofauna, primarily composed of small nematode worms and harpacticoid copepods, refers to invertebrates small enough to live between sand grains. Meiofauna also declines in abundance with depth (Pequegnat et al., 1990; Gallaway et al., 2003; USDOI, MMS, 2001b; page 3-64). The overall density (mean of 707,000/m^2) of meiofauna is approximately two orders of magnitude greater than the macrofauna throughout the depth range of the slope (Gallaway et al., 1988). These authors reported 43 major groups of meiofauna with nematodes, harpacticoid copepods (adults and larvae), polychaete worms, ostracods, and kinorhynchs accounting for 98 percent of the total numbers. Nematode worms and harpacticoids were dominant in terms of numbers, but polychaetes and ostracods were dominant in terms of biomass, a feature that was remarkably consistent across all stations, regions, seasons, and years (Gallaway et al., 2003). Meiofaunal densities appeared to be somewhat higher in the spring than in the fall. Meiofaunal densities reported in the NGMCS Study are among the highest recorded worldwide (Gallaway et al., 2003). There is also evidence that the presence of chemosynthetic communities may enrich the density and diversity of meiofauna in the immediate surrounding area (Gallaway et al., 2003).

3.2.3.2.4. Microbiota

Less is known about the microbiota, primarily bacteria, in the GOM than the other size groups, especially in deep water (USDOI, MMS, 2000; page IV-15; CSA, 2000). Very little is known about the microbiota group Archaea, which includes bacteria. While direct counts of bacteria have been coupled with some *in situ* and repressurized metabolic studies performed in other deep ocean sediments (Deming and Baross, 1993), none have been made in the deep GOM. Cruz-Kaegi (1998) made direct counts using a fluorescing nuclear stain at several depths down the slope, allowing bacterial biomass to be estimated from their densities and sizes. Mean biomass was estimated to be 2.37 g of C/m^2 for the shelf and slope combined, and 0.37 g of C/m^2 for the abyssal plain. In terms of biomass, data indicate that bacteria are the most important component of the functional infaunal biota. Cruz-Kaegi (1998) developed a carbon cycling budget based on estimates of biomass and metabolic rates in the literature. She discovered that, on the deep slope of the Gulf, the energy from organic carbon in the benthos is cycled through bacteria.

3.2.3.3. Chemosynthetic Communities

Chemosynthetic communities are defined as persistent, largely sessile assemblages of marine organisms dependent upon symbiotic chemosynthetic bacteria as their primary food source (MacDonald, 1992). Chemosynthetic clams, mussels, and tube worms are similar to (but not identical with) the hydrothermal vent communities of the eastern Pacific (Corliss et al., 1979). Bacteria live within specialized tissues in these invertebrate organisms and are supplied with oxygen and chemosynthetic compounds by the host via specialized blood chemistry (Fisher, 1990). The host, in turn, lives off the organic products released by the chemosynthetic bacteria and may even feed on the bacteria themselves. Free-living chemosynthetic bacteria may also live in the substrate within the invertebrate communities and may compete with those that are symbiotic for sulfide and methane energy sources. Enhanced densities of heterotrophic organisms typical of soft-bottom communities have been reported in association with chemosynthetic communities near seep locations (Carney, 1993).

Initial discoveries of cold-water seep communities indicated that they are primarily associated with hydrocarbon and hydrogen sulfide (H_2S) seep areas (Kennicutt et al., 1985; Brooks et al., 1986). Since the initial discovery in 1984 of chemosynthetic communities dependent on hydrocarbon seepage in the GOM off the west coast of Florida, their geographic range has been found to include the Texas, Louisiana, and Alabama continental slope with a depth range varying from less than 300 m to 2,200 m (984 to 7,218 ft) (Rosman et al., 1987; MacDonald, 1992). Four general community types have been described by MacDonald et al. (1990). These are communities dominated by (1) vestimentiferan tube worms, (2) mytilid mussels, (3) vesicomyid bivalves, and (4) infaunal lucinid or thyasirid bivalves. These faunal groups tend to display distinctive characteristics in terms of how they aggregate, the size of aggregations, the geological and chemical properties of the habitats in which they occur and, to some degree, the heterotrophic fauna that occur with them.

The reliance of deep-sea chemosynthetic communities on nonphotosynthetic carbon sources limits their distribution in the Gulf to areas where hydrocarbon sources are available. Within the northern Gulf, chemosynthetic communities are generally associated with moderate-rate oil and gas seeps, volcanoes, and mineral seeps (Roberts and Carney, 1997). The most common energy source for the Gulf communities is a hydrocarbon seep. Faults in hydrocarbon reservoirs at depth may have allowed oil and gas to migrate upward to the seafloor over the past several million years (Sassen et al., 1993a and b). Hydrocarbons seeping to the surface diffuse through overlying sediments where bacterial degradation creates the carbonate substrate taken up by symbiotic invertebrates. Vestimentiferan tube worms and lucinid and vesicomyid bivalves rely on H_2S, whereas mytilid mussels used dissolved methane (CH_4). Mud volcanoes and mineral seeps provide similar chemosynthetic source material, but they are far less common than oil and gas seeps.

Hydrocarbon seep communities in the Central Gulf have been reported to occur at water depths between 290 and 2,200 m (951 and 7,218 ft) (Roberts et al., 1990; MacDonald, 1992). The total number of chemosynthetic communities in the Gulf is now known to exceed 50; however, little exploration for potential chemosynthetic community sites has occurred below a depth of 1,000 m (MacDonald, 1992; Boland, personal communication, 2000; Gallaway et al., 2000). A new study co-funded by MMS and NOAA Office of Exploration will begin field work in 2006 to study chemosynthetic communities exclusively below a depth of 1,000 m (3,280 ft).

The nearest known chemosynthetic community to the proposed location of the Independence Hub is in Atwater Valley Block 245, 50 nmi (93 km) southwest of Mississippi Canyon Block 920 and approximately 36 nmi (67 km) southwest of the nearest subsea well site (Merganser) in Atwater Valley Block 37. A review for the potential occurrence of chemosynthetic communities at the Hub location, along the gathering flowlines from well sites to the Hub, and along the Independence Trail export trunk pipeline from the Hub to the junction platform in West Delta Block 68, was performed for this EA. The well sites, which are the locations for subsea production equipment, were examined at the time the operator's EP's were reviewed and approved by MMS.

Chemosynthetic communities are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS. 2002; Chapter 3.2.3), the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Chapter III.C.3.a), the EPA Multisale Final EIS (USDOI, MMS, 2003a; 3.2.1.3), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 3.2.2.2.1). These discussions are incorporated into this SEA by reference.

3.2.3.4. Coral Communities

On the northern GOM continental shelf, shallow-water coral communities are associated with topographic highs. The East and West Flower Garden Banks comprise the only thriving shallow-water coral reefs in the northern GOM. Many other topographic features support hermatypic (reef-building) and ahermatypic (non-reef-building) corals in lesser quantities. These banks are frequently dominated by algal-sponge communities. Reef-building corals have also been found encrusting numerous offshore oil and gas platforms (Sammarco et al., 2004). No reef-building corals occur in the vicinity of the Independence Hub project because of water depth. There is a high likelihood for corals to develop on the submerged Hub platform structure after some period of years.

Currently, there is limited information regarding deepwater coral habitats and their abundance in the Gulf. Moore and Bullis (1960) collected more than 136 kg (300 lb) of scleractinian coral, *Lophelia prolifera*, from a depth of 421-512 m (1,381-1,680 ft), about 23 mi (37 km) from Viosca Knoll Block 907 (USDOI, MMS, 2000; page IV-14). Recently, there have been observations of large amounts of *Lophelia* in Viosca Knoll Block 826. These deepwater corals form complex habitats on some hard bottoms in the GOM but require the presence of hard substrates for these communities to develop. No geophysical signatures of hardground substrates are present in the area of interest around proposed Hub facilities.

3.2.3.5. Marine Mammals

Twenty-eight cetacean (whales and dolphins) and one sirenian (manatee) species have confirmed occurrences in the northern GOM (Table 3-5) (Davis and Fargion, 1996). Cetaceans are divided into two major suborders: Mysticeti (baleen whales) and Odontoceti (toothed whales and dolphins). Of the seven baleen whale species occurring in the Gulf, five are listed as endangered or threatened. Of the 21 toothed whale species occurring in the Gulf, only the sperm whale is listed as endangered. The only member of the Order Sirenia found in the Gulf is the endangered West Indian manatee.

The sperm whale is among the toothed whales and is common in the Gulf, whereas the baleen whales are considered uncommon. Cetacean distribution in the Gulf is influenced by both water depth and by the presence of mesoscale hydrographic features (cold-core and warm-core rings and confluences). The GulfCet studies showed that cetaceans were concentrated along the upper continental slope in water depth from 650-3,280 ft (200 to 1,000 m) and sighted less often over the abyssal regions in water depths >6,560 ft (2,000 m). Cetaceans are observed frequently on the upper continental slope and tend to be associated with upwelling events, cyclones and the confluence between cyclone-anticyclone pairs. These hydrographic features concentrate zooplankton and micronekton biomass, and indicate richer concentrations of cetacean prey. Since cyclones in the northern Gulf are dynamic and usually associated with westward moving cyclone-anticyclone pairs, cetacean distribution tends to be dynamic. Bottlenose dolphins, Atlantic spotted dolphins, and possibly Bryde's whales that typically occur on the continental shelf or along the shelf break are outside the influence of major eddies. A preferred area for foraging by sperm whales is the area south of the mouth of the Mississippi River. The continental shelf here is narrow compared to the east or west, and is a deepwater environment with locally enhanced primary and secondary productivity. For any given area in the offshore GOM, observing species of marine mammals known to occur in that area is as much a function of survey effort and currents at the time of the survey as it is actual animal occurrences.

Table 3-5

Marine Mammals of the Northern Gulf of Mexico

Order, Suborder, and Family of Cetacea	Common Name
Suborder Mysticeti (baleen whales)	
Family Balaenidae	
Eubalaena glacialis	northern right whale*
Family Balaenopteridae	
Balaenoptera musculus	blue whale*
Balaenoptera physalus	fin whale*
Balaenoptera borealis	sei whale*
Balaenoptera edeni	Bryde's whale
Balaenoptera acutorostrata	minke whale
Megaptera novaeangliae	humpback whale*
Suborder Odontoceti (toothed whales)	
Family Physeteridae	
Physeter macrocephalus	sperm whale*
Kogia breviceps	pygmy sperm whale
Kogia simus	dwarf sperm whale
Family Ziphiidae	
Mesoplodon bidens	Sowerby's beaked whale
Mesoplodon densirostris	Blainville's beaked whale
Mesoplodon europaeus	Gervais' beaked whale
Ziphius cavirostris	Cuvier's beaked whale
Family Delphinidae	
Orcinus orca	killer whale
Pseudorca crassidens	false killer whale
Feresa attenuate	pygmy killer whale
Globicephala macrorhynchus	short-finned pilot whale
Grampus griseus	Risso's dolphin
Peponocephala electra	melon-headed whale
Tursiops truncatus	Atlantic bottlenose dolphin
Steno bredanensis	rough-toothed dolphin
Stenella coeruleoalba	striped dolphin
Stenella attenuate	pantropical spotted dolphin
Stenella clymene	Clymene dolphin
Stenella frontalis	Atlantic spotted dolphin
Stenella longirostris	spinner dolphin
Lagenodelphis hosei	Fraser's dolphin
Order Sirenia	
Family Trichechidae	
Trichechus manatus	West Indian manatee*

* endangered.

Baleen Whales

Among the representatives of this group that have been documented from the northern Gulf include Bryde's whale and minke whale.

Toothed Whales

Among the representatives of this group that have been documented from the northern Gulf include, kogia, the beaked whales, melon-headed whale, pygmy killer whale, killer whale, short-finned pilot whale, false killer whale, bottlenose dolphin, Atlantic spotted dolphin, Risso's dolphin, pantropical spotted dolphin, clymene dolphin, striped dolphin, spinner dolphin, rough-toothed dolphin, and Frasier's dolphin.

Marine mammals and their distribution are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.2.4), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 3.2.3), the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Chapter III.C.4), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 3.3.3). These discussions are incorporated into this SEA by reference.

3.2.3.6. Fish Resources and Essential Fish Habitat

Pelagic fishes occur throughout the water column from the beach to the open ocean. Water-column structure (temperature, salinity, and turbidity) and food availability are the principal partitioning mechanisms of this vast habitat. On a broad scale, pelagic fishes recognize different water masses based upon physical and biological characteristics. Three ecologic groups of pelagic fish are recognized, primarily by water depth: (1) coastal pelagic species; (2) oceanic species; and (3) mesopelagic species. Two of these three pelagic ecological groups − oceanics and mesopelagics − would be encountered in the area of the Independence Hub project. Coastal pelagic species occur in waters from the shoreline to the shelf edge, generally delineated by the 656 ft (200-m) isobath.

Oceanic Pelagics

Common oceanic pelagic species include tunas, marlins, sailfish, swordfish, dolphins, wahoo, and mako sharks. In addition to these large predatory species, there are halfbeaks, flyingfishes, and driftfishes (Stromateidae). Lesser-known oceanic pelagics include opah, snake mackerels (Gempylidae), ribbonfishes (Trachipteridae), and escolar.

Oceanic pelagic species occur throughout the GOM, especially at or beyond the shelf edge. Oceanic pelagics are reportedly associated with mesoscale hydrographic features such as fronts, eddies, and discontinuities. Fishermen contend that yellowfin tuna aggregate near sea-surface temperature boundaries or frontal zones; however, Power and May (1991) found no correlation between longline catches of yellowfin tuna and sea-surface temperature (defined from satellite imagery) in the GOM. The occurrence of bluefin tuna larvae in the GOM associated with the Loop Current boundary and the Mississippi River discharge plume is evidence that these species spawn in the GOM (Richards et al., 1989). Many of the oceanic fishes associate with drifting *Sargassum*, which provides forage areas and/or nursery refugia.

Data on oceanic pelagic species distribution and abundance comes from commercial longline catches and recreational fishing surveys. The NOAA Fisheries has conducted routine surveys of the GOM billfishery since 1970 (Pristas et al., 1992). Effective July 1, 2000, additional restrictions have been placed on the harvest of some sharks, which may be temporary migrants or might spend some of their life cycles in oceanic pelagic or mesopelagic habitats. It is now prohibited to retain, possess, sell, or purchase the following sharks: white, basking, sand tiger, bigeye sand tiger, dusky, bignose, Galapagos, night, Caribbean reef, narrowtooth, Caribbean sharpnose, smalltail, Atlantic angel, longfin, mako, bigeye thresher, sevengill, sixgill, and bigeye sixgill.

Mesopelagics

Mesopelagic fishes occur deeper in GOM waters than the oceanic species group, usually at depths between 656-3,280 ft (200 and 1,000 m) below the surface. Mesopelagic fish assemblages in the GOM are numerically dominated by myctophids (lanternfishes), with gonostomatids (bristlemouths) and sternoptychids (hachetfishes) common but less abundant in collections. These fishes make extensive vertical migrations during the night from mesopelagic depths (656-3,280 ft or 200-1,000 m) to feed in higher, food rich layers of the water column (Hopkins and Baird, 1985). Mesopelagic fishes are important ecologically because they transfer substantial amounts of energy between mesopelagic and epipelagic zones over each diurnal cycle.

Mesopelagic fish assemblages have been studied in the Eastern GOM by Bakus et al. (1977), Hopkins and Lancraft (1984), and Gartner et al. (1987). Hopkins and Lancraft (1984) collected 143 mesopelagic fishes from the Eastern GOM during 12 cruises from 1970 to 1977. Most of their collections were made near 27° N. latitude, 86° W. longitude. Lanternfishes were most common in the catches made by Bakus et al. (1977) and Hopkins and Lancraft (1984). Bakus et al. (1977) analyzed lanternfish distribution in the western Atlantic Ocean and recognized the GOM as a distinct zoogeographic province. Species with tropical and subtropical affinities were most prevalent in the GOM lanternfish assemblage. This was particularly true for the Eastern Gulf, where Loop Current effects on species distribution were most pronounced. Gartner et al. (1987) collected 17 genera and 49 species of lanternfish in trawls fished at discrete depths from stations in the southern, central, and eastern Gulf. The most abundant species in decreasing order of importance were *Ceratoscopleus warmingii*, *Notolychus valdiviae*, *Lepidophanes guentheri*, *Lampanyctus alatus*, *Diaphus dumerili*, *Benthosema suborbitale*, and *Myctophum affine*. Gartner et al. (1987) sampled three stations near the region, including one near DeSoto Canyon (87°01' W. longitude, 29° 01' N. latitude). Forty-two of the 49 lanternfish species collected from all stations were taken from the northeastern stations. The most abundant species were similar to those for the entire Eastern Gulf, with the exception of *Diaphus mollis*, which ranked among the seven most abundant species. Ichthyoplankton collections from oceanic waters yielded high numbers of mesopelagic larvae as compared with larvae of other species (Richards et al., 1989). Lanternfishes of the Eastern Gulf generally spawn year-round, with peak activity in spring and summer (Gartner, 1993). Darnell and Kleypas (1987) reported some lanternfishes in trawl collections from near the rim of DeSoto Canyon.

Healthy fish resources and fishery stocks depend on essential fish habitat (EFH); waters and substrate necessary to fish for spawning, breeding, feeding, and growth to maturity. Because of the wide variation of habitat requirements for all life history stages for managed species, EFH has been identified throughout the GOM, including all coastal and marine waters and substrates from the shoreline to the seaward limit of the Exclusive Economic Zone (EEZ) (200 mi or 321900 m from shore).

The Magnuson Fishery Conservation and Management Act (USDOI, MMS, 2002; page 1-12) established the provisions for Fishery Management Councils (FMC) and Fishery Management Plans (FMP). There are FMP's in the GOM region for (1) shrimp, (2) red drum, (3) reef fishes, (4) coastal migratory pelagics, (5) stone crabs, (6) spiny lobsters, (7) coral and coral reefs, (8) billfish, and (9) highly migratory species. The Gulf of Mexico FMC's *Generic Amendment for Addressing Essential Fish Habitat Requirements* amends the first seven FMP's listed above, identifying estuarine/inshore and marine/offshore EFH for over 450 managed species (about 400 in the coral FMP). The Gulf of Mexico FMC's *Generic Amendment* also identifies threats to EFH and makes a number of general and specific habitat preservation recommendations for oil and gas exploration, production, and pipeline activities within State waters and OCS areas. These recommendations can be found in the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; page III-91).

Fisheries and EFH are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.2.9), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 3.2.8), the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Chapter III.C.9), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 3.3.6). These discussions are incorporated into this SEA by reference.

3.2.4. Offshore Endangered and Threatened Species

3.2.4.1. Marine Mammals

There are five baleen (northern right, blue, fin, sei, and humpback) whale species, one toothed (sperm) whale species, and one sirenian (West Indian manatee) occurring in the GOM that are endangered.

Marine mammals that are endangered or threatened under the ESA are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.2.4), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 3.2.3), the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Chapter III.C.4), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 3.3.3). These discussions are incorporated into this SEA by reference.

Northern Right Whale

The northern right whale is one of the world's most endangered whales. It has a massive head that can be up to one-third of its body length (Jefferson et al., 1993). Right whales forage primarily on subsurface concentrations of calanoid copepods by skim feeding with their mouths agape (Watkins and Schevill, 1976). Northern right whales range from wintering and calving grounds in coastal waters of the southeastern U.S. to summer feeding, nursery, and mating grounds in New England waters and northward to the Bay of Fundy and the Scotian Shelf. Five major habitats or congregation areas have been identified for the western North Atlantic right whale: (1) southeastern U.S. coastal waters; (2) Great South Channel; (3) Cape Cod Bay; (4) Bay of Fundy; and (5) the Scotian Shelf. The distribution of approximately 85 percent of the winter population and 33 percent of the summer population is unknown. During the winter, a portion of the population moves from the summer foraging grounds to the calving/breeding grounds off Florida, Georgia, and South Carolina. Calves are produced off the coast of the southeastern U.S.

The coastal nature and slow swimming speed of the northern right whale makes it especially vulnerable to human activities (USDOC, NMFS, 1991). Based on a census of individual whales identified using photo-identification techniques, the western North Atlantic population size was estimated to be 295 individuals in 1992 (Waring et al., 1999). Confirmed historical records of northern right whales in the GOM consist of a single stranding in Texas (Schmidly et al., 1972) and a sighting off Sarasota County, Florida (Moore and Clark, 1963; Schmidly, 1981). The northern right whale is not a normal inhabitant of the GOM; existing records probably represent extralimital strays from the wintering grounds of this species off the southeastern U.S. from Georgia to northeastern Florida (Jefferson and Schiro, 1997).

Blue Whale

The blue whale is the largest animal known. Like all rorquals, the blue whale is slender and streamlined. The blue whale feeds almost exclusively on zooplankton via a combination of gulping and lunge-feeding in areas of heavy prey concentration (Yochem and Leatherwood, 1985). The blue whale occurs in all major oceans of the world; some blue whales are resident, some are migratory (Jefferson et al., 1993; USDOC, NMFS, 1998). Those that migrate move 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 (Lowery, 1974). There is little justification for considering the blue whale to be a regular inhabitant of the GOM (Jefferson and Schiro, 1997).

Fin Whale

The fin whale is the second largest rorqual. The fin whale has unusual head coloration; it is markedly asymmetric with the right lower jaw being largely white in contrast to the rest of the head, which is dark. Fin whales are active lunge feeders, taking small invertebrates, schooling fishes, and squid (Jefferson et al., 1993). Fin whales have a worldwide distribution and are most commonly sighted where deepwater approaches the coast (Jefferson et al., 1993). The fin whale makes regular seasonal migrations between temperate waters, where it mates and calves, and the more polar feeding grounds occupied in the summer months. Sightings in the Gulf have typically been made in deeper waters, more commonly in the north-central area (Mullin et al., 1991). There are seven reliable reports of fin whales in the Gulf, indicating that fin whales are not abundant in the GOM (Jefferson and Schiro, 1997). It is possible that the Gulf represents a portion of the range of a low latitude western Atlantic population; however, it is more likely that fin whales are extralimital to this area (Jefferson and Schiro, 1997).

Sei Whale

The sei whale is a medium-sized rorqual. Sei whales skim copepods and other small prey types, rather than lunging and gulping like other rorquals (Gambell, 1985). Sei whales are open ocean whales, not often seen close to shore (Jefferson et al., 1993). They occur from the tropics to polar zones, but are more restricted to mid-latitude temperate zones than are other rorquals (Jefferson et al., 1993). The sei whale is represented in the Gulf by only four reliable records (Jefferson and Schiro, 1997). One stranding was reported for the Florida Panhandle (Jefferson and Schiro, 1997). This species should be considered most likely to be of accidental occurrence in the Gulf, although it is worth noting that three of the four reliable records were from strandings in eastern Louisiana (Jefferson and Schiro, 1997).

Humpback Whale

The humpback whale is more robust in body than other balaenopterids. They have rounded heads and extremely long flippers that are often all or partly white. They occur in all oceans, feeding in higher latitudes during spring, summer, and autumn, and migrating to a winter range over shallow tropical banks, where they calve and presumably mate (Jefferson et al., 1993). Humpbacks are adaptable lunge feeders, using a variety of techniques to help concentrate krill and small schooling fish for easier feeding (Winn and Reichley, 1985). During summer, there are at least five geographically distinct humpback whale feeding aggregations occurring between latitudes 42° N. and 78° N. latitude; the western North Atlantic stock is considered to include all humpback whales (an estimated 5,450 individuals) from these five feeding areas. Humpback whales from all feeding areas migrate to the Caribbean in winter, where courtship, breeding, and calving occur, although some animals have been reported in the feeding regions during winter. There have been occasional reports of humpback whales in the northern Gulf in Florida waters: a confirmed sighting of a humpback whale in 1980 in the coastal waters off Pensacola (Weller et al., 1996); two questionable records of humpback whale sightings from 1952 and 1957 off the coast of Alabama (Weller et al., 1996); a stranding east of Destin, Florida, in mid-April 1998 (Mullin, personal communication, 1998); and a confirmed sighting of six humpback whales in May 1998 in DeSoto Canyon (Ortega, personal communication, 1998). It seems likely that some humpbacks stray into the GOM during the breeding season on their return migration northward. The time of the year (winter and spring) and the small size of the animals involved suggest that these sightings are inexperienced yearlings on their first return migration (Weller et al., 1996).

Sperm Whale

The sperm whale is the largest toothed whale. Large mesopelagic squid are the primary diet of sperm whales; other cephalopods, demersal fishes, and occasionally benthic invertebrates may also be eaten (Rice, 1989; Clarke, 1996). Sperm whales are distributed from the tropics to the pack-ice edges in both hemispheres, although generally only large males venture to the extreme northern and southern portions of their range (Jefferson et al., 1993). As a group, sperm whales seem to prefer certain areas within each major ocean basin, which historically have been termed “grounds” (Rice, 1989). As deep divers, sperm whales tend to inhabit oceanic waters, but they do come close to shore where submarine canyons or other physical features bring deepwater near the coast (Jefferson et al., 1993).

The sperm whale is the most abundant large cetacean in the GOM; it has been sighted on most surveys conducted in deeper waters (Fritts et al., 1983; Mullin et al., 1991; Davis and Fargion, 1996). Abundance estimates are 57 and 37 from ship and aerial surveys of the EPA slope, respectively, and 387 for the oceanic northern Gulf (Davis et al., 2000). Sperm whales are found primarily in deep waters beyond the edge of the continental shelf, frequently along the lower slope (1,000-2,000 m water depth), although there are a few records from over the shelf (Collum and Fritts, 1985; Mullin et al., 1994; Jefferson and Schiro, 1997). Sperm whales in the Gulf occur in waters with a mean bottom depth of 3,625 ft (1,105 m) (Davis et al., 1998).

Mesoscale patterns in the biological and physical environment are important in regulating sperm whale habitat usage (Griffin, 1999). Baumgartner (1995) noted that sperm whales avoided warm features characterized by a depressed 15°C isotherm and warm water at 328 ft (100-m) water depth; the highest sighting rates occurred in a cooler watermass characterized by intermediate to cool temperatures at 328 ft (100 m) and a moderately shallow 15°C isotherm. Sperm whales were found in waters with the steepest sea surface temperature gradient; sperm whales may forage along the thermal fronts associated with eddies (Davis et al., 1998). The GulfCet II study found that most sperm whales were concentrated along the slope in or near cyclones (Davis et al., 2000). Congregations of sperm whales are commonly seen off the shelf edge in the vicinity of the Mississippi River Delta (Mullin et al., 1994; Davis and Fargion, 1996; Davis et al., 2000). Low-salinity, nutrient-rich water from the Mississippi River, which may contribute to enhanced primary and secondary productivity in the north-central Gulf, may explain the year-round presence of sperm whales south of the delta. Sperm whales have also been sighted with some regularity in the DeSoto Canyon in the northeastern Gulf. These observations have included very large male sperm whales. It is likely that there is a resident population of sperm whales in the Gulf (Jefferson and Schiro, 1997), consisting of females, calves, and immature whales (Davis and Fargion, 1996; Weller et al., 2000). Sperm whales in the Gulf are currently considered to be a separate stock from those in the Atlantic and Caribbean (Waring et al., 1997).

West Indian Manatee

The West Indian manatee (*Trichechus manatus*) is the only sirenian known to occur in tropical and subtropical coastal waters of the southeastern U.S., GOM, Caribbean Sea, and the Atlantic coast of northern and northeastern South America (Reeves et al., 1992; Jefferson et al., 1993; O'Shea et al., 1995). There are two subspecies of the West Indian manatee: the Florida manatee *(T. m. latirostris*), which ranges from the northern GOM to Virginia; and the Antillean manatee *(T. m. manatus*), which ranges from northern Mexico to eastern Brazil, including the islands of the Caribbean Sea.

The manatee has been reported in Lake Pontchartrain and Louisiana coastal waters, but the coastal waters of Peninsular Florida and the Florida Panhandle are the manatee's normal habitat. During warmer months, manatees are common along the west coast of Florida from the Everglades National Park northward to the Suwannee River in northwestern Florida and less common farther westward. In winter, the population moves southward to warmer waters. The winter range is restricted to smaller areas at the southern tip of Florida and to waters near localized warm-water sources, such as power plant outfalls and natural springs in west-central Florida. Crystal River, in Citrus County, is typically the northern limit of the manatee's winter range on the Gulf Coast.

Notwithstanding their association with coastal areas, a manatee was documented far offshore at several OCS work barges where it grazed on algae growing on the vessel's sides and bottom (Valade, written communication, 2001). Multiple sightings of this animal occurred in October 2001 in water exceeding 5,000 ft (1,500 m) deep in Mississippi Canyon Block 85, approximately 45 mi (72 km) north of Mississippi Canyon Block 920 where the Independence Hub is proposed. This occurrence would be considered extralimital and highly uncharacteristic of the species.

3.2.4.2. Sea Turtles

Five marine turtle species inhabit or frequent the northern GOM coastal areas and are protected under the ESA as either endangered or threatened: green, leatherback, hawksbill, Kemp's ridley, and loggerhead. All except the loggerhead turtle (threatened) are endangered. Sea turtles are long-lived, slow-reproducing animals that spend nearly all of their lives in the water. Females must emerge periodically from the ocean to nest on beaches. It is generally believed that all sea turtle species spend their first few years in pelagic waters, occurring in driftlines and convergence zones (in *Sargassum* rafts) where they find refuge and food in items that accumulate in surface circulation features (Carr and Caldwell, 1956; Carr, 1987). Genetic analysis of sea turtles has revealed in recent years that discrete, non-interbreeding stocks of sea turtles make up "worldwide extensive ranges" of the various species.

Adult turtles are apparently less abundant in the deeper waters of the Gulf than they are in waters less than 80-160 ft (27-50 m) deep (NRC, 1990) and more abundant in the northeastern Gulf than in the northwestern Gulf (Thompson, 1988). Sea turtle abundance appears to increase dramatically east of Mobile Bay (Davis et al., 2000). Factors such as water depth and turbidity, bottom sediment type, salinity, and prey availability may account for this. In the offshore Gulf, sea turtle distribution has been linked to zones of convergence.

Sea turtles are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.2.5), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 3.2.8), the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Chapter III.C.5), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 3.3.4). These discussions are incorporated into this SEA by reference.

Green

The green turtle (*Chelonia mydas*) is the largest hard-shelled sea turtle and commonly reaches 330 lb (150 kg) (USDOC, NMFS and USDOI, FWS, 1990). The green turtle has a global distribution in tropical and subtropical waters. Green turtles primarily occur in coastal waters, where they forage on seagrasses, algae, and associated organisms (Carr and Caldwell, 1956; Hendrickson, 1980). Some green turtles may move through a series of "developmental" feeding habitats as they grow (Hirth, 1997). Small pelagic sea turtles are omnivorous. Adult green turtles in the Caribbean and GOM are herbivores, feeding primarily on seagrasses and, to a lesser extent, on algae and sponges. Known feeding areas for green turtles in Florida include the Indian River, Florida Bay, Homosassa River, Crystal River, and Cedar Key (USDOC, NMFS and USDOI, FWS, 1990). Green turtles in the Western Gulf are primarily restricted to the lower Texas coast where seagrass meadows and algae-laden jetties provide them developmental habitat, especially during warmer months (Landry and Costa, 1999; USDOC, NMFS, 1990).

Leatherback

The leatherback (*Dermochelys coriacea*) is the largest of the sea turtles and commonly reaches 400-1,540 lb (200-700 kg) (USDOC, NMFS and USDOI, FWS, 1992a). 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). This species is the most wide-ranging of sea turtles, undertaking extensive pelagic migrations following depth contours for hundreds, even thousands, of kilometers (Morreale et al., 1996; Hughes et al., 1998).

The leatherback's distribution is not entirely oceanic. Numerous references cited in recent MMS publications (USDOI, MMS, 2003b, page 40; USDOI, MMS, 2002; Chapter 3.2.5, Sea Turtles) indicate it is commonly found in relatively shallow continental shelf waters along the U.S. Atlantic Coast. Based on a summary of several studies, Davis and Fargion (1996) concluded that primary habitat of the leatherback in the northwestern Gulf is oceanic (>200 m (656 ft)). In contrast, the overall densities of leatherbacks in the Eastern Gulf on the shelf and in water >200 m were similar (Davis et al., 2000). Davis and Fargion (1996) suggested that the region from Mississippi Canyon east to DeSoto Canyon appears to be an important habitat for leatherbacks. The majority of sightings of leatherbacks during the GulfCet surveys occurred just north of DeSoto Canyon (Davis and Fargion, 1996; Davis et al., 2000). The nearly disjunct summer and winter distributions of leatherback sightings on the slope in the Eastern Gulf during GulfCet II indicate that specific areas may be important to this species either seasonally or for short periods of time. These specific locations are most probably correlated with oceanographic conditions and resulting concentrations of prey. Large numbers of leatherbacks in waters off the northeastern U.S. have been associated with concentrations of jellyfish (Shoop and Kenney, 1992). Other clusterings of leatherback sightings have been reported for the northern Gulf: 8 leatherbacks were sighted on one day in DeSoto Canyon (Davis and Fargion, 1996), 11 during one day just south of the Mississippi River Delta, and 14 during another day in DeSoto Canyon (Lohoefener et al., 1990).

Hawksbill

The hawksbill sea turtle (*Eretmochelys imbricata)* is a medium-sized sea turtle that can reach up to 176 lb (80 kg) (Hildebrand, 1982; USDOC, NMFS and USDOI, FWS, 1993). The hawksbill occurs in tropical and subtropical seas of the Atlantic, Pacific, and Indian Oceans. The species is widely distributed in the Caribbean Sea and western Atlantic Ocean. In the continental U.S., the species is recorded from all the Gulf States and from along the eastern seaboard as far north as Massachusetts, with the exception of Connecticut; however, sightings north of Florida are rare (USDOC, NMFS and USDOI, FWS, 1993). Stranded hawksbills have been reported in Texas (Hildebrand, 1982; Amos, 1989) and in Louisiana (Koike, 1996); these tend to be either hatchlings or yearlings. They have been reported accidentally caught in a purse seine net offshore of Louisiana (Rester and Condrey, 1996). Texas and Florida are the only states where hawksbill turtles are sighted with any regularity (USDOC, NMFS and USDOI, FWS, 1993).

Kemp's Ridley

The Kemp's ridley (*Lepidochelys kempi*) is the smallest sea turtle and the most imperiled, generally weighing less than 100 lb (45 kg). The GOM's population of nesting females has dwindled from an estimated 47,000 in 1947 to a current nesting population of approximately 1,500 females (Byles et al., 1996). The population crash that occurred between 1947 and the early 1970's may have been the result of both intensive annual harvesting of the eggs and mortality of juveniles and adults in trawl fisheries (NRC, 1990). The recovery of the species has been forestalled primarily by incidental mortality from commercial shrimping that has prevented adequate recruitment into the breeding population (USDOC, NMFS, 1992b; USDOI, FWS, 1992).

There is little prolonged utilization of offshore habitats by this species. Hatchlings appear to disperse offshore and are sometimes found in *Sargassum* mats (Collard and Ogren, 1990; Manzella et al., 1991). In the pelagic stage, the turtle is dependent on currents, fronts, and current gyres to determine their distribution. In the Gulf, Kemp's ridleys inhabit nearshore areas, being most abundant in coastal waters from Texas to west Florida (Ogren, 1989; Marquez, 1990 and 1994; Rudloe et al., 1991). Kemp's ridleys display strong seasonal fidelity to tidal passes and adjacent beachfront areas of the northern Gulf (Landry and Costa, 1999).

Loggerhead

The loggerhead sea turtle (*Caretta caretta*), reaching 250 lb (110 kg), is the most common sea turtle species in the northern Gulf (e.g., Fritts et al., 1983; Fuller and Tappan, 1986; Rosman et al., 1987; Lohoefener et al., 1990) and the most abundant species of sea turtle occurring in U.S. waters. The loggerhead occurs throughout the inner continental shelf from Florida through Cape Cod, Massachusetts.

Juvenile and subadult loggerheads are omnivorous, foraging on pelagic crabs, molluscs, jellyfish, and vegetation captured at or near the surface (Dodd, 1988; Plotkin et al., 1993). Adult loggerheads are generalist carnivores that forage on nearshore benthic invertebrates (Dodd, 1988). The banks off the central Louisiana coast and near the Mississippi River Delta are important sea turtle feeding areas (Hildebrand, 1982).

Aerial surveys indicate that loggerheads are largely distributed in water depths less than 100 m (328 ft) (Shoop et al., 1981; Fritts et al., 1983). Loggerheads were sighted throughout the northern Gulf continental shelf, near the 100-m isobath during GulfCet aerial surveys (Davis et al., 2000) and also in deep water (>1,000 m or (3,281 ft). Loggerhead abundance in slope waters of the eastern Gulf increased appreciably during winter (Davis et al., 2000). It is not clear why adult loggerheads would occur in oceanic waters, unless they were traveling between foraging sites in distant and separate areas on the continental shelf or were seeking warmer waters during winter (Davis et al., 2000). Loggerheads have been found to be abundant in Florida waters (Fritts and Reynolds, 1981; Fritts et al., 1983; Davis et al., 2000). In the Central Gulf, loggerheads are very abundant just offshore of Breton and Chandeleur Islands (Lohoefener et al., 1990).

3.3. Socioeconomic and Human Resources

Socioeconomic and human resources in the Central and Eastern Gulf are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapters 3.3.1 to 3.3.4). Offshore resources in the Eastern Gulf are characterized in the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Section III.D.1), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapters 3.3.1 to 3.3.5), and the PEA for exploration in the EPA (USDOI, MMS, 2003b; Chapter 3.4.1 to 3.4.5). All of these sources are incorporated into this SEA by reference where appropriate.

3.3.1. Socioeconomic Resources

Summaries of socioeconomic resources include (1) the impact area for the proposed Independence Hub project, (2) commercial fisheries, (3) recreational resources, and (4) archaeological resources.

3.3.1.1. Socioeconomic Impact Area

The MMS defines the GOM impact area for population, labor, and employment as that portion of the GOM coastal zone whose social and economic well-being (population, labor, and employment) is directly or indirectly affected by the OCS oil and gas industry. For this analysis, the coastal impact area consists of 80 counties and parishes along the U.S. portion of the GOM. This area includes 24 counties in Texas, 26 parishes in Louisiana, 4 counties in Mississippi, 2 counties in Alabama, and 24 counties in the Panhandle of Florida, which are listed below. Ten subareas divide the impact area for analysis purposes and are considered in Chapter 4.3 (Impacts on Socioeconomic and Human Resources) as the economic impact area for the proposed Independence Hub project.

LA-1

Acadia, LA
Calcasieu, LA
Cameron, LA
Iberia, LA
Lafayette, LA
Livingston, LA
St. Martin, LA
Vermilion, LA

LA-2

Ascension, LA
Assumption, LA
East Baton Rouge, LA
Iberville, LA
Lafourche, LA
St. James, LA
St. Mary, LA
Tangipahoa, LA
Terrebonne, LA
West Baton Rouge, LA

LA-3

Jefferson, LA
Orleans, LA
Plaquemines, LA
St. Bernard, LA
St. Charles, LA
Stone, MS
St. John the Baptist, LA
St. Tammany, LA

MS-1

Baldwin, AL
Mobile, AL
Hancock, MS
Harrison, MS
Jackson, MS
St. Landry, LA

TX-1

Aransas, TX
Calhoun, TX
Cameron, TX
Jackson, TX
Kenedy, TX
Kleberg, TX
Nueces, TX
Refugio, TX
San Patricio, TX
Victoria, TX
Willacy, TX

TX-2

Brazoria, TX
Chambers, TX
Fort Bend, TX
Galveston, TX
Hardin, TX
Harris, TX
Jefferson, TX
Liberty, TX
Matagorda, TX
Montgomery, TX
Orange, TX
Waller, TX
Wharton, TX

FL-1

Bay, FL
Escambia, FL
Okaloosa, FL
Santa Rosa, FL
Walton, FL

FL-2

Dixie, FL
Franklin, FL
Gulf, FL
Jefferson, FL
Levy, FL
Taylor, FL
Wakulla, FL

FL-3

Charlotte, FL
Citrus, FL
Collier, FL
Hernando, FL
Hillsborough, FL
Lee, FL
Manatee, FL
Pasco, FL
Pinellas, FL
Sarasota, FL

FL-4

Miami-Dade, FL
Monroe, FL

The criteria for including counties and parishes in this impact area are explained in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.3.3.1, Figure 4-1).

3.3.1.2. Commercial Fisheries

The GOM provides slightly over 18 percent of the commercial fish landings in the continental U.S. by weight on an annual basis and over 22 percent by dollar value. The most recent, complete information on landings and value of fisheries for the U.S. was compiled by NOAA Fisheries for 2002. During 2002, commercial landings of all fisheries in the GOM totaled nearly 1.7 billion pounds, valued at over $704 million (USDOC, NMFS, 2003).

The most important species, such as menhaden, shrimps, oyster, crabs, and drums, are all species that depend heavily on estuarine habitats and these fisheries are restricted to the continental shelf. Menhaden, with landings of about 1.3 billion pounds valued at $78.2 million, was the most important GOM species in terms of quantity landed during 2002. Landings remained nearly the same compared to 2000. Shrimp, with landings of about 231 million pounds valued at about $382 million was the most important GOM species in terms of value landed in 2002, but was substantially reduced from the total of 655 million pounds valued at of $478 million landed during 2000. The 2002 GOM oyster fishery accounted for over 90 percent of the national total of all oyster landings of 24 million pounds of meats, valued at about $51 million. The GOM blue crab fishery accounted for 39 percent of the national total with landings of 70 million pounds, valued at about $44 million (USDOC, NMFS, 2003).

Commercial fishing in deeper waters, that is, water >200 m (>656 ft) deep, of the GOM is characterized by fewer species, and lower landed weights and values than the fisheries on the continental shelf. Historically, the deepwater offshore fishery contributes less than 1 percent to the regional total weight and value (USDOI, MMS, 2001b; page 3-98). Target species can be classified into three groups: (1) epipelagic fishes (open waters into which enough light penetrates for photosynthesis), (2) reef fishes, and (3) invertebrates. The Independence Hub development is beyond the normal depth range of commercial reef fishes and invertebrates. While it is possible that new species of demersal fish or invertebrates may be pursued in the future, if other fisheries fail, it appears unlikely at present because of the high cost and risk of fishing in extreme water depths. In addition, considerable time, effort, and finances would have to be expended to develop markets for new species. Thus, if new fisheries develop in the deepwater Gulf, the most likely target species would be the epipelagic fishes, normally fished using surface longlines.

Epipelagic commercial fishes include dolphin, silky, and tiger sharks (many other species of shark are now protected and harvest is prohibited), snake mackerels (escolar and oilfish), swordfish, tunas (bigeye, blackfin, bluefin, and yellowfin), and wahoo (USDOI, MMS, 2001b; page 3-98). These species are widespread in the Gulf and would occur in the area of the Independence Hub project. Oceanic pelagic fishes were not landed in high quantities relative to other finfish groups. During 1983-1993 in the Eastern Gulf, however, they were very valuable, ranking second to reef fishes in average dollar value of landings. The most important species, yellowfin tuna and swordfish, were caught primarily by surface longline near the edge of the continental shelf and offshore. Catches responsible for specific State landings could have been made in waters outside the area because these fisheries operate in the open Gulf.

The Spiderman (DeSoto Canyon Blocks 620 and 621) and San Jacinto (DeSoto Canyon Block 618) gas fields occur within one of two areas in the EPA totaling 32,800 mi^2 (84,950 km^2), that is closed to pelagic longline fishing (USDOI, MMS, 2003b; Figure 3-2: USDOI, MMS, 2003a; Figure 3-9). These areas were designated by NOAA Fisheries to reduce bycatch and bycatch mortality in the pelagic longline fishery, particularly with respect to young swordfish. Surface longline fishing is prohibited in these DeSoto Canyon blocks, eliminating a space-use conflict with oil and gas activity during installation and removal of subsea production equipment.

Commercial fisheries are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.3.1), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 3.3.1), the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Chapter III.D.1), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 3.4.1). These discussions are incorporated into this SEA by reference.

3.3.1.3. Recreational Resources

Over the past 20 years the northern GOM coastal zone has become increasingly developed, with residential and recreational land use dominating the transition. In addition to homes, condominiums, and some industry, the Gulf Coast is one of the major recreational regions of the U.S., particularly for marine fishing, sports diving, and beach activities, both of which are viewed as public assets belonging to no one individual or company. There is a diversity of natural and developed landscapes and seascapes, including coastal beaches, barrier islands, estuarine bays and sounds, river deltas, and tidal marshes. Other recreational resources are publicly owned, administered, or designated. These would include (1) national and State seashores, parks, beaches, wildlife refuges, wilderness areas, and preservation areas; (2) historic sites and landmarks such as forts and lighthouses; (3) research reserves; and (4) scenic rivers and highways.

National reserves are located in the parishes with Gulf coastline − Cameron, Terrebonne, Lafourche, Jefferson and Plaquemines − and include (1) Barataria-Terrebonne National Estuary Program, (2) Atchafalaya National Wildlife Refuge, (3) Jean Lafitte National Historic Park and Reserve, and (4) Breton National Wilderness Area and Wildlife Refuge. The State of Louisiana owns or manages additional acreage in wildlife management areas. Among these are (1) Pointe-au-Chien in Terrebonne and Lafourche Parishes, (2) Wisner Wildlife Management Area in Lafourche Parish, close to Port Fourchon, and (3) Pass a Loutre in Plaquemines Parish. Birdwatching is a growing activity in Gulf Coast areas.

Although there is recreational use of the Central Gulf Coast year round, the primary season for activity on shorelines and on the water is the spring and summer. Gulf Coast residents and tourists from throughout the nation and from foreign countries use these resources extensively and intensively for recreational activity. Marine fishing and diving are important to Louisiana’s economy, generating millions of dollars in sales of equipment, transportation, food, lodging, insurance, and services. Just over one-third of the marine recreational fishing trips in the GOM extend into OCS water under Federal jurisdiction (>3 mi from shore). Very few fishing trips, however, go beyond the 200-m isobath (approximate edge of continental shelf) or are >100 mi (160 km) from shore. Recreational fishermen catch a variety of species including barracuda, shark, drum, snapper, and flounder. Recreational diving trips are popular in near shore and offshore waters near natural and artificial reefs. An MMS study found that fishing, party, and diving trips originating from Louisiana's coast numbered over 3 million in 1999, higher than any of the other three states lining the GOM (Hiett and Milon, 2002; pages 2-4). Commercial and private recreational facilities and establishments, such as resorts, casinos, marinas, amusement parks, and ornamental gardens, are also attractions.

Recreational resources are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.3.4), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 3.3.3), the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Chapter III.D.2), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 3.4.2). These discussions are incorporated into this SEA by reference.

3.3.1.4. Archaeological Resources

Archaeological resources are any material remains of human life or activity that are at least 50 years old and that are of archaeological interest. The archaeological resources regulation (30 CFR §250.194) provides specific authority to each MMS Regional Director to require archaeological resource surveys, analyses, and reports. Surveys are required prior to any exploration or development activities proposed on leases within the high-probability areas (NTL 2002-G01, *Archaeological Resource Surveys and Reports*).

3.3.1.4.1. Prehistoric

Available geologic evidence indicates that sea level in the northern GOM was at least 90 m (295 ft), and possibly as much as 130 m (427 ft), lower than present sea level, and that the low sea-stand occurred during the period 20,000-17,000 years before present (B.P.) (Nelson and Bray, 1970). Sea level in the northern Gulf reached its present stand around 3,500 years B.P. (Coastal Environments, Inc., 1986).

During periods that the continental shelf was above sea level and exposed, the area was open to habitation by prehistoric peoples. The advent of early man into the GOM region is currently accepted to be around 12,000 years B.P. (Aten, 1983). According to the sea-level curve for the northern GOM proposed by Coastal Environments, Inc. (CEI), sea level at 12,000 B.P. would have been approximately 45 m (148 ft) below the present level (CEI, 1977 and 1982). On this basis, the continental shelf shoreward of the 45-m to 60-m (148 to 197 ft) bathymetric contours has a potential for prehistoric sites dating after 12,000 B.P. Because of inherent uncertainties in both the extent of emergent continental shelf and the entry date of prehistoric man into North America, MMS adopted the 12,000 years B.P. and the 60-m (197 ft) water depth as the seaward extent of the prehistoric archaeological high-probability area.

3.3.1.4.2. Historic

With the exception of the Ship Shoal Lighthouse structure, historic archaeological resources on the OCS consist of historic shipwrecks. An historic shipwreck is defined as a submerged or buried vessel, at least 50 years old, that has sunk, stranded, wrecked, burned, or was destroyed by hostile action and is at present lying on or embedded in the seafloor. This includes vessels (except abandoned hulks) that exist intact or as scattered components on or in the seafloor. A 1977 MMS archaeological resources baseline study for the northern GOM concluded that two-thirds of the total number of shipwrecks in the northern Gulf lie within 1.5 km (0.9 mi) of shore and most of the remainder lie between 1.5 and 10 km (0.9 and 6.2 mi) (CEI, 1977). Garrison et al. (1989) found that changes in the late 19th and early 20th century sailing routes increased the frequency of shipwrecks in the Eastern Gulf to nearly double that of the Western and Central Gulf. The highest observed frequency of shipwrecks occurred within areas of intense marine traffic, such as the approaches and entrances to seaports and the mouths of navigable rivers and straits.

The Garrison et al. (1989) and Pearson et al. (In press.) shipwreck databases list about 2,100 wrecks in the GOM. They should not be considered exhaustive compilations of shipwrecks, but they do constitute the most comprehensive surveys available. These resources identify two reported shipwrecks that fall within the area of the proposed Independence Hub (Table 3-6). Regular reporting of shipwrecks did not occur until late in the 19^{th} century, and losses of several classes of vessel, such as small fishing boats, were largely unreported in official records.

Table 3-6

Shipwrecks in the Independence Hub Project Area

Area	Shipwreck Name	Date Sunk
Mississippi Canyon	*B-1*	1942
Mississippi Canyon	*Nokomis*	1905

Aside from acts of war, hurricanes cause the greatest number of wrecks in the Gulf. Wrecks occurring in deeper water on the Federal OCS would have a moderate to high preservation potential because they lie beyond the influence of storm currents and waves. Additionally, temperature at the seafloor in deep water is extremely cold, which slows the oxidation of ferrous metals and helps to preserve wood structures and features. The cold water would also eliminate the wood-boring shipworm *Terredo navalis* (Anuskiewicz, 1989).

Shipwrecks occurring in shallow water nearer to shore are more likely to have been reworked and disturbed by storms. Historic research indicates that shipwrecks occur less frequently in Federal waters, where they are likely to be better preserved, less disturbed, and, therefore, more likely to be eligible for nomination to the National Register of Historic Places than are wrecks in shallower State waters.

The NTL's 2005-G07 and 2005-G10 both became effective July 1, 2005. These NTL's, respectively, state the requirements for archaeological surveys, and requires such surveys in the Mississippi Canyon area. Because the application for the surface Hub for this project was submitted prior to the effective date of these NTL's, MMS would not require an archaeological survey as long as a shallow hazards survey and assessment have already been provided. However, all survey data in support of this project will be reviewed by MMS archaeologists. The Independence Hub will be located in Mississippi Canyon Block 920. The 12-pile mooring system for the Hub will require anchors in the four OCS blocks that are immediately adjacent to Block 920; that is, Mississippi Canyon Blocks 876, 919, 921, and 964. All of these blocks are located in a shipwreck high-probability area, and MMS requires an archaeology survey of the Hub's proposed anchor positions to establish that it is clear of any historical shipwreck.

Archaeological resources are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.3.2), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 3.3.4), the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Chapter III.D.3), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 3.4.4). These discussions are incorporated into this SEA by reference.

3.3.2. Human Resources and Economic Activity

Summaries of human resources and economic activity include (1) population and education, (2) infrastructure and land use, (3) navigation and port use, (4) current economic baseline data, (5) employment, and (6) environmental justice.

3.3.2.1. Population and Education

Table B-2 (Appendix B) shows baseline population projections for the potential impact area. Baseline projections are for the impact area in the absence of the proposed activity. The analysis area consists of highly populated metropolitan areas (such as the Houston Metropolitan Statistical Area (MSA), which dominates Subarea TX-2) and sparsely populated rural areas (as is much of Subarea TX-1). Some communities in the analysis area experienced extensive growth during the late 1970's and early 1980's when OCS activity was booming. Many of these same areas experienced a loss in population following the mid-1980's drop in oil prices (Gramling, 1984; Laska et al., 1993). All subarea populations would be expected to grow at a higher rate than the United States' average annual population growth rate over the 20-year total lifecycle of the proposed action. This trend reflects continuation of historic regional migration patterns favoring the south and west over the northeast and Midwest (USDOC, Bureau of the Census, 2001). Average annual population growth projected over the life of the proposed action ranges from a low of 0.45 percent for Subarea LA-3 (dominated by the Orleans MSA) to a high of 3.27

percent for Subarea FL-3 in the lower panhandle of Florida. Over the same time period, the population for the United States is expected to grow at about 1.36 percent per year.

This analysis uses the 2000 U.S. Census Supplementary Survey Profile educational attainment data for States. For people 25 years and over, 75.2 percent of the population in the U.S. has graduated from high school, while 20.3 percent received bachelor's degrees. Texas' educational attainment percentages are higher than the national average for both categories: 76.8 and 23.5 percent, respectively. Louisiana, while higher than the national average for high school graduates, 76.7 percent, is lower for college degrees, 19.5 percent. Mississippi's educational attainments are lower than the Nation's for both categories—74.3 and 18.6 percent, respectively. Alabama, like Louisiana, has a higher than national high school graduation rate (76.0%), but a lower rate for bachelor's degrees (20.2%). Florida mirrors Texas; its educational attainments are higher than the national rates for high school graduation and bachelor's degrees—81.9 and 23.2 percent, respectively.

Demographic trends in the area characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.3.3.4), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 3.3.5.4), the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Chapter III.D.4.b), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 3.4.5.1). These discussions are incorporated into this SEA by reference.

3.3.2.2. Infrastructure and Land Use

The GOM OCS has one of the highest concentrations of oil and gas activity in the world. The offshore oil and gas industry has experienced dramatic changes over recent years, particularly since 1981. Most of this activity has been concentrated on the continental shelf off the coasts of Texas and Louisiana. Future activity is expected to extend into progressively deeper waters. The high level of offshore oil and gas activity in the GOM is accompanied by an extensive development of onshore service and support facilities (USDOI, MMS, 2002; Figure 3-12). The major types of onshore infrastructure include gas processing plants, navigation channels, oil refineries, pipelines and pipeline landfalls, pipecoating and storage yards, platform fabrication yards, separation facilities, service bases, terminals, and other industry-related installations such as landfills and disposal sites for drilling and production wastes.

Louisiana's coastal impact area is mostly vast areas of wetlands and small communities and industrial areas that extend inland. Alabama's coastal impact area is predominantly recreational beaches, and small residential and fishing communities. Mississippi's coast consists of barrier islands, some wetlands, recreational beaches, and urban areas. Land use in the impact area varies from state to state. The coasts of Florida and Texas are a mixture of urban, industrial, recreational beach, wetland, forest, and agricultural areas.

The landfall of Hurricane Katrina on August 29, 2005, caused widespread destruction of homes, businesses, roads, bridges, and oil and gas infrastructure in St. Bernard and Plaquemines Parishes, Louisiana. Oil spills from storage tanks at one or more refineries fouled parts of these parishes.

Infrastructure and land use in the area are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.3.5), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 3.3.3), the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Chapter III.D.4), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapters 3.4.5). These discussions are incorporated into this SEA by reference.

3.3.2.3. Navigation and Port Use

A service base is a community of businesses that load, store, and supply equipment, supplies, and personnel needed at offshore work sites. Although a service base may primarily serve the OCS planning area and subarea in which it is located, it may also provide significant services for the other OCS planning areas and subareas. As OCS operations have progressively moved into deeper waters, larger vessels with deeper drafts (>27 ft or 8 m) have been phased into service mainly for their greater range of travel, greater speed of travel, and larger carrying capacity. Service bases with the greatest appeal for deepwater activity have several common characteristics: (1) a strong and reliable transportation system; (2) adequate depth and width of navigation channels; (3) adequate port facilities; (4) existing petroleum industry support infrastructure; (5) location central to OCS deepwater activities; (6) adequate worker population within commuting distance; and (7) insightful and strong leadership.

Port Fourchon and Venice, Louisiana, have longstanding and intensively used support facilities. Port Fourchon lies approximately 150 mi (142 km) northwest of Mississippi Canyon Block 920 (Figure 1-3). The designated backup onshore support base at Venice, Louisiana, lies 160 mi (257 km) northwest of Block 920. Both bases are capable of providing the services necessary for the proposed activity. They each have 24-hour service; a radio tower and phone patch; dock space; indoor and outdoor equipment and supply storage space; forklift, crane, and docking services; tractor trailer parking; and drinking water supplies. Either base will serve as a loading point for tools, equipment and machinery, drilling and completion chemicals, and crews needed for well completions and platform operations. Hurricanes Katrina and Rita caused damage to both the Port Fourchon and Venice shorebases; however, at the time of completion of this EA, Port Fourchon, the primary shorebase and port of debarkation for equipment, supplies, and crews for the Independence Hub project was back in operation and supporting deepwater projects. More severe damage was done in Venice by Katrina, but in time this base will recover as well. Overall, hurricane impacts in 2005 on these shorebases should not affect the progress of the Hub project.

Navigation and port use in the area are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.3.5), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 3.3.3), the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Chapter III.D.4.a., d., and e), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapters 3.4.5). These discussions are incorporated into this SEA by reference.

3.3.2.4. Current Economic Baseline Data

Current crude oil and natural gas prices are substantially above the economically viable threshold for drilling in the GOM. As of November 9, 2005, Henry Hub Natural Gas closed at $11.67 per million Btu and West Texas Intermediate closed at $58.93 per barrel (Oilnergy, 2005). Natural gas prices increased sharply during the last few weeks as the lower 48 states experienced hotter temperatures. The heat has lifted demand for natural gas from power generators in order to meet cooling demands across the country. The U.S. government weather forecasters also predict a colder than usual winter, which will create a higher demand on gas supplies if forecasts are correct. The higher demand for natural gas in the U.S. does not appear to have any mitigating circumstances and increased prices for this commodity are likely to be the result over the next several years.

Economic activity and employment in the area are characterized in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 3.3.5.5), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 3.3.3.5), the Final EIS for Lease Sale 181 (USDOI, MMS, 2001a; Chapter III.D.4.c), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapters 3.4.5.2). These discussions are incorporated into this SEA by reference.

3.3.2.5. Employment

Table B-3 (Appendix B) depicts baseline employment projections for the potential impact area. Baseline projections are for the impact area in the absence of the proposed activity. Average annual employment growth projected over the 20-year total life cycle of the proposed action ranges, for example, from a low of 17.8 percent increase for Subarea LA-3 (predominated by the Orleans MSA) to a high of 29.2 percent increase for Subarea FL-3 in the lower panhandle of Florida. Over this time employment for the U.S. is expected to grow at about 2.25 percent per year, while the GOM analysis area is expected to grow at about 2.06 percent per year. These projections assume continuation of existing trends in OCS activity and in other area industries.

The landfall of Hurricane Katrina on August 29, 2005, caused widespread destruction of homes, businesses, roads, bridges, and oil and gas infrastructure in southeast Louisiana. The economic impacts and the increase in employment from rebuilding these homes and facilities is likely to be a major stimulus to the area, but to quantify such impacts at this time would be impossible.

The industrial composition for the subareas in the WPA and those in the CPA are similar. With the exception of Subareas LA-2, LA-3, and FL-4, the top four ranking sectors in terms of employment in the analysis area are the service, manufacturing, retail trade, and State and local government sectors. In Subareas LA-2 and LA-3, construction replaces manufacturing as one of the top four industries on the basis of employment. In Subarea FL-4, transportation, communication, and public utilities replaces manufacturing as one of the top four industries on the basis of employment. The service industry employs more people in all subareas and is also the fastest growing industry.

3.3.2.6. Environmental Justice

Environmental justice is defined by the USEPA as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies." (USEPA 1999b; page 7). Environmental justice policy, based on Executive Order 12898 (dated February 11, 1994) requires Federal agencies to determine whether their proposed actions will result in disproportionately high and adverse environmental effects on minority and low-income populations. Minority populations, as designated by the Council on Environmental Quality (CEQ), include American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic (CEQ, 1997; page 25). Low income populations for this analysis were determined based on the U.S. Dept. of Commerce, Bureau of Census, 1999 poverty thresholds (U.S. Census Bureau, 2005).

Onshore locations potentially impacted by the Independence Hub project include Plaquemines and Lafourche Parishes in Louisiana, and San Patricio County in Texas. Plaquemines Parish does not contain significant percentages of minority or low-income populations to constitute an environmental justice concern. According to a recent study by MMS, south Lafourche Parish still provides valuable habitat land for traditional subsistence activities such as hunting, fishing, and trapping practiced by the Houma Indians and other groups in the area (Hemmerling et al., 2003). The area around the onshore support base at Port Fourchon, however, is sparsely populated and does not constitute a significant environmental justice concern (Hemmerling and Colten, 2003). Fabrication for the Hub topside facilities will occur at the Kiewit Offshore Services site in the city of Ingleside in San Patricio County, Texas. San Patricio is an area of environmental justice concern as it contains a 50 percent minority (Hispanic) population. In addition, the City of Ingleside also contains an EPA active Superfund site.

4. POTENTIAL IMPACTS ON PHYSICAL, BIOLOGICAL, SOCIOECONOMIC, AND HUMAN RESOURCES

This chapter identifies the impact-producing factors and the potential impacts on physical, biological, socioeconomic, and human resources as a result of the proposed Independence Hub in Mississippi Canyon Block 920. Impacts on these resources from the perspective of the OCS oil and gas program can be found in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 4.5) and the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 4.5). These discussions are incorporated into this SEA by reference.

4.1. IMPACTS ON PHYSICAL RESOURCES

4.1.1. Impacts on Water Quality

The impact-producing factor likely to have the most impact on water quality would be spilled oil; however, these potential impacts are not a major consideration for this proposal because the Independence Hub would produce predominantly gas with minor condensate. Approximately 1-2 bbl of condensate are expected to be produced for every MMcf of natural gas. The design basis peak production for Independence Hub liquids is 4,250 bbl of condensate per day. The weight of the condensate varies by field, but generally ranges from very light to medium in the American Petroleum Institute specific gravity spectrum.

Sources that originate upriver from the Mississippi River Delta as well as coastal sources contribute to water quality degradation in nearshore and offshore environments of the GOM. These sources can be broadly characterized as point or nonpoint, and industrial, agricultural, or municipal. They include the following: (1) petrochemical industry; (2) agriculture, including livestock and fish processing; (3) forestry, including pulp and paper mills; (4) paved and developed urban areas; (5) municipal and industrial point sources; (6) power generation; (7) marinas and recreational boating; (8) maritime shipping; and (9) hydromodification activities.

No blowouts are projected as a result of 21 well completions and gas production from the Independence Hub based on historical trends in the GOM (Appendix A). No spills of condensate or diesel fuel are expected. If diesel should spill from the Hub, an installation or completion rig, or service vessels, or if condensate spills during production, it would tend to be volumetrically small and would take place close to the Hub in Mississippi Canyon Block 920, along pipeline flowlines, or at the subsea production infrastructure located at well sites (Appendix A). The natural gas being produced is not spillable.

A discussion of impacts on coastal and offshore water quality from OCS activity is provided in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapters 4.1.3.4 and 4.2.1.3), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapters 4.1.3.4 and 4.2.1.2), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 4.3.1.2). These discussions are incorporated into this SEA by reference.

4.1.1.1. Impacts on Coastal Waters

The impact-producing factors associated with installation and production of the Independence Hub project in Mississippi Canyon Block 920 that could affect coastal water quality include (1) effluents from onshore support bases and OCS service vessels, such as sanitary and domestic wastes; (2) turbidity increases from vessel traffic; (3) and accidental spills of crude oil, diesel fuel, or other materials from vessels in coastal waters.

Domestic and sanitary waste would be discharged from support vessels after required treatment. Effects on coastal waters from the Independence Hub project would primarily occur in heavy traffic areas such as navigation corridors and turning basins at Port Fourchon and Venice, Louisiana, the designated onshore support bases. State regulations are in place to control contaminants associated with waste discharges that take place onshore. Minor and transient changes in water quality caused by vessel or onshore discharges, such as localized enriched nutrient contents or oxygen depletion, would be intermittent.

Service vessels that use navigation channels, turning basins, shallow harbors, and docking facilities can cause increases in water turbidity from mud resuspended by propeller wash. Dredging and spoil disposal carried out to maintain, deepen, or straighten navigation channels can also increase the turbidity of coastal waters. Actions attributed specifically to vessels supporting the Independence Hub project would add incremental impacts, but to an insignificant degree.

Effluents from the petrochemical industry are regulated by USEPA NPDES permits or State environmental agency permits and by USCG regulations. Petrochemical infrastructure includes facilities for the development, transportation, and processing of the extensive oil and gas resources found onshore in Louisiana, within State waters, on the Federal OCS, and imports transported into the area from other states and foreign suppliers.

The NRC recently released a revised assessment of *Oil in the Sea III: Inputs, Fates, and Effects* (NRC, 2003). Nearly 85 percent of the 672,700 bbl of petroleum that enter North American ocean waters each year as a result of human activity comes from activities based on the consumption of petroleum such as (in relative order): (1) land-based runoff and polluted rivers; (2) recreational boats and jet skis; particularly those with 2-cycle engines; (3) deposition from the atmosphere; and (4) jettison of aircraft fuel (NRC, 2003; Table 3-2). Approximately 9 percent comes from transportation activity, such as tanker or pipeline spills, and only 3 percent from spills during oil exploration and extraction (NRC, 2003; pages 2-3).

The Independence Hub project is located approximately 92 mi (148 km) from the nearest Louisiana coastline (Mississippi River Delta, Plaquemines Parish). The distance of this project from coastal waters introduces lengthy spill travel times and tremendous dilution factors for any accidental spills of condensate or diesel fuel. Spills that affect coastal waters would tend to originate from vessels in transit to or from the coastal area. Spills that occur in Mississippi Canyon Block 920 present an extremely small likelihood of affecting coastal water resources. A blowout of one of the 21 wells from the nine anchor fields that will supply the Independence Hub is unlikely during the completion activity because of well control protocols and installation of a blowout preventer on each wellhead. Spills of condensate or chemicals used to prevent hydrate formation could occur from accidents aboard the Hub or through the rupture of umbilicals, gathering flowlines, or the Independence Trail export trunk line. Spills of diesel fuel could occur in offshore waters from vessels during fuel transfer accidents. If a large spill (≥1,000 bbl) were to occur at the surface or originate from a well blowout, the condensate would form a thin surface slick. Response efforts can recover or disperse some of the slick, and high surf could contribute to its break-up while at sea. Weathering and evaporation of volatile organics can degrade a slick while at sea. Slicks existing for 10 days or more have a small chance to wash ashore. Coastal environments can take several years to recover from oiling, as was observed on Texas beaches after the *Ixtoc* blowout in 1979-1980. Oil can also be trapped in the marsh grass of coastal wetlands where it would affect the local water quality while degrading.

Some wastes not permitted for offshore disposal are brought ashore for disposal or recycling and can present spill hazards if not handled properly. Nonhazardous oil-field wastes include oil-based drilling fluids, specialized liquid wastes ("fracing" fluids, i.e., fluids forced into formations to fracture, dissolve cement, or prop open pore throats), emulsifiers, workover fluids, mud additives, and possibly well test solids and produced sand would also transported across coastal waters to shore. The recycling or disposal facilities for these waste products generally lie inland rather than directly on the coasts. Spillage or improper storage of these wastes at dockside facilities can adversely impact surrounding coastal waters and wetland areas.

Conclusion

No significant long-term impacts on coastal water quality would be expected from the Independence Hub project. Because the Hub would use existing onshore support bases, only discharges from these support bases and service vessels there or in transit would result in effects to coastal waters. The Hub project's contribution to impact-producing factors is expected to be very minor, transient, and not contribute significantly to degradation of coastal water quality. Spilled oil originating in coastal waters and attributable to the Independence Hub project would not be ≥1,000 bbl and is expected to be substantially recovered while still at sea. If a diesel spill occurred from the Hub, installation rig, or service vessels, it is expected to be within historical norms for this category of spill (10-100 bbl).

4.1.1.2. Impacts on Offshore Waters

The impact-producing factors associated with installation and production of the Independence Hub project in Mississippi Canyon Block 920 that could affect offshore water quality include (1) degradation of GOM offshore waters from coastal activity, runoff, and riverine inputs; (2) discharges, such as produced water, from offshore OCS oil and gas production; (3) activities that contact or disturb the sea bottom to cause increased turbidity; (4) oil spill from a well blowout, and (5) accidental spills of condensate, diesel fuel, or other materials from service vessels in offshore waters.

Operations

Water depths in the Independence Hub project area range from 8,000 to 9,000 ft (2,438 to 2,743 m). These ultra-deep marine waters and environments would be most directly affected by the Independence Hub's presence and operation.

A range of effluents and wastes would be discharged overboard from the Independence Hub. Overboard discharges and wastes intended for onshore disposal from the project are shown in the wastes and discharge tables (Tables 1-6 and 1-7). The types and discharge rates will be in accordance with the USEPA NPDES General Permit GMG290000 for USEPA Region 6 that was reissued October 7, 2004 (*Federal Register*, 2004). Wastes destined for onshore disposal or recycling pose no potential impacts to affected resources unless spilled.

Estimates for total overboard discharges and wastes taken onshore during the Independence Hub project are shown in Table 4-1. The cumulative estimates in Table 4-1 are based on per well estimates or were calculated with the discharge rates noted in Chapter 1.3.9 over 16 months of well completion, pipeline/Hub installation, 20-year production life, and decommissioning, except where otherwise noted.

Table 4-1

Estimated Quantities of Overboard Discharges and Wastes for the Proposed Independence Hub Project

Waste Type	Duration (yr)	Cumulative Volumes (bbl)
Hub Domestic Water	20	208,570
Hub Sanitary Water	20	139,047
1 Completion Rig Domestic Water	1.3	10,390
1 Completion Rig Sanitary Water	1.3	6,930
2 Service Vessels—Sanitary and Domestic Water*	20	312,857
Drilling Mud	1.3	+11,400
Seawater and Caustic Soda	1.3	+152,000
Hub Deck Drainage	20	**657,000
Produced Water	20	7,300,000
Produced Sand (taken onshore)	20	4,000
Uncontaminated Ballast Water	20	8,687,000
Desalinization Unit Water	20	2,628,000
Chemically Treated Sea/Fresh Water (taken onshore)	1.3	+420
Solid Wastes (taken onshore)	20	++7,542

* Service vessels (1 crewboat and 1 service boat with a total crew of 30).
** Rainfall dependent, maximum estimated.
\+ Based on per well estimate for 21 wells.
++ Total of 1,200 m^3; conversion factors 1 m^3 = 264 U.S. gallons, 1 bbl = 42 U.S. gallons.

The APC estimates 16 months to install the Hub, complete 21 wells, install flowlines and subsea equipment, and install the Independence Trail export trunk line, followed by 20 years of production. For simplicity, the project duration is estimated at 21.3 years or 255 months. Volumetrically, the largest overboard discharge during production would be 7,300,000 bbl of produced water (see discussion of produced water in Chapter 1.3.9), for which APC indicates that discharge would be at the sea bottom.

Sanitary and domestic waste discharges from the Hub and service vessels are based on their crew size. The MMS estimates 20 gal/day/person of sanitary waste (blackwater) and 30 gal/day/person of domestic water (graywater) for the 40-person crew aboard the Hub and for the completion rig crew estimated at 30 people. A combined total of 60 gal/day/person for domestic and sanitary wastes is estimated for service vessels (NERBC, 1976). A crewboat and a supply boat are estimated to have a total crew of 30. Domestic and sanitary discharges would be expected to increase nutrient input and biochemical oxygen demand (BOD) slightly in receiving water, but this is not a concern in open oceanic waters. Other discharges from development activities such as deck drainage, well treatment or completion fluids, and uncontaminated seawater used for cooling are either benign or would affect water quality only with a few feet of discharge outfalls. Uncontaminated ballast water is completely benign. Deck drainage undergoes treatment in separators to remove small fractions of grease or oil, and sanitary wastes and domestic wastes undergo chlorination and grinding, respectively, to kill bacteria and reduce particle size before discharge. The nutrient content or BOD of water within 50 ft (15 m) of the discharge point may be increased slightly. No significant impacts on any physical or biological resources in the Independence Hub project area would be expected from the overboard discharge of any of these wastes.

Large quantities of sediment would be resuspended because of direct disturbance of the sea bottom. These disturbances would include Hub anchoring, subsea equipment and in-field flowline placement, and jetted sediment from installation of 20 mi (32 km) of the Independence Trail export trunk line in the part of its route between West Delta Blocks 91 and 68 that lies in water <200 ft (61 m) deep. An estimate of 282,000 ft^3 (8,000 m^3) of mud and silt would be resuspended for each mile of pipeline buried (USDOI, MMS, 2002; page 4-14), for an estimated total of 5,640,000 ft^3 (160,000 m^3) of resuspended sediment during installation. Resuspended sediment has little impact on water quality because it occurs close to the sea bottom and inflicts no deleterious effect on the water itself except perhaps causing resuspension of contaminants that may have been deposited in the sediment. These effects are insignificant at depths of 7,920 ft (2,414 m) at the Hub and similar depths at the locations for subsea production equipment.

The well completion process would discharge relatively small quantities of water-based drilling mud at the seafloor as the temporary cement plugs installed at the time the well was temporarily abandoned are drilled through. Similarly, TCW fluids consisting of caustic soda or other specialized fluids would be circulated downhole and discharged at the sea floor, or in some cases collected for onshore recycling. These discharge types and quantities are spatially separated between the nine anchor gas fields and restricted to the Hub installation period of 1.3 years.

Decommissioning effects would be similar in scope and magnitude with offshore construction and installation operations. Disturbances of the sea bottom would be reduced if flowlines and some parts of the subsea production system were to be abandoned in place.

Accidental Events

Failure or disconnects of a riser system could result in release of some or all of the fluid in the annuli. Riser system failures and disconnects, though not common, have occurred in the past (USDOI, MMS, 2003a). Should the annular fluid, typically an insulating agent, be released into the water column from a riser failure, no impacts to physical or biological resources would be expected for the following reasons: (1) the maximum quantity of fluid that could be released in an incident is small (approximately 500 bbl); (2) the physical characteristics and low toxicity of the fluid itself (brine based) are essentially benign; and (3) any incident would take place in water 7,920 ft (2,414 m) deep and any released fluid would be rapidly dispersed and diluted. Leaks from umbilicals, gathering lines, or surface storage tanks could result in the release of methane hydrate-inhibiting chemicals, such as methanol and glycols. No impacts to physical or biological resources would be expected because these chemicals are highly miscible in water and because they would rapidly disperse and biodegrade (Boehm et al., 2001).

No blowouts are projected as a result of 21 well completions and gas production from the Independence Hub based on historical trends in the GOM (Appendix A). No spills of condensate or diesel fuel are expected. If diesel should spill from the Hub, an installation or completion rig, or service vessels, or if condensate spills during production, it would tend to be volumetrically small; and would take place close to the Hub in Mississippi Canyon Block 920, along pipeline flowlines or at the subsea production infrastructure located at well sites (Appendix A). The natural gas being produced is not spillable.

A surface slick from an oil spill begins to weather as soon as it forms, depending on a number of factors, particularly the characteristics of the released oil and oceanographic conditions. Some of the subsurface oil may disperse within the water column. Evidence from a recent experiment in the North Sea indicated that oil released during a deepwater blowout [844 m (2,769 ft) water depth] would quickly rise to the surface and form a slick (Johansen et al., 2001). A variety of physical, chemical, and biological processes act to disperse and degrade the slick once oil enters the ocean. These include spreading, evaporation of the more volatile constituents, dissolution into the water column, emulsification of small droplets, agglomeration sinking, microbial modification, photochemical modification, and biological ingestion and excretion. Some oil from the slick would be mixed into the water and dispersed by wind and waves. The quality of marine waters on the surface or in a rising subsurface plume from a blowout would be temporarily affected by the solubility of hydrocarbon components and by small, dispersed oil droplets that do not rise to the surface because of current activity or that are mixed downward by surface turbulence. Dispersion by currents and microbial degradation remove the oil from the water column and eventually dilute the constituents to background levels.

Conclusion

No significant long-term impacts on offshore water quality would be expected from the proposed Independence Hub project. Near-bottom water quality would be affected by increased turbidity and disturbed substrates during the period of installation of subsea infrastructure, including the anchors and mooring chains, subsea production infrastructure, risers, and pipelines that would transport the oil and gas to the Hub and from the Independence Hub development to shore. Any effects from the elevated turbidity would be short term, localized, and reversible. Small numbers of bottom-dwelling invertebrates may be killed or adversely impacted.

Impacts on offshore water quality from the operational discharges that would be expected to result from the Independence Hub project are insignificant because of (1) existing environmental regulations, (2) great water depth, (3) distance of the project and grid from the coast, (4) spill transit times, and (5) dilution factors. An accidental oil spill would affect water quality at the surface (top few meters of the water column). Spilled oil originating from the project would not be ≥1,000 bbl and is expected to be substantially recovered while still at sea. Operator-initiated activities to contain and clean up an oil spill would begin as soon as possible after an event. Small quantities of unrecovered oil would weather and largely biodegrade within two weeks.

4.1.2. Impacts on Air Quality

Air quality would be affected in the immediate vicinity of the completion rig, the Hub installation rig, service vessels, and aircraft. The cumulative impact from emissions for APC's DOCD will not exceed the MMS's exemption levels. The proposed well completion, Hub installation, and production activities are not expected to significantly affect onshore air quality. The distance from Mississippi Canyon Block 920 to any Prevention of Significant Deterioration Class I air quality area such as the Breton National Wildlife Refuge is >200 km (124 mi). Lafourche Parish, the location of the primary service base of Port Fourchon, is not in attainment for ozone (USDOI, MMS, 2002; Figure 3-1).

Air quality could be affected by a gas release from a well or pipeline that is part of the Hub. Methane, the main constituent of natural gas, is a so-called greenhouse gas. A gas release to the atmosphere would increase the amount of greenhouse gas in the atmosphere by an infinitesimal amount. Greenhouse gases in the atmosphere have been implicated in climatic perturbations.

Air quality could be affected in the event of spilled condensate. The volatile organic compounds (VOC), which would escape to the atmosphere from a surface slick, are precursors to photochemically produced ozone. A spike in VOC's could contribute to a corresponding spike in ozone, especially if the release were to occur on a hot sunny day in a NO_2-rich environment. The corresponding onshore area is in attainment for ozone. If a fire occurs, particulate and combustible emissions will be released in addition to the VOC's.

A discussion of impacts on coastal and offshore air quality from OCS activity is provided in the CPA/ WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 4.2.1.4), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 4.2.1.1), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 4.3.1.1). These discussions are incorporated into this SEA by reference.

Conclusion

No significant long-term impacts on air quality would be expected from the proposed Independence Hub project. The air quality in the immediate vicinity of the proposed activities would be affected by the projected emissions. The distance between the Independence Hub project area and the shoreline introduces tremendous dilution factors for point-source emissions in Mississippi Canyon Block 920. No special mitigation, monitoring, or reporting requirements apply to this project.

4.2. Impacts on Biological Resources

4.2.1. Impacts on Coastal Resources

The impact-producing factor that could have the most impact on coastal resources is spilled oil. These potential impacts are not an issue with this proposal because the Independence Hub would produce predominantly gas with minor condensate. The peak production level for condensate from the Independence Hub is 4,250 bbl of condensate per day.

The impact-producing factors associated with the proposed installation, production, and decommissioning of the Independence Hub project in Mississippi Canyon Block 920 that could affect barrier beaches and dunes, wetlands, and subtidal seagrass communities include (1) oil spills from blowouts, (2) chemical or diesel fuel spills from service vessels, and (3) oil-spill response and cleanup. Large oil spills represent a high consequence and low-probability accidental event when they make landfall.

No blowouts are projected as a result of 21 well completions and gas production from the Independence Hub based on historical trends in the GOM (Appendix A). No spills of condensate or diesel fuel are expected. If diesel should spill from the Hub, an installation or completion rig, or service vessels, or if condensate spills during production, it would tend to be volumetrically small, and would take place close to the Hub in Mississippi Canyon Block 920, along pipeline flowlines or at the subsea production infrastructure located at well sites (Appendix A). The natural gas being produced is not spillable.

Appendix A (Table A-4) indicates Gulfwide oil-spill occurrence rates. The statistics show that there have been numerous spills of >1 but <50 bbl but very few spills ≥1,000 bbl for all OCS operations per billion barrels of oil handled. A blowout is the only accident category that could yield a spill ≥1,000 bbl over the 20-year life cycle of Independence Hub field production. The probability of a blowout is small (less than 1 in 100,000), and the combined probability of a spill ≥1,000 bbl making landfall in Louisiana or adjacent states would be extremely small (<0.5%).

Spills that could occur in the deepwater environment in the Independence Hub project area would consist of condensate, a light molecular weight hydrocarbon prone to volatilize rapidly at the sea surface in comparison to crude oil. It would not be large enough to enable it to persist long enough in the marine environment before weathering processes significantly degrade the spill before it landfalls. The transport time would allow a slick to weather, dissolve, and disperse while still in the marine environment. If a spill occurs at sea, mechanical cleanup is assumed to collect up to 10 percent of spilled oil. Approximately 30 percent is assumed to be chemically dispersed, further reducing the overall probability and severity of spills that may enter coastal waters and make landfall. Because landfall of spilled oil, diesel fuel, drilling fluids, or chemicals is highly unlikely from the proposed activities, the potential impacts from spill landfall, (i.e., response and cleanup activities on barrier beaches and dunes, wetlands, and seagrass communities) would not be expected to occur.

An inland fuel-oil spill may occur at a shore base as a result of a vessel collision or rupture of an inshore pipeline. The probability of an inland or inshore fuel-oil spill occurring in association with the proposed action is very small. Should a spill occur inshore or in nearshore waters, it presents a greater potential for adversely impacting wetlands than an offshore deepwater spill simply because of its proximity to coastal resources and the short travel times to reach them.

Oil-spill response activity is governed by area contingency plans (ACP) authorized by the Oil Pollution Act and coordinated by the USCG. These plans specify response procedures, priorities, and appropriate countermeasures for local coastal resources. The cleanup of slicks in wetland areas or protected waters (0-5 ft or 0-1.5 m deep) may be performed using "john" boats, booms, anchors, and skimmers mounted on boats or shore vehicles. Oil-spill cleanup personnel in water shallower than about 3 ft (1 m) may simply wade through the water to complete their tasks. Trampling by foot traffic, swamp buggies, and cleanup equipment can cause damage to sensitive coastal resources by working oil more deeply into the sediments so that it is less available for dissolution, oxidation, or microbial degradation.

The loss of sensitive coastal environments from subsidence can result from multiple causes including (1) natural compaction of deltaic muds; (2) fluid withdrawal, either oil water or natural gas; (3) dredging to maintain channels; (4) flood control projects; (5) listric faulting; and (6) construction and channelization (USDOI, MMS, 2002; page 4-54). Insofar as the oil and gas industry on the OCS is one of many industrialized uses of coastal waters, it contributes to cumulative impacts like subsidence consistent with its proportion of total activity.

In 2005, the Mississippi and Louisiana coastlines and barrier islands were severely impacted by the landfall of Hurricane Katrina at 8:00 a.m. on August 29. Katrina made landfall with sustained wind velocities in Slidell, Louisiana, of 176 mph, with tidal surges of 23-26 ft (7-8 m) (City of Slidell, 2005). Complete destruction of homes and businesses from tidal surge and wind along the coastline between Gulfport and Biloxi, Mississippi, took place many miles inland. The eye of Katrina passed over the Chandeleur Islands in St. Bernard Parish, Louisiana. The degree to which the Chandeleur barrier system or the barrier islands off the Mississippi coast were affected by Katrina's storm surge is yet to be officially documented.

Three weeks after Katrina, Hurricane Rita made landfall near Cameron, Louisiana, near the Texas-Louisiana border in southwestern Louisiana. Rita was a Category 3 hurricane that caused additional flooding in levee-damaged parts of New Orleans.

A discussion of impacts on sensitive coastal resources from OCS activity is provided in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 4.2.1.1), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 4.2.1.3), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 4.3.2). These discussions are incorporated into this SEA by reference.

4.2.1.1. Impacts on Barrier Beaches and Dunes

The Isles Dernieres and Timbalier barrier islands lie a few miles off the Louisiana coast and many miles northwest of the Independence Hub project area. These islands lie seaward of, or adjacent to, large bays or estuaries. Spill volumes of drilling fluids, chemicals, or diesel that could occur from the proposed activity are very unlikely to be large enough to impact barrier beaches or dunes. The likelihood of contact of spilled materials with these resources is dependent on the meteorological and current conditions at the time of the spill, and the quantity and location of the spill.

In coastal Louisiana, heights of dune lines range from 1.6 to 4.3 ft (0.5-1.3 m) above mean high tide levels. An analysis of 37 years of tide-gauge data from Grand Isle, Louisiana, shows that the probability of water levels reaching lower sand dune elevations ranges up to 16 percent. For spilled condensate to move onto beaches or across dunes, strong southerly winds must persist for an extended time prior to or immediately after the spill to elevate water levels. Strong winds would accelerate oil-slick dispersal, spreading, and weathering, thereby reducing impact severity at a landfall site. Any barrier beach or dune contact by a spill associated with the proposed activity is very unlikely except during abnormally high water levels, such as might occur during a hurricane. A study in Texas showed that oil disposal on sand and vegetated sand dunes had little deleterious effects on the existing vegetation or on the recolonization of the oiled sand by plants (Webb, 1988). Oil or its components that remain in the sand after cleanup may be (1) released periodically when storms and high tides resuspend or flush beach sediments, (2) decomposed by biological activity, or (3) volatilized and dispersed during hot or sunny days.

The cleanup operations associated with large oil spills can affect the stability of barrier beaches more than the spill itself. Cleanup of oil spills that contact beaches is described in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002). Beach cleanup can affect beach stability if large quantities of sand are removed. Affects from no noticeable change to accelerated rates of shoreline erosion in sand-starved or eroding barrier beaches, such as those found on the Louisiana coast, can occur when beach profiles are changed after sand removal. Disturbed beach would adjust to approximately predisturbance conditions within a few months to 2 years after a cleanup. Some beached oil and tarballs would penetrate or be buried to various depths under the sand, depending upon the viscosity of the oil, wind and wave energies, and the temperature, wetness, and nature of the sand. Some of this oil may be beneath the reach of cleanup methods and may remain in the sand.

A discussion of impacts on barrier beaches and dunes from OCS activity is provided in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 4.2.1.1.1), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 4.2.1.3.1), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 4.3.2.1). These discussions are incorporated into this SEA by reference.

Conclusion

No significant long-term impacts on the physical shape and structure of barrier beaches and dunes would be expected from accidental spills of condensate, diesel fuel, or chemicals. The probability of a blowout or pipeline rupture is small (less than 1 in 100,000) and the combined probability of a spill ≥1,000 bbl making landfall in Louisiana or adjacent states would be extremely small (<0.5%). There is a very low probability of a diesel fuel spill at the proposed Independence Hub or aboard a service vessel that would be greater than historical norms (10-100 bbl). Spilled condensate simply would not endure long enough in the marine environment to make landfall. Should a spill landfall and a cleanup take place, impacts on barrier beaches and dunes would be minimal. Recovery periods longer than 2 years would be very unlikely.

4.2.1.2. Impacts on Wetlands

Forested wetlands (bottomland and swamp), bay and canal-fringing wetlands, and marshes occur along the southern Louisiana coastline. Spill volumes of crude oil, diesel fuel, or drilling fluids that might occur from the proposed installation, production, and decommissioning activities are extremely unlikely to be large enough to impact wetlands. Elevated tides or strong southerly winds would be needed to drive a surface slick into coastal waters and environments. High winds would act to disperse oil slicks before they contact vegetated wetlands behind barrier islands, pass over narrow shoreline beaches, or penetrate inland along shorelines lacking beaches; like many parts of coastal Louisiana. The waters in bays and estuaries tend to be warmer and contain more suspended particulate matter than offshore Gulf waters. Small oil droplets can adhere to particles in suspension that act as nucleation points for oil to settle from the water and enter bottom sediments; thereby accelerating dispersion of the slick. For these reasons, no offshore spills related to the installation, production, and decommissioning activities of the proposed action would be expected to significantly impact inshore wetlands. Should contact occur, oiling would be very light and spatially isolated, with impacts to vegetation unlikely to exceed 2 years.

An inland fuel-oil spill may occur at a shore base or as a result of a vessel collision. The probability of an inland, fuel-oil spill occurring in association with the proposed action is very small. Should a spill occur inshore or in nearshore waters, it presents a greater potential for adversely impacting wetlands than an offshore deepwater spill simply because of its proximity to coastal resources and the short travel times to reach them. The works of several investigators (Webb et al., 1981 and 1985; Alexander and Webb, 1983, 1985, and 1987; Lytle, 1975; Delaune et al., 1979; Fischel et al., 1989) evaluated the effects of potential spills to area wetlands. For wetlands along the central Louisiana coast, the critical oil concentration is assumed to be 1.0 l/m^2 of marsh. Concentrations above this would result in longer-term effects to wetland vegetation, including some plant mortality and loss of land. Concentrations less than this may cause diebacks for one growing season or less, depending upon the concentration and the season during which contact occurs.

A discussion of impacts on wetlands from OCS activity is provided in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 4.2.1.1.2), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 4.2.1.3.2), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 4.3.2.2). These discussions are incorporated into this SEA by reference.

Conclusion

No significant long-term impacts on the configuration and structure of salt-, brackish-, or freshwater wetlands would be expected to occur from accidental spills of condensate, diesel fuel, or chemicals. The probability of a blowout or pipeline rupture is small (less than 1 in 100,000) and the combined probability of a spill ≥1,000 bbl making landfall in Louisiana or adjacent states would be extremely small (<0.5%). There is a very low probability of a diesel fuel spill at the proposed Independence Hub or aboard a service vessel that would be greater than historical norms (10-100 bbl). Spilled condensate simply would not endure long enough in the marine environment to make landfall. Should a spill landfall and a cleanup take place, impacts on wetlands would be insignificant. Recovery periods longer than 2 years would be very unlikely.

4.2.1.3. Impacts on Seagrass Communities

Seagrass meadows occur in protected environments behind barrier islands and are among the most common coastal ecosystems in the Gulf. These communities are much less common along coastal Louisiana, however, than elsewhere along the Gulf Coast, particularly in the Eastern Gulf. Spill volumes of crude oil, diesel fuel, or other chemicals that might occur from the proposed installation, production, and decommissioning activities are extremely unlikely to be large enough to impact seagrass communities. Subtidal seagrasses have generally experienced little or no damage from oil spills (Chan, 1977; Zieman et al., 1984).

The extensive rhizome root system for seagrass protects much of the biomass in sediment and therefore makes the ecosystem resilient. Seagrasses are usually protected from exposure to the air and therefore from direct contact with spilled oil, except under unusual conditions such as wind-enhanced extreme low tides. If such an extraordinary event is coupled with landfall of an oil slick, dieback of all exposed vegetation could occur until regenerated in the next 1-2 growing seasons. Fauna living among seagrasses and epifauna attached to grass fronds can be fouled and smothered. Minute oil droplets in water, whether emulsified or bound to suspended particulates, may adhere to fronds, other marine life, or settle to the bottom. Oil may be ingested by filter-feeding or sediment-ingesting invertebrates, degrading the health or diversity of the fauna living within with seagrass communities.

Damage could occur to seagrass communities from secondary effects caused by an oil slick on water over a seagrass community. Depending upon slick thickness, currents, and the nature of the coastal geography an oil slick might be large enough to remain over a submerged bed of vegetation long enough to reduce light levels reaching the sea bed. If light reduction continued for several days, chlorophyll contents in grass fronds will decrease (Wolfe et al., 1988) causing yellowing and reduced productivity, but not likely causing mortality.

A slick that resides over submerged vegetation in an embayment will reduce or eliminate oxygen exchange between the air and the water of the embayment (Wolfe et al., 1988). The circulation of oxygenated water between a restricted embayment and the open environment depends on tides, currents, weather, temperature, slick coverage, and biochemical oxygen demand (BOD). Seagrass communities and related epifauna can be stressed and perhaps suffocated if a stationary oil spill shades the sea bed for a matter of days to weeks. Dieback of weakened seagrasses caused by shading or high BOD would not seriously damage the ecosystem, nor would irreversible impacts occur.

Vessels that vary their transit route or depart from established navigation channels can directly scar subtidal seagrass beds with their propellers, keels (or flat bottoms), and anchors (Durako et al., 1992). These scars can be significant enough to be visible from Earth orbit.

A discussion of impacts on submerged seagrass communities from OCS activity is provided in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 4.2.1.1.3), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 4.2.1.3.3), the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 4.3.2.2). These discussions are incorporated into this SEA by reference.

Conclusion

No significant long-term impacts on the configuration or structure of subtidal seagrass communities would be expected to occur from accidental spills of condensate, diesel fuel, or chemicals. The probability of a blowout or pipeline rupture is small (less than 1 in 100,000) and the combined probability of a spill ≥1,000 bbl making landfall in Louisiana or adjacent states would be extremely small (<0.5%). There is a very low probability of a diesel fuel spill at the proposed Independence Hub or aboard a service vessel that would be greater than historical norms (10-100 bbl). Spilled condensate simply would not endure long enough in the marine environment to make landfall. Should a spill landfall and a cleanup take place, impacts on subtidal seagrass communities would be insignificant. Recovery periods longer than 2 years would be very unlikely.

4.2.1.4. Impacts on Coastal and Marine Birds

The impact-producing factors associated with installation, production, and decommissioning of the Independence Hub project in Mississippi Canyon Block 920 that could affect coastal and marine birds include (1) air emissions; (2) helicopter and service-vessel traffic and noise; (3) lights from the Hub; and (4) effluents, produced water, trash, and debris from the Hub and service vessels. The impact-producing factor likely to have the most impact on offshore biological resources is spilled oil and oil-spill response activity; however, this potential is much diminished because the Independence Hub would produce predominantly gas with minor condensate. These impact-producing factors apply to nonthreatened or nonendangered bird species as well as those that are listed.

Operations

The major effects of air pollution on birds include direct mortality, debilitating injury, disease, physiological stress, anemia, hypocalcemic condition, bioaccumulation of air pollutants with associated decrease in resistance to debilitating factors, and population declines (Newman, 1979). Contamination of birds or other wildlife by air emissions can occur by inhalation, absorption, and ingestion.

Air emissions from the project would have a negligible effect on coastal or marine birds that inhabit or transit the offshore OCS area near Mississippi Canyon Block 920. Impacts on offshore air quality by emissions from activities associated with Hub installation, operation, or decommissioning would be insignificant because of the prevailing atmospheric conditions, emission heights, and pollutant concentrations. No impacts would be expected on onshore air quality that could be deleterious to birds because the Hub is 92 mi (148 km) from the nearest shore.

Helicopter and service-vessel traffic related to the proposed action could sporadically disturb birds while feeding, resting, or nesting, or cause them to abandon nests or preferred habitat onshore. The FAA (Advisory Circular 91-36C) and corporate helicopter policy state that the specified minimum altitude is 2,000 ft (610 m) when flying over populated areas and biologically sensitive areas such as wildlife refuges and national parks. Approximately 10 percent of helicopter trips would be expected to occur at altitudes somewhat below this minimum because of inclement weather, emergency situations, or aircraft ascent or landings. Bird populations inhabiting helicopter descent corridors at the Port Fourchon or Venice onshore service bases could be disturbed. Although only seconds in duration and sporadic in frequency, these incidents can disrupt coastal bird behavior and, at worst, possibly result in habitat or nest abandonment.

Service vessels would use selected transit corridors and adhere to protocol established by the USCG for reduced vessel speeds within these inland areas. Routine presence and low speeds of service vessels in nearshore and coastal navigation corridors, bays, and estuaries would ameliorate disturbances from service vessels on coastal and marine bird populations. The effects of routine service-vessel traffic on coastal and marine birds would be negligible.

No drilling fluids and cuttings would be discharged offshore to possibly contact birds on the water or their food supplies. Produced water is expected to be discharged at the sea bed, and routine discharges from the Hub would be highly diluted in the open marine environment. These effluents would be within permitted limits and therefore have no effects on marine birds that may come into contact with outfall sources.

Seabirds (e.g., laughing gulls and petrels) may be attracted by lights and structures in the remote offshore and may remain to rest and feed in the vicinity of fixed platforms. They may be diverted from traditional migration routes or feeding grounds.

Coastal and marine birds are commonly observed entangled and snared in floating trash and debris. In addition, many species ingest small plastic debris, either intentionally or incidentally, mistaking it for food. Such interactions can lead to serious injury and death. The MMS's operating regulations 30 CFR §250.300 and NTL 2003-G06 (*Marine Trash and Debris Awareness and Elimination*) prohibits the disposal of equipment, containers, and other materials into offshore waters by lessees. Coastal and marine birds would, therefore, not be expected to become entangled in or ingest OCS-related trash and debris. MARPOL (Annex V, Public Law 100-220; 101 Statute 1458; effective January 1989) prohibits the disposal of any plastics at sea or in coastal waters. Because of the low potential for interaction between coastal and marine birds and project-related debris, impacts would not be expected.

Accidental Events

Spills that occur from installation, production, and decommissioning of the Hub would be few, volumetrically small, and located near project activities in Mississippi Canyon Block 920 if they occurred at all. Contact with spilled condensate and oil-contaminated prey may be lethal or have serious long-term impacts on marine birds. Stress and shock can enhance the effects of exposure to oil. The direct oiling of coastal or marine birds in a fresh slick is usually lethal (Nation, 2003). Contact between birds and a weathered or dissipated slick may lead to sublethal effects. Several mechanisms for long-term impacts can be postulated including (1) sublethal initial exposure to oil causing pathological damage and weakening of body systems or inhibiting reproductive success; (2) chronic exposure to residual hydrocarbons in the environment, (3) ingestion of contaminated prey; and (4) altered prey availability resulting from a spill.

Pneumonia can occur in oiled birds after they inhale droplets of oil while cleaning their feathers. Exposure to oil can cause severe and fatal kidney damage (Frink, 1994). Ingestion of oils might reduce the function of the immune system and reduce resistance to infectious diseases (Leighton, 1990). Ingested oil may cause toxic destruction of red blood cells and varying degrees of anemia (Leighton, 1990). It is not clear which, if any, of the pathological conditions noted in necropsies are directly caused by hydrocarbons or are a final effect in a chain of events with oil as the initiating cause followed by an intermediate effect of chronic and generalized stress (Clark, 1984). Low levels of oil could stress birds by interfering with food detection, feeding impulses, predator avoidance, territory definition, homing of migratory species, susceptibility to physiological disorders, disease resistance, growth rates, reproduction, and respiration. Recovery would depend on subsequent in-migration of birds from nearby feeding, roosting, and nesting habitats.

Oil-spill cleanup methods often require heavy traffic on beaches and wetland areas, application of oil dispersants and bioremediation chemicals, and the distribution and collection of oil containment booms and absorbent material. The presence of humans, along with boats, aircraft, and equipment, could also disturb coastal birds after a spill. Investigations have shown that oil dispersant mixtures pose a threat to bird reproduction similar to that of oil (Albers, 1979; Albers and Gay, 1982) and may reduce chick survival more than exposure to oil alone. Successful dispersal of a spill would generally reduce the probability of exposure of coastal birds to oil (Butler et al., 1988). It is possible that changes in the size of a breeding population may also be a result of disturbance from increased human activity related to cleanup, monitoring, and research efforts (Maccarone and Brzorad, 1994). A growing number of studies indicate that current rehabilitation techniques are not effective in returning healthy birds to the wild (Anderson et al., 1996; Boersma, 1995; Sharp, 1995 and 1996). Deterrent or preventative methods such as scaring birds from the path of an approaching oil slick or using booms to protect sensitive colonies display good intentions but have extremely limited success.

A discussion of impacts from OCS activity on coastal and marine birds can be found in (Impacts on Coastal and Marine Birds) in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 4.2.1.8) and the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 4.2.1.8). These discussions are incorporated into this SEA by reference.

Conclusion

The proposed Independence Hub project is expected to have little or no impact on the vitality of any coastal or marine birds or productivity of any population endemic to the northern GOM. It is expected that impacts on coastal and marine birds would be minimal, consisting of behavioral changes and temporary disturbances or displacement of localized groups in inshore areas. Chronic stress such as digestive distress or occlusion, sublethal ingestion, and behavioral changes, however, are often difficult to detect or attribute. Such stresses can weaken individuals and make them more susceptible to infection and disease as well as making migratory species less fit for migration. Recovery would take place in a period of months to 1 year by the cessation of a disturbance and by the influx of birds from nearby feeding, roosting, and nesting habitats that are unaffected. Impacts from spilled condensate, should a spill occur, and spill-response activity is unlikely because the Independence Hub would produce predominantly gas with minor condensate.

4.2.2. Impacts on Coastal Endangered and Threatened Species

The impact-producing factors that could have the most impact on coastal species listed under the ESA are spills and spill response activities. Coastal birds and beach mice are susceptible to fouling by slicks from oil spills that make landfall or by subsequent cleanup activities. These potential impacts are much diminished, however, because the Independence Hub would produce predominantly gas with minor condensate.

4.2.2.1. Impacts on Beach Mice and Salt Marsh Vole

Impact-producing factors associated with installation and production from Independence Hub that may affect beach mice and the Florida salt marsh vole include would involve beach trash and debris. Trash and debris may be mistakenly consumed by beach mice and voles, or it could ensnare them. The habitat areas for the beach mice on Perdido Key and panhandle Florida and salt marsh vole in its only known habitat in Waccasassa Bay, Florida, are over 135 mi (217 km) and 300 mi (482 km) distant, respectively, from the Independence Hub location in Mississippi Canyon Block 920. It is highly unlikely that trash or debris attributable to this proposed action would come into contact with any beach mouse or vole populations or individuals. Furthermore, the vast majority of trash on shorelines or beaches originates from visitors to these localities, and the amount contributed by OCS activities in general is under 15 percent based on trash origin analyses carried out during Gulf beach sweeps.

Conclusion

The proposed Independence Hub project is expected to have no impact on the vitality of beach mouse or salt marsh vole populations in the northern GOM, their critical habitats, or to any individual.

4.2.2.2. Impacts on the Gulf Sturgeon and Smalltooth Sawfish

The impact-producing factors associated with installation and production of the Independence Hub project in Mississippi Canyon Block 920 affect ESA listed as well as non-listed fish, including the smalltooth sawfish and Gulf sturgeon. These impact-producing factors are described in Chapter 4.2.3.5 of this SEA. There are no impact-producing factors that uniquely target either listed species. The normal coastal range for the smalltooth sawfish along peninsular Florida and the coastal to continental shelf range of the Gulf sturgeon are very distant from the open marine and ultra-deepwater setting of Independence Hub 92 mi (148 km) from the nearest shore.

Conclusion

The proposed Independence Hub project is expected to have little or no impact on the vitality of Gulf sturgeon or smalltooth sawfish populations endemic to the northern GOM, or any individual.

4.2.2.3. Impacts on Listed Coastal and Marine Birds

Impact-producing factors associated with installation and production of the Independence Hub in Mississippi Canyon Block 920 affect ESA listed coastal and marine birds, including the piping plover (threatened), whooping crane (endangered), least tern (inland populations only endangered), bald eagle (threatened), and brown pelican (endangered). These impact-producing factors are described in Chapter 4.2.1.4 of this SEA. There are no impact-producing factors that uniquely target any of these listed species. Except for the brown pelican, these ESA-listed bird species inhabit coastal and inshore habitats and do not range into the open marine waters 92 mi (148 km) from the nearest shore where the Independence Hub would be located.

Conclusion

The proposed Independence Hub project is expected to have little or no impact on the vitality of any listed coastal or marine birds or productivity of any populations endemic to the northern GOM, their critical habitats, or any individual.

4.2.3. Impacts on Offshore Resources

The impact-producing factor that could have the most impact on offshore resources is spilled condensate or oil-spill response activity, and only on species spending time at the surface, such as resting marine birds, marine mammals, or sea turtles; however, this potential is much diminished because the Independence Hub would produce predominantly gas with minor condensate.

Additional impact-producing factors associated with installation, production, and decommissioning of the Independence Hub in Mississippi Canyon Block 920 that could affect benthic environments, marine mammals, sea turtles, birds, and fish include (1) physical contact or crushing with anchor piles, mooring lines, and emplacement of other subsea structures; (2) turbidity and sedimentation; (3) noise in the air and sea; (4) collisions with vessels; (5) lights in the remote offshore environment; (6) Hub effluent discharges and produced water; and (7) solid trash and debris originating from the Hub or service vessels.

Of these potential impact-producing factors, oil spills represent a high consequence, low-probability accidental event. No blowouts are projected as a result of development drilling, well completions, workovers, or hydrocarbon production associated with the Independence Hub project based on historical trends in the GOM (Table A-1). Spills that occur from installation, production, and decommissioning activity for the Independence Hub project would be few (if any), volumetrically small, and be located near project activities in Mississippi Canyon Block 920.

Appendix A (Table A-4) indicates Gulfwide oil-spill occurrence rates. The statistics show that there have been numerous spills of >1 but <50 bbl but very few spills ≥1,000 bbl for all OCS operations per billion barrels of oil handled. A blowout is the only accident category that could yield a spill ≥1,000 bbl for the duration of the Independence Hub project. The probability of a blowout is very small (less than 1 in 100,000).

Spills occurring in the deepwater environment in the Independence Hub project area would not be large enough to persist long enough in the marine environment before weathering processes significantly degrade the spill; dissipating at sea or making landfall in a degraded form. The transport time would allow a slick to weather, dissolve, and disperse while still in the marine environment. If a spill occurs at sea mechanical cleanup is assumed to collect up to 10 percent of spilled condensate and approximately 30 percent is assumed to be chemically dispersed, further reducing the overall probability and severity of spills that may move inshore. Because landfall of spilled condensate, diesel fuel, drilling fluids, or chemicals is highly unlikely, the potential impacts from spill landfall, i.e., cleanup activities on barrier beaches and dunes, and among wetlands and seagrass communities, are not expected.

A discussion of impacts on sensitive offshore resources from OCS activity is provided in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 4.2.1.2) and the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 4.2.1.4). These discussions are incorporated into this SEA by reference.

4.2.3.1. Impacts on Deepwater Benthic Communities

The most important impact-producing factor on deepwater benthic communities would be physical disturbance of the seafloor during installation, operation, or decommissioning. Bottom impacts would result from (1) pile driving and removal; (2) mooring line swing of the Hub platform or the moored semisubmersible well completion unit if used for the San Jacinto development in DeSoto Canyon Block 618 during installation; (3) installation, maintenance, or removal of subsea gathering flowlines and umbilicals, production trees, production risers, manifolds, the Independence Trial export trunk line; and (4) a blowout that resuspends sediment during well completions or workovers for the 21 wells over 20 years to maintain production and to abandon the wells at Hub decommissioning.

4.2.3.1.1 Impacts on Soft-Bottom Benthic Communities

The vast expanse of the GOM deepwater sea bottom is mostly covered by pelagic clay and silt. Typical reports of soft-bottom faunas (Gallaway et al., 1988) include widespread associations of bacteria, meiofauna, and larger megafauna such as sea cucumbers, sea pens, crinoids, demersal fish, decapod crustaceans, brittle stars, and various infauna living in burrows, such as polycheate worms. These populations would be impacted by emplacement of equipment and pipelines on the sea bottom or by sediment disturbances.

Installation of suction piles and mooring lines during Hub installation can cause disturbances with lethal effects in small footprints on the seafloor of a few acres. Among the range of disturbances would be (1) crushing of benthic faunas by anchor piles, subsea production equipment, and flowlines; (2) burial or disruption of fauna by scraping of bottom sediment as mooring lines pivot on their anchors; and (3) increased turbidity from sediment that is resuspended as a result of equipment contacting the sea bottom that fouls or interferes with filter-feeding organs. Cutting discharges at the sea bottom estimated to be approximately 15 bbl/well would be associated with drilling through the temporary cement plugs used to temporarily abandon each well prior to completion activity.

Impacts to benthic communities caused by installation, operation, and decommissioning of the Hub project would range from crushing or burial of infauna and epifauna to bottom disturbance and sediment resuspension that would temporarily impact bottom habitats. Crushing of organisms would occur from the emplacement of bottom-founded infrastructure such as pipelines and templates laid on the sea bottom and sediment scraping while equipment is manipulated from the surface during installation or removal or as a result of mooring lines scraping on the sea bottom in response to surface motion of the Hub topsides or during repositioning of the semisubmersible to be used to complete the three wells in DeSoto Canyon Block 618. Mechanical contact with the sea bottom by equipment or ROV propeller wash would tend to resuspend mud and increase turbidity. The MMS estimated the area of sea bottom that would be impacted (Table 4-2). The estimates in Table 4-2 are believed to be conservative. In reality they are likely to be less than either the upper or lower bounds estimated in Table 4-2. Upper and lower estimates are made for completeness.

Table 4-2

Estimated Bottom Area Subject to Impacts from Hub Activities

Type of Bottom Disturbance	Estimated Bottom Area (ac) Disturbed by Crushing or Sediment Scraping	Estimated Bottom Area (ac) Disturbed by Sediment Resuspension or Increased Turbidity
Emplacement and Removal of Hub Pilings and Mooring Lines	12	24
Emplacement and Removal of Moored Semisubmersible Drilling Unit for San Jacinto*	18-2,240*	36-4,480*
Emplacement and Removal of Subsea Production Equipment	5	10
Emplacement of Gathering Flowlines and Umbilicals to Hub	168	337
Emplacement of Independence Trail Trunk Line 115 mi from Hub to Depth of 200 ft	69	138
Emplacement of Independence Trail Trunk Line 20 mi from 200 ft Depth to West Delta Block 68 Platform A	32	64
Total ac Total mi^2	304-2,526* 0.47-3.9*	609-5,053* 0.95-7.9*

Note: Estimates calculated either by crushing area multiplied by 2 or disturbed area divided by 2.
* Lower end of range corresponds to semi-taught mooring system; higher end of range to catenary mooring system.
1 mi^2 = 640 ac.

The APC expects the well completion rig for 18 wells and the barge used to install the Hub would be dynamically positioned; therefore, no bottom impacts would be expected from their operation. Localized crushing and sediment displacement during pile emplacement and bottom disturbances that increase turbidity are expected as part of Hub installation, maintenance, and eventual removal. Bottom disturbances would occur by emplacing the 12 suction piles and mooring lines for the Hub's topside facilities. The Hub anchor system consists of four clusters of three piles each as shown in Figure 1-2. Each pile would disturb a footprint area of about 2 ac (0.8 ha), for a total of 24 ac (9.7 ha).

Installation, maintenance, and decommissioning of subsea production infrastructure either requiring removal or abandonment in place include 21 horizontal well trees and blowout preventers, four manifolds, 17 umbilical termination assemblies with umbilicals, 29 flowline termination sleds with 8- and 10-in diameter (20-25 cm) in-field flowlines; ROW gathering pipelines would also cause bottom sediment disturbance. The installation of all subsea production equipment would directly impact the sea bottom area by crushing. The estimated total footprint of these structures would be approximately 5 ac (2 ha).

Approximately 121 mi (195 km) of 8-in diameter (20 cm) flowlines, 55 mi (89 km) of 10-in diameter (25 cm) flowlines and 105 mi (169 km) of 6-in diameter (15 cm) umbilicals tie the wells to the Hub structure in Mississippi Canyon Block 920. The installation of these pipelines and umbilicals amounts to approximately 281 mi (452 km) linear miles of equipment installed on the sea bottom. The MMS estimates that 1.2 ac (.5 ha) of sea bottom is disturbed by pipeline installation per linear mile (Cranswick, 2001; page 14), for a total of 337 ac (136 ha).

Approximately 135 mi (217 km) of 24-in diameter (61 cm) export trunk pipeline (Independence Trail) would carry product from the Hub to shore. The portion of this pipeline emplaced in water <200 ft (61 m) deep would disturb approximately 2 ac of sea bottom per linear mile, slightly larger than the estimate provided in Cranswick (2001) because this is a large diameter pipeline and it will be buried. The length of export pipeline requiring burial is approximately 20 mi (32 km), for a total disturbance area of 64 ac (26 ha). An estimate of 282,000 ft^3 (8,000 m^3) of mud and silt would be resuspended for each mile of pipeline buried (USDOI, MMS, 2002; page 4-14), for an estimated 5,640,000 ft^3 (160,000 m^3) of total resuspended sediment. The portion of this pipeline emplaced in water >200 ft (61 ft) deep would disturb approximately 1.2 ac of sea bottom per linear mile because burial is not required. The length of export trunk pipeline emplaced deeper than 200 ft (61 ft) is approximately 115 mi (185 km), for a total disturbance area of 138 ac (56 ha).

Dominion expects to use a moored semisubmersible drilling rig, the *Noble Amos Runner*, to complete the three wells in the San Jacinto field in DeSoto Canyon Block 618. Dominion has yet to decide upon the exact configuration for the mooring system to be deployed. Completing the three wells would involve anchoring the rig once and then changing stations for each well by differential pulling on the mooring lines to move the rig over each well site. Dominion is in the process of choosing between preset suction piles and a semi-taught cable with polyester components and a conventional bottom pile and chain catenary mooring system. There would be nine bottom anchor points irrespective of the mooring system deployed. The semi-taught line system would have very little or no direct impact on the sea bottom, because mooring lines would not rest on the bottom. With a semi-taught configuration, MMS estimates that the area of bottom disturbed would be approximately 2 ac (0.8 ha) per anchor, for a total of 18 ac (7.2 ha). The chain catenary system, if chosen, would involve substantially more bottom disturbance for deployment because varying lengths of chain (or cable) would be resting on the bottom and would scrape sediment into heaps and ridges when the tension on mooring lines was changed to reposition the rig over each of the three wells in the field. With a chain catenary mooring system, MMS estimates that the area of sea bottom disturbed would be approximately 2,240 ac (906 ha) or 2.25 mi^2 (3.6 km^2) These bottom disturbances would have lethal to adverse impacts on individual epifaunal and infaunal organisms, but insignificant impact on soft-bottom communities overall due to repopulation from adjacent undisturbed areas. Repositioning of the moored semisubmersible rig during well completion and installations for the San Jacinto field are separated spatially but not temporally. Bottom impacts from this activity would occur over a relatively large area and would be closely spaced in time to constitute the greatest single impact variable on soft-bottom communities. The bottom disturbances that would be caused by Hub installation and emplacement of subsea pipelines and production equipment at the remaining gas fields in the Hub project use a DP drillship and are spatially and temporally separated over the 20-year lifetime of the Hub's installation, operation, and decommissioning. The impacts of crushing and increased turbidity would be most intense during the installation and decommissioning stages of the project. Crushing of soft-bottom benthos by bottom-founded infrastructure such as pipelines and templates would be permanent and irreversible; however, much of the area impacted by sediment scraping from mooring lines would recover. Elevated turbidity would be a short term, localized, and reversible condition once the disturbance ceases. Elevated turbidity levels in the bottom water may interfere with the feeding organs of invertebrate filter-feeders. Bottom disturbances from anchoring by service vessels supporting the Independence Hub would not be an issue because the waters are too deep for anchoring by individual vessels. The Hub will be equipped with a mooring buoy system for vessel docking.

A blowout at the seafloor during well completion could create a crater on the sea bottom, and resuspend and disperse large quantities of bottom sediments within a 184 ft (300-m) radius of the blowout site, potentially burying both in faunal (in the sediment) and avifaunal (on the sediment) organisms and interfering with sessile invertebrates that rely on filter-feeding organs. Anchoring and other bottom-disturbing activities can resuspend bottom sediments but not to the degree achieved by a blowout event. Bottom dwelling invertebrates have adaptive strategies for coping with or escaping rapid sedimentation. Rapid burial by sediment blankets >1 ft (30 cm) in thickness is likely to be lethal for all benthic organisms based on analysis of escape trace fossils from the geologic record (Frey, 1975, page 135; Basan et al., 1978, page 20; Eckdale et al., 1984, page 92). Burial by thinner accumulations of sediment (or cuttings) may be lethal to some sessile (attached or immotile) invertebrates and survivable by motile organisms.

No additional development wells are proposed by APC for the proposed Independence Hub project. Rather, completion of existing exploratory wells that were temporarily abandoned will be necessary. Temporarily abandoned wells are typically sealed with a cement plug through approximately 100 ft (30 m) of the wellbore. These cement plugs will be drilled through to install production tubing or gravel packs at the produced layers, yielding a small amount of cement cuttings in the process. The total amount of cuttings would be widely distributed at the different well locations and constitute about 5 bbl of cuttings per plug drilled or around 95 bbl of cement cuttings discharged at the sea bottom for the 21 wells in this project.

Routine discharges from the Hub or any spilled condensate or diesel fuel are not expected to have any impact on deepwater, soft-bottom benthic communities. Routine effluents discharged at the surface, or spilled oil, diesel fuel, or chemicals occurring at the surface would have no direct or indirect impacts on organisms living on the seafloor. Any minor discharge of mud from drilling out cement well plugs would similarly undergo tremendous dilution and cuttings volume would be insignificant.

A discussion of impacts on soft-bottom communities from OCS activity is provided in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 4.2.1.2.4), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 4.2.1.4.2.2), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 4.3.2.5). These discussions are incorporated into this SEA by reference.

Conclusion

Impacts to benthic communities caused by installation, operation, and decommissioning of the Hub project would range from crushing or burial of infauna and epifauna to bottom disturbance and sediment resuspension that would temporarily impact bottom habitats. If a semi-taught mooring system is used for the San Jacinto development, up to approximately 0.95 mi^2 (1.5 km^2) of bottom area would be impacted. If catenary mooring lines are used for the San Jacinto development, the total bottom area impacted could be up to approximately 7.9 mi^2 (1.3 km^2) A large portion of these impacts would be attributable to scraping of the bottom by the mooring lines, which would not result in permanent impacts, because repopulation of benthos would occur via recruitment from adjacent undisturbed areas.

Routine discharges from the production platform are not expected to adversely impact benthic communities because of the water depths in Mississippi Canyon Block 920. Bottom disturbance from a blowout during completion or subsequent workovers for the 21 production wells is not likely, based on the historical record of blowout events in the Gulf.

Overall impacts to the ecological function, biological productivity, or distribution of soft-bottom communities in this vast, ultra-deepwater area of the GOM are not expected to be significant. Bottom disturbances would be separated spatially and temporally across the large area involving the Hub project and the 20-year lifetime of the Hub's installation, operation, and decommissioning.

4.2.3.2.2. Impacts on Chemosynthetic Communities

Although no high-density chemosynthetic communities have been reported in the Independence Hub project area, it is possible that they could be discovered there. Chapter 4.2.1.2.3 (Chemosynthetic Deepwater Benthic Communities) in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; pages 4-81 through 4-85) contains a discussion of impacts from OCS activity and is incorporated into this SEA by reference.

NTL 2000-G20 (*Deepwater Chemosynthetic Communities*) makes mandatory the evaluation for and avoidance of dense chemosynthetic communities (such as Bush Hill-type communities) or areas that have a high potential for supporting these community types, as interpreted from geophysical records. The NTL is exercised on all applicable leases and is not an optional protective measure. Under the provisions of this NTL, lessees intending to explore or develop in water depths greater than 400 m (1,310 ft) are required to conduct geophysical surveys of the area of proposed activities and to evaluate the data for indications of conditions that may support chemosynthetic communities. If such conditions are indicated, the lessee must either move the operation to avoid the potential communities or provide photodocumentation of the absence of high-density chemosynthetic communities. If such communities are indeed present, no drilling operations or other bottom-disturbing activities may take place in areas surrounding the communities with specific buffer zones; if the communities are not present, drilling or anchoring may proceed.

The Hub's 12 anchor points, routes for ROW pipelines that gather product from wellheads to the Hub, and the Independence Trail export trunk line have been surveyed and determined to be free of indications of chemosynthetic communities. The locations for subsea production equipment at the fields to be produced by the Hub were screened at the time MMS evaluated the operator's Exploration Plans. No impacts are therefore expected on chemosynthetic communities as a result of this proposed action.

A discussion of impacts on chemosynthetic communities from OCS activity is provided in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 4.2.1.2.3), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 4.2.1.4.2.1), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 4.3.2.4). These discussions are incorporated into this SEA by reference.

Conclusion

The proposed Independence Hub is expected to have no impact on the ecological function, biological productivity, or distribution of chemosynthetic communities. The proposed Hub project will not impact known locations of high-density chemosynthetic communities. The potential for these communities to be present has been evaluated by geophysical surveys and indications of the potential presence for communities are absent from well site areas and pipeline routes that would be subject to bottom disturbances.

4.2.3.4. Impacts on Coral Communities

Hermatypic corals (those containing photosynthetic algae) cannot live in deepwater environments; however, ahermatypic corals can live on suitable hard substrates (hardgrounds) in these environments. Scleractinian corals are recognized in deepwater habitats, but there is limited information regarding their distribution or abundance in the Gulf (USDOI, MMS, 2000; page IV-14). Scleractinian corals may occupy isolated hard-bottom habitats and can occur in association with high-density chemosynthetic communities that often are situated in close association with carbonate hardgrounds. However, no hard-bottom areas were observed in the vicinity of any of the well sites or other proposed areas for installation of Hub facilities.

Conclusion

The proposed Independence Hub is expected to have no impact on the ecological function, biological productivity, or distribution of deepwater coral habitats. The occurrence and distribution of deepwater scleractinian corals is not well known at the depths of the proposed action. The Independence Hub project will disturb approximately 1.25 mi^2 (2 km^2) of the sea bottom. Sea-bottom area bearing geophysical characteristics of historical hydrocarbon seepage and potential chemosynthetic communities is absent from the project area. Therefore, corals that require hardgrounds that could utilize available hard substrate associated with chemosynthetic communities are also very unlikely.

4.2.3.5. Impacts on Essential Fish Habitat and Fish Resources

The impact-producing factors associated with installation, production, and decommissioning of the Independence Hub project in Mississippi Canyon Block 920 that could affect essential fish habitat (EFH) and fish resources include (1) coastal and marine environmental degradation, (2) rig presence, (3) discharge of produced water and permitted effluents, and (4) blowouts or accidentally spilled condensate or diesel fuel.

Coastal and marine environmental degradation and adverse effects on EFH result from the loss or degradation of nursery habitat in wetlands and estuaries and from decreased water quality in nearshore and open marine habitats (Chambers, 1992; Stroud, 1992). Loss of wetland environments can take place from subsidence and submergence of nursery habitats. Chronic levels of contamination from spilled hydrocarbons can adversely affect fish and EFH, although these impacts would be localized and relatively minor. Produced water discharged at the surface would influence water quality locally, but would have no significant effect on fish resources and EFH. Produced water discharged from the platform is expected to be treated, if required, and is subject to tremendous dilution factors in the offshore environment. Routine discharges from the Hub would be highly diluted within very short distances in the open marine environment.

Marine EFH in the GOM includes both high- and low-relief live bottoms and both natural and artificial reefs. No natural reefs or live bottoms have been documented within the ultra-deepwater environments proximal to Mississippi Canyon Block 920, nor would artificial reefs be intentionally established on the sea bottom in these extreme water depths. Over a period of 10-20 years, the Independence Hub structure would establish a *de facto* artificial reef by providing hard substrate in the photic zone where none existed before. The resulting artificial reef will provide a hard substrate for encrusting invertebrates such as hard corals, soft corals, and sponges, and will attract species of pelagic or reef-associated fish to live on or near the platform. Many, if not most, of the species attracted to the structure will represent net biomass production that would not have been possible without the presence of the artificial habitat.

No drilling fluids and cuttings would be discharged offshore (other than minor cuttings volumes generated from drilling through cement plugs). Accidental oil spills or blowouts also have the potential to affect fish resources and EFH, but there is no evidence that fish or EFH in the Gulf have been adversely affected on a regional population level by spills or chronic contamination. Spills that occur from installation, production, and decommissioning of the Hub would be few, volumetrically small, and located near project activities in Mississippi Canyon Block 920, if they occurred at all. Fish resources, particularly embryonic and larval stages, can be affected by oil-spill components that become dissolved, dissipated, and dispersed in the water, and by oil that adheres to particulate matter and sinks into sediment. These effects degrade water and substrate quality but the impacts are temporary and recoverable. Adult fish will, for the most part, avoid the oil (Malins et al., 1982; NRC, 1985; Baker et al., 1991). Farr et al. (1995) reported the behavioral avoidance of dissolved concentrations of a polynuclear aromatic hydrocarbon (PAH) as low as 14.7 µg/l by a species of minnow. Furthermore, adult fish must be exposed to crude oil for some time, probably on the order of several months to sustain a dose that causes biological damage (Payne et al., 1988). Adult fish also possess some capability for metabolizing oil (Spies et al., 1982).

Impacts on phytoplankton and zooplankton populations within 984 ft (300 m) of permitted platform discharge outfalls, or in contact with spilled diesel or condensate, can receive concentrations of organic materials or chemicals that are toxic and deleterious. Individual plankters may be subject to lethal or sublethal effects for short periods ranging from minutes to hours. Invertebrate larvae, fish eggs, and fish larvae are known to be very sensitive to oil in water (Linden et al., 1979; Longwell, 1977; Baker et al., 1991). Most fish species produce very large numbers of eggs and larvae spread far and wide in nearshore and offshore marine environments. In order for an oil spill to affect fish resources at the population level, it would have to be very large and correspond to an area of highly concentrated eggs and larvae. The oil would also have to disperse deep enough into the water column at concentrations high enough to cause toxic effects. Given the potential for oil spills, none of these events are likely. The use of dispersants, while potentially beneficial for birds, turtles, and mammals at the surface, could add to adverse effects on plankton, eggs, and larvae. An oil spill in a bay or estuary containing eggs and larvae of important inshore species such as menhaden, shrimp, or blue crabs would present the worst case of potential impact to fish and EFH. The potential spawning areas of marine fish are widespread enough in the GOM to avoid catastrophic effects on single species or large population levels of varied species from even a large spill.

A discussion of impacts on EFH and fish resources from OCS activity is provided in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 4.2.1.10), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 4.2.1.10), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 4.3.2.8). These discussions are incorporated into this SEA by reference.

Conclusion

The proposed Independence Hub project is expected to have no significant impacts on any coastal or marine fish, EFH, or commercial fisheries endemic to the northern GOM. The Hub, as an artificial hardground, will attract a variety of invertebrate and fish species that would live on and near the structure as long as it is present. Impacts on adult fish or EFH are not expected. If a condensate or diesel spill occurred, plankton, fish eggs, or larvae would suffer mortality in areas where their numbers are concentrated in the upper few meters of water and where oil concentrations under the slick are high enough. Specific effects from oil spills would depend on several factors, including timing, location, volume and type of oil, environmental conditions, and countermeasures used. Losses from larvae and plankton mortality would be replaced in 1-2 years by fish from adjacent unaffected areas that replenish larvae in early phases of the life cycle.

4.2.4. Impacts on Offshore Endangered and Threatened Species

4.2.4.1. Impacts on Marine Mammals

The impact-producing factors associated with installation, production, and decommissioning of the Independence Hub project in Mississippi Canyon Block 920 that could affect marine mammals include (1) excess noise in air and water from helicopters, the Hub, or service vessels; (2) trash and debris from the Hub and service vessels; (3) entanglement in lines or cables; (4) collision potential with service vessels; (5) degradation of water quality from Hub discharges; (6) blowouts or accidentally spilled condensate or diesel fuel; and (7) spill-response activities. These impact-producing factors are the same for nonthreatened and nonendangered marine mammal species as well as those listed under the ESA. The impact-producing factor likely to have the most impact on listed offshore species is spilled condensate or diesel fuel and oil-spill response activity; however, this potential is much diminished because the Independence Hub would produce predominantly gas with minor condensate.

Operations

The noise from helicopter operation can cause a startle response and can interrupt whales and dolphins while resting, feeding, breeding, or migrating. The FAA Advisory Circular 91-36C encourages pilots to maintain higher than minimum altitudes over noise-sensitive areas: a minimum altitude of (700 ft (213 m) while in transit offshore and 500 ft (152 m) while working between platforms. Guidelines and regulations promulgated by NOAA Fisheries under the authority of the Marine Mammal Protection Act include provisions specifying that helicopter pilots maintain an altitude of 1,000 ft (305 m) within 300 ft (91 m) of marine mammals.

The proposed action will have an approximate total of 448 helicopter flights to and from the Hub throughout the 16 months of Hub installation and 2,880 flights over the 20 years of production and operational lifetime of the Hub. Both the noise and the shadow cast by the helicopter during routine overflights to the Hub, and landings and take-offs from the Hub, can elicit a response from nearby cetaceans (Richardson et al., 1995). These occurrences would be temporary and pass within seconds, having no long-term impact on cetaceans. Frequent overflights could have long-term consequences if they repeatedly or consistently disrupt important life functions such as feeding and breeding. It is unlikely that cetaceans would be affected by routine helicopter traffic operating at prescribed altitudes.

Atmospheric noise inputs, however, are negligible relative to other sources of noise that are propagated in water (e.g., platform operations and vessel traffic). The effect of underwater noise on cetaceans is a subject of controversy with little empirical or measured data. Noise from service-vessel traffic may elicit a startle and/or avoidance reaction from whales and dolphins or mask their sound reception abilities. There is the possibility of short-term disruption of movement patterns and behavior, but such disruptions are unlikely to affect survival or productivity. Also uncertain is whether or not long-term displacement of animals from an area can be caused by vessel noise. It is not known whether toothed whales exposed to recurring vessel disturbance will be stressed or otherwise affected in a negative but inconspicuous way. Smaller dolphins approach vessels that are in transit to bow-ride, and bottlenose dolphins have poor sensitivity to sounds generated by most industrial noise. The behavioral disruptions apparently caused by noise and the presence of service-vessel traffic are unlikely to affect long-term survival or productivity of marine mammal populations in the northern GOM.

Well completion and workover activity, and operation of the Hub would produce sounds transmitted to the water at intensities and frequencies that could be heard by whales and dolphins. Noise from installing or decommissioning the Hub could be intermittent, sudden, and at times high-intensity as one-of-a-kind operations take place. Noise during the production phase of operation is expected to be semi-constant but at low-intensity levels. Toothed-whales echolocate and communicate at higher frequencies than the dominant sounds generated by production platforms in operation (Gales, 1982). Bottlenose dolphins, one of the few species in which low-frequency sound detection has been studied, have been found to have poor sensitivity levels at the level where most industrial noise energy from oil and gas production is concentrated. There is some concern for baleen whales since they are apparently more dependent on low-frequency sounds than other marine mammals. Except for the Bryde’s whale, which is considered uncommon, baleen whales are extralimital and are rare in the GOM (Würsig et al., 2000).

The potential effects that water-transmitted noise have on GOM marine mammals include disturbance (subtle changes in behavior, interruption of previous activities, or short- or long-term displacement), masking of sounds (calls from conspecifics, reverberations from own calls, and other natural sounds such as surf or predators), physiological stress, and hearing impairment. Marine mammals exposed to recurring vessel disturbance could be stressed or otherwise affected in a negative but inconspicuous way. The behavioral or physiological responses to Hub noise, however, are unlikely to affect long-term survival or productivity of whale or dolphin populations in the northern GOM. Whether or not persistent noise-producing loci (like production platforms) cause cetaceans to avoid the area is unknown.

Toothed whales, particularly sperm whales, have been known to become entangled in subsea cables. Heezen (1957) suggested that sperm whales become entangled while swimming along the bottom with their lower jaws plowing the sediment to stir up food or that whales attack tangled masses of cable mistaking them for food. The Independence Hub subsea production facilities will have miles of flowlines on the sea bed, and 6- to 8-in-diameter (15-20 cm) jumper lines connecting each well tree to a flowline via a line termination sled. Jumpers expand and contract in the water column according to the temperature and production rate of the hydrocarbon produced and can arch upward to several meters above the seabed. This hardware would present a potential hazard to sperm whales if they manifest a sediment plowing behavior, but the likelihood of whale entanglement in thick umbilical lines, steel jumper lines, or thick flowlines is remote. There is no documentation of whales becoming entangled in subsea production equipment, production risers, or floating platform mooring lines.

Many types of plastic materials end up as solid waste during drilling and production operations. Some of this material may be accidentally lost overboard and available to whales and dolphins that may consume or become ensnared in it. The result of plastic ingested into the digestive tract is certainly deleterious and could be lethal. The probability of a marine mammal encountering trash that appears edible is probably very low. Disposal of solid wastes offshore takes place in covered bins that are warehoused in a secure area on the platform. These bins are returned to shore by service vessels for landfill disposal. The MMS issued NTL 2002-G13 (*Marine Trash and Debris Awareness and Elimination*) to specify handling requirements to help mitigate the potential threat trash and debris pose to marine mammals, fish, sea turtles, and other marine animals.

The APC does not propose to drill additional development or production wells for the Independence Hub project. Consequently, no drilling fluids and cuttings would be discharged offshore to possibly contact whales and dolphins. Produced water is expected to be discharged overboard, after treatment, if required, and is subject to tremendous dilution factors in the offshore environment. The routine discharges from the Hub would be highly diluted in the open marine environment. These effluents would be within permitted limits and therefore would have no effect on cetaceans that may come into contact with Hub outfall sources.

Accidental Events

Spills that occur from installation, production, and decommissioning of the Hub would be few, volumetrically small, and located near project activities in Mississippi Canyon Block 920, if they occurred at all. Spilled condensate or diesel fuel and/or spill-response activities have the potential to adversely affect whales and dolphins. Impacts could include soft tissue irritation, fouling of baleen plates, respiratory stress from inhalation of toxic fumes, food reduction or contamination, direct ingestion of oil, and temporary displacement from preferred habitats or migration routes. Some short-term (months) effects of oil may be as follows: (1) changes in cetacean distribution associated with avoidance of aromatic hydrocarbons and surface oil (fleeing or avoiding pollution); (2) changes in prey distribution and human disturbance; (3) increased mortality rates from ingestion or inhalation of oil; (4) increased petroleum compounds in tissues; and (5) impaired health (e.g., immunosuppression) (Harvey and Dahlheim, 1994). Several mechanisms for long-term injury can be postulated: (1) initial sublethal exposure to oil causing pathological damage; (2) continued exposure to hydrocarbons persisting in the environment, either directly or through ingestion of contaminated prey; and (3) altered availability of prey as a result of the spill (Ballachey et al., 1994).

While no conclusive evidence of an impact on whales and dolphins by the 1989 *Exxon Valdez* spill has been documented (Dahlheim and Matkin, 1994; Harvey and Dahlheim, 1994; Loughlin, 1994), investigations on the effects on sea otters and harbor seals revealed pathological effects on the liver, kidney, brain (also evidenced by abnormal behavior), and lungs, as well as gastric erosions (Ballachey et al., 1994; Lipscomb et al., 1994; Lowry et al., 1994; Spraker et al., 1994). Harbor seal pup production and survival also appeared to be affected (Frost et al., 1994). Oil spills have the potential to cause greater chronic (longer-term lethal or sublethal spill-related injuries) and acute (spill-related deaths during a spill) effects on mammals than originally suspected. A few chronic effects include (1) change in distribution and abundance because of reduced prey resources or increased mortality rates, (2) change in age structure in the breeding stock because certain year-classes were impacted more by an oil spill, (3) decreased reproductive success, and (4) increased rate of disease or neurological problems from exposure to oil (Harvey and Dahlheim, 1994). It has been speculated that mortalities of killer whales may be linked to the *Exxon Valdez* spill (Matkin and Sheel, 1996). There was no documented evidence to directly link the Gulf War oil spill to marine mammal deaths that occurred at that time (Preen, 1991; Robineau and Fiquet, 1994). No marine mammal deaths were attributed to the Santa Barbara Channel oil spill in 1969 (Nation, 2003).

The effects of cleanup activities on cetaceans are unknown. The impacts of dispersant chemicals used on a slick may be as much of an irritant to tissues and sensitive membranes as the oil itself. The increased human presence (e.g., vessels) could add to changes in whale behavior and/or distribution, thereby stressing animals further, and perhaps making them more vulnerable to various physiologic and toxic effects.

Clearly, the vitality or productivity of seals can suffer long-term impacts from oil spills, but the evidence for cetaceans being among affected populations has not been convincingly established. There is, however, substantial circumstantial evidence based on effects documented in other marine mammals that harmful effects from contact between spilled condensate or diesel fuel and individual whales or dolphins can be reasonably expected. Although there may now be a greater awareness of the chronic effects of spilled oil on some types of marine mammals, an interaction between marine mammals at sea and spilled oil are unlikely to be realized. Contact between marine mammals and spilled condensate or diesel fuel is so unlikely, and the duration of this contact with mobile animals in the open ocean so fleeting, that effects on marine mammals would be insignificant.

Service vessels present a collision hazard to marine mammals. The Independence Hub project will have approximately 128 supply boat trips and 192 crewboat trips to and from the installation rig and Hub throughout the 16 months of facility installation, and 960 supply boat trips and 960 crewboat trips during the subsequent 20 years of production over the Hub lifetime. The MMS issued NTL 2002-G14 (*Vessel Strike Avoidance and Injured/Dead Protected Species Reporting*) to help avoid collisions between vessel and marine mammals. Dolphins may bow-ride vessels that are in transit from a shore base to an offshore location in Hub project area. Vessels may also be a collision threat to coastal dolphins, where the majority of OCS vessel traffic occurs. Marine mammalogists conducting surveys in the CPA during the summer of 2001 documented an adult killer whale that bore conspicuous and aged scarring across its back that were likely caused by a collision with a motor vessel. The consequence of a vessel collision with a marine mammal is likely to be lethal, but the probability of a collision taking place is low with the current mitigations in place.

A discussion of impacts on marine mammals from OCS activity is provided in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 4.2.1.5), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 4.2.1.5), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 4.3.2.6). These discussions are incorporated into this SEA by reference.

Conclusion

The proposed Independence Hub project is expected to have no significant impact on the vitality of any marine mammal species or productivity of any population endemic to the northern GOM. There is no conclusive evidence as to whether or not anthropogenic noise in the water has caused displacements of marine mammal populations or is injurious to the vitality of individuals. Proper legally regulated handling of plastics and other debris and the low probability of encounter of marine mammals with occasional accidental debris lost overboard make impacts of such debris on marine mammals minimal. There is no demonstration that whales become entangled in bottom lines or cables. Collisions between service vessels and marine mammals would be extremely rare, but they could be lethal or crippling if realized. The MMS's regulations and NTL's are designed to reduce the possibility of collisions. Produced water and other routinely discharged effluents would be within permitted limits and therefore would have no effect on cetaceans that may come into contact with Hub outfall sources. No deaths would be expected from direct and acute exposure to spilled condensate or diesel fuel or from chronic long-term effects. Although interaction between marine mammals and a weathered oil spill is possible, sublethal effects would be the likely result.

4.2.4.2. Impacts on Sea Turtles

The impact-producing factors associated with installation, production, and decommissioning of the Independence Hub project in Mississippi Canyon Block 920 that could affect loggerhead, Kemp's ridley, hawksbill, green, and leatherback turtles, all listed as endangered or threatened species, include (1) noise from helicopter flights, Hub operations, and service vessel traffic, (2) possible collisions with service vessels, (3) brightly-lit Hub topsides, (4) project-related trash and debris, (5) water-quality degradation from platform effluents, and (6) blowouts, condensate spills, diesel fuel spills, and spill-response activities. The impact-producing factor likely to have the most impact on turtles is spilled condensate or diesel fuel and oil-spill response activity. This potential is much diminished because the Independence Hub would produce predominantly gas with minor condensate, and the most vulnerable time for turtles would be during nesting and hatchling migration on beaches. A condensate spill from a blowout, at the Hub, at any well sites, or along pipeline routes is unlikely to be large enough to persist long enough in the marine environment to make landfall in anything but a highly degraded state.

Operations

The noise from helicopter operation can elicit a startle response and can interrupt sea turtles while resting, feeding, breeding, or migrating. The proposed action will have an approximate total of 448 helicopter flights to and from the Hub throughout the 16 months of Hub installation, and 2,880 flights over the 20 years of production and operational lifetime of the Hub. There are no published systematic studies about the reactions of sea turtles to aircraft overflights and anecdotal reports are scarce. Sea turtles spend more than 70 percent of their time underwater, but it is assumed that sea turtles can hear helicopter noise at or near the surface and that unexpected noise may cause animals to alter their activity (Advanced Research Projects Agency, 1995). There is evidence suggesting that turtles may be receptive to low-frequency sounds, which is the level where most industrial noise energy is concentrated. Atmospheric noise inputs are negligible relative to other sources of noise that are propagated in water (e.g., platform operations and vessel traffic). It is unlikely that sea turtles would be adversely affected by routine helicopter traffic operating at prescribed altitudes.

Transportation corridors for service vessels will be through areas where sea turtles would be expected and have been sighted. Noise from service-vessel traffic may elicit a startle and/or avoidance reaction from sea turtles or mask their sound reception. Potential effects on turtles include disturbance (subtle changes in behavior, interruption of behavior), masking of natural sounds (e.g., surf and predators), and stress (physiological). There is the possibility of short-term disruption of movement patterns and behavior, but such disruptions are unlikely to affect survival of individuals or productivity of a breeding population. Sea turtles exposed to recurring vessel disturbance could be stressed or otherwise affected in a negative but inconspicuous way. Whether or not persistent noise-producing loci (like production platforms) cause sea turtles to avoid the area is unknown.

Well completion and workover activity, and operation of the Hub produce sounds transmitted to the water at intensities and frequencies that could be heard by sea turtles. Noise from installing or decommissioning the Hub could be intermittent, sudden, and at times high-intensity as one-of-a-kind operations take place. Noise during the production phase of operation is expected to be semi-constant but at low-intensity levels. The industrial noises from platform installation and operation, and vessel traffic would have sublethal effects on sea turtles.

The Independence Hub project will have approximately 128 supply boat trips and 192 crewboat trips to and from the installation rig and Hub throughout the 16 months of facility installation, and 960 supply boat trips and 960 crewboat trips during the subsequent 20 years of production over the Hub lifetime. Vessel traffic that was previously absent in the proposed Hub area incrementally raises the probability of collisions between ships and sea turtles, from which injury or death to some animals may result.

Brightly-lit offshore drilling rigs and platforms present a potential distraction to hatchlings (Owens, 1983). Hatchlings are known to be attracted to light (Raymond, 1984; Witherington and Martin, 1996; Witherington, 1997) and could be expected to orient toward lighted offshore facilities (Chan and Liew, 1988). If this occurs, hatchling predation would increase dramatically since large birds and predacious fish also congregate around the platforms (Owens, 1983; Witherington and Martin, 1996). The very short duration of the light attraction for hatchlings, however, would indicate that this is a risk only for facilities very close to nesting beaches. Furthermore, the Hub would be located 92 mi (148 km) from shore

Many types of materials, including plastic wrapping materials, end up as solid waste during installation, production, and decommissioning operations. Some of this material could be accidentally lost overboard where sea turtles could encounter it. Ingesting materials that are lost overboard could be lethal. Leatherback turtles are known to mistake plastics for jellyfish and may be more vulnerable to gastrointestinal blockage than other sea turtle species. The probability of a sea turtle encountering trash that appears edible is probably very low. Sea turtles could also become entangled or suffer crippling injuries from debris that is lost by service vessels or the Independence Hub. Disposal of solid wastes offshore takes place in covered bins that are warehoused in a secure area on the platform. The bins are returned to shore by a service vessel for landfill disposal. The MMS issued NTL 2002-G13 (*Marine Trash and Debris Awareness and Elimination*) to establish storage requirements that help mitigate the potential threat trash and debris pose to marine mammals, fish, sea turtles, and other marine animals.

The APC does not propose to drill additional wells for the Independence Hub project. Consequently, no drilling fluids and cuttings would be discharged offshore to possibly contact sea turtles. Produced water is expected to be discharged overboard, after treatment, if required, and is subject to tremendous dilution factors in the offshore environment. The routine discharges from the Hub would be highly diluted in the open marine environment. These Hub effluents would be within permitted limits and therefore are expected to have no effects on sea turtles that may come into contact with Hub outfall sources.

Accidental Events

Spills that occur from installation, production, and decommissioning of the Hub would be few, volumetrically small, and located near project activities in Mississippi Canyon Block 920, if they occurred at all. When an oil spill occurs, the severity of effects and the extent of damage to sea turtles are affected by (1) geographic location, (2) hydrocarbon type, (3) duration of contact, (4) weathering state of a slick, (5) impact area, (6) oceanographic and meteorological conditions, (7) season, and (8) growth stage of the animal (NRC, 1985). All sea turtle species and life stages are vulnerable to the harmful effects of oil through direct contact or by fouling of their habitats and food.

Contact with spilled condensate or diesel fuel and consumption of oil-contaminated prey may be lethal or have serious long-term impacts on sea turtles. There is direct evidence that sea turtles, especially hatchlings and juveniles, have been seriously harmed by oil spills. Sea turtles directly exposed to oil or tarballs may suffer inflammatory dermatitis, ventilatory disturbance, salt gland dysfunction or failure, red blood cell disturbances, impaired immune system responses, and digestive disorders or blockages (Vargo et al., 1986; Lutz and Lutcavage, 1989; Lutcavage et al., 1995). Although disturbances may be temporary, long-term effects remain unknown, and chronically ingested oil may accumulate in organs.

No deaths would be expected from direct exposure to spilled condensate or diesel fuel or from chronic long-term effects. Several mechanisms for long-term impacts can be postulated: (1) sublethal initial exposure to oil causing pathological damage and weakening of body systems or inhibiting reproductive success; (2) chronic exposure to residual hydrocarbons persisting in the environment or through ingestion of contaminated prey; and (3) altered prey availability as a result of the spill. Turtles may be temporarily displaced from areas impacted by spills. The magnitude of impacts on sea turtles would depend upon the oils that they are exposed to, the state of weathering of a slick, and the period of exposure. Because sea turtle habitat in the Gulf includes coastal and oceanic waters, as well as numerous beaches in the region, sea turtles could be impacted by accidental spills from vessels supporting the proposed action that are in transit near these environments. Although there is documentation of the harmful effects of acute exposure to spilled oil, the effects of chronic exposure are less certain and are largely inferred. An interaction between sea turtles at sea and spilled condensate or diesel fuel is unlikely to be realized. Contact between sea turtles and condensate or diesel fuel is so unlikely and the duration of this contact with mobile animals in the open ocean is so fleeting that the effects on sea turtles would be insignificant.

No juvenile deaths or sublethal impacts on young sea turtles, newly-hatched sea turtles, or nests on nesting beaches would be expected because the probability of shoreline impact from an oil spill from a well blowout on the Independence Hub project is very small. Further, a slick would be unlikely to survive weathering and sea conditions that would allow it to make landfall.

Oil-spill-response activities, such as beach sand removal, can adversely affect sea turtles. Vehicular and vessel traffic during spill-response actions in sensitive habitats during nesting season can occur. Harm to sea turtles is expected to be minimized; however, because of efforts to prevent contact between spilled condensate in sensitive areas, and by protective spill remediation procedures used in sensitive habitats that are specified in the spill-response plans required by the Oil Pollution Act. Increased human presence in nesting habitats could alter behavior of turtles, reduce their distribution, or cause them to move to less favorable areas, making them more vulnerable to various physiologic and toxic effects.

A discussion of impacts on sea turtles from OCS activity is provided in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 4.2.1.6), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 4.2.1.6), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 4.3.2.7). These discussions are incorporated into this SEA by reference.

Conclusion

The proposed Independence Hub development project is expected to have no significant impact on the vitality of any sea turtle species or productivity of any population endemic to the northern GOM. Sea turtle individuals exposed to a weathered and degraded oil slick would the most likely result in sublethal impacts. There is no conclusive evidence whether or not anthropogenic noise in the water has caused displacements of sea turtle populations or is harmful to life activities and vitality of individuals. Collisions between service vessels and sea turtles would be rare, but they could be lethal if realized. Sea turtles could be injured or killed by eating indigestible debris or plastic items originating from Independence Hub development activities, but the likelihood of such an encounter is very small.

4.3. Impacts on Socioeconomic and Human Resources

In Chapter 3.3.1.1 (Socioeconomic Impact Area), MMS defined the potential impact region as that portion of the GOM coastal zone wherein the social and economic well-being (population, labor, and employment) is directly or indirectly affected by the OCS oil and gas industry. In this section, MMS evaluates how and where future changes may occur as a result of the proposed Independence Hub project.

4.3.1. Impacts on Socioeconomic Resources

The impacts on socioeconomic resources including (1) commercial fisheries, (2) recreational resources, and (3) archaeological resources are discussed in the following sections.

4.3.1.1. Impacts on Commercial Fisheries

The impact-producing factors associated with installation, production, and decommissioning of the Independence Hub project in Mississippi Canyon Block 920 that could affect commercial fishing include (1) underwater OCS obstructions, (2) coastal and marine environmental degradation, (3) space-use conflicts, (4) discharge of produced water and permitted effluents, and (5) blowouts, condensate, or diesel fuel spills.

The most likely objectives for commercial fishing would be epipelagic species that are highly mobile and have the ability to avoid disturbances and disturbed areas. This fishery is traditionally pursued using a highly mobile longline fleet. Desirable pelagic fish species may be attracted to the Independence Hub production facility because the structure acting as a fish attracting device (FAD). The reasons pelagic fish are attracted to deepwater structures are not simple and are not yet clearly understood yet. As encrusting invertebrates, such as hard and soft corals and sponges become attached to the structure, they provide a micro-ecosystem that attracts fish. A tiny area previously available to longline fishing will be eliminated by the installation of the Independence Hub (1.2 ac or 0.5 ha) and its safety zone. A semisubmersible platform in deep water requires as much as 12.3 ac (5 ha) of navigation safety zone. As of early 2003, only seven deepwater production structures have established official safety zones with the USCG, but they do not restrict vessels less than 100 ft (30 m) in length.

Virtually all commercial trawling in the GOM is performed in water <656 ft (200 m) deep. Longline fishing is performed in water depths >328 ft (100 m) and usually deeper than 984 ft (300 m). Either activity is carried out in water depths that are substantially shallower than the bottom locations of potential obstructions from the Independence Hub project. Subsea production infrastructure for the Hub would be located in water depths from 8,000 to 9,000 ft (2,438 to 2,743 m). No drilling fluids and cuttings would be discharged offshore (other than a small volume of cuttings from drilling through temporary cement plugs), and routine discharges from the Hub would be highly diluted in the open marine environment. Produced water discharged from the platform is expected to be treated, if required, and is subject to tremendous dilution factors in the offshore environment.

Chronic, low-level contamination from oils, nutrients, and trace chemicals in surface runoff and rivers discharging into nearshore and open marine environments is a persistent physiological irritation to fish within range of these impacts. Because many commercial species are estuary dependent, coastal environmental degradation has the potential to adversely affect commercial fisheries. Spills that contact coastal bays and estuaries of the OCS when pelagic eggs and fish larvae are present have the greatest potential to affect commercial fishery resources by killing large numbers of fish eggs and larvae. If a spill contacts nearshore waters, commercially important migratory species, such as mackerel, cobia, and crevalle, could be impacted, as would more localized populations, such as menhaden, shrimp, blue crabs, or oysters. Although the quantity of commercial landings of migratory species in the GOM is comparatively small, these species can be of high value. There are no commercially important demersal fish resources in the water depths for the Independence Hub project area.

Spills that occur from installation, production, and decommissioning of the Hub would be few, volumetrically small, and located near project activities in Mississippi Canyon Block 920, if they occurred at all. A blowout or large condensate spill (≥1,000 bbl) from the Independence Hub would be recovered offshore, and what is not recovered would arrive inshore in a highly weathered and degraded state. Adult fish must become exposed to crude oil for some time, probably on the order of several months, to sustain a dose that causes biological damage (Payne et al., 1988). Adult fish also possess some capability for metabolizing oil (Spies et al., 1982). Farr et al. (1995) documented an avoidance reaction by fish to waters containing dissolved hydrocarbon, and analogous behavior can be expected of commercially important fish.

Besides the risk of contact from an offshore spill, Louisiana coastal waters could experience a spill along vessel transit corridors and near ports that support offshore development and production operations. According to the USCG, 95 percent of all reported coastal spills each year are <24 bbl, so the great majority of coastal spills would likely be small, would disperse quickly, and would have no discernable effect on commercial fisheries. The MMS assumes that a degraded petroleum spill from OCS activity will occasionally contact and affect nearshore and coastal areas of migratory Gulf fisheries. There is no evidence that commercial fisheries in the Gulf have been adversely affected on a regional population level by spills or chronic contamination.

Even if fish resources successfully avoid spills, tainting (oily-tasting fish), public perception of tainting, or the potential of tainting commercial catches will prevent fishermen (either voluntarily or imposed by regulation) from operating in a spill area. Restrictions on catch could decrease landings and/or value for several months. Because the ranges of commercially important fish resources are large, Gulf fishermen do not fish in one locale and have responded to past petroleum spills by moving elsewhere for a few months without substantial loss of catch or income. The effect of oil spills on commercial fishing is expected to cause less than a 1 percent decrease in commercial fishing efforts, landings, or value of those landings. Any affected commercial fishing activity would recover within 6 months or by the next fishing season. Potential negative effects caused by Hub installation, operation, and decommissioning would be indistinguishable from variations because of natural causes.

There is also substantial evidence that offshore structures act as fish attracting devices (FAD's) for deepwater pelagic species. This attraction is so strong that presently most of the world's catch of yellowfin tuna is taken around drifting or anchored objects that serve as FAD's (Fonteneau et al., 2000). There will likely be an enhanced fishery for some pelagic species around the Independence Hub structures, particularly for yellowfin tuna.

A discussion of impacts on commercial fisheries from OCS activity is provided in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 4.2.1.11), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 4.2.1.11), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 4.3.3.1). These discussions are incorporated into this SEA by reference.

Conclusion

There will be some unavoidable loss of fishing space because of the physical presence of the Hub surface facilities that could otherwise have been used for pelagic longline fishing. This impact is not considered to be significant because the overall footprint of the development is <15 ac (6 ha), tiny compared to the total space available in the Gulf. A large oil spill might have commercial implications but, for the most part, the Gulf fishing fleets are highly mobile. A large spill may cause them to vary their operational areas for up to 1 year. In addition, there are no commercially important demersal species in the ultra-deepwater where the Hub is located.

The Independence Hub project is expected to have little impact on the productivity of any commercial fisheries endemic to the northern GOM. There are no commercial fisheries that are restricted exclusively to The Independence Hub project area, nor is the Independence Hub project uniquely located to impact a commercial fishery. Bottom obstructions are not expected to be an issue because of extreme water depths and the lack of commercially important species. Desirable pelagic fish species may also be attracted to the Hub structure and could potentially improve commercial catches using fishing techniques other than longlining.

4.3.1.2. Impacts on Recreational Resources

The impact-producing factors associated with installation, production, and decommissioning of the Independence Hub project in Mississippi Canyon Block 920 that could affect recreational resources include trash and debris originating from the project, well blowouts, and spilled oil.

Millions of annual visitors attracted to the coast are responsible for thousands of local jobs and billions of dollars in regional economic activity. Most recreational activity occurs along shorelines and includes such activities as beach use, boating and marinas, camping, water sports, recreational fishing, and bird watching, and casino resorts with gambling. The location of the Independence Hub 92 mi (148 km) from the nearest shoreline, which happens to be uninhabited, precludes any visual impacts on people engaged in activity along the shoreline or in coastal waters. A mobile offshore drilling rig is visible to a person standing at sea level to distances of 3-10 mi (5-16 km) depending on atmospheric conditions. The lights on top of a drilling mast could be visible to approximately 20 mi (32 km) under optimal conditions. All of the offshore facilities associated with the Independence Hub project are >100 mi (160 km) from the nearest inhabited shorelines in Mississippi, Louisiana, Alabama, and Florida making this development project impossible to see from the shore.

Very few recreational fishing trips go into deep water >100 mi (160 km) from shore and beyond the 656 ft (200-m) isobath (the edge of the continental shelf). No impacts would be expected on recreational fishing.

The oil and gas industry is not the main source for trash and debris that litter shorelines along the Gulf. People engaged in recreational activities along the coast are mainly responsible for this litter, as well as trash and debris originating onshore but ending up in the sea through deliberate or careless acts of disposal. The U.S. National Park Service documented the origins of trash and debris on South Padre Island in Texas. About 13 percent of the 63,000+ items collected were attributable to the offshore oil and gas industry (Miller and Echols, 1996). Other sources of trash, debris, and plastics include (1) accidental loss from staffed structures in State and Federal waters where hydrocarbons are produced, (2) commercial shrimping and fishing, (3) private and recreational boats, (4) runoff from storm drains, (5) combined storm and sewage systems in older cities, and (6) commercial and recreational fishermen.

Condensate spills that occur from installation, production, and decommissioning of the Hub would be few, volumetrically small, and located near project activities in Mississippi Canyon Block 920, if they occurred at all. Should a blowout or large oil spill ≥1,000 bbl occur as a result of Independence Hub project activity, the likelihood of contact with shoreline resources is very small. Should a spill slick make landfall, it could present aesthetic impacts, but it is likely to be in a degraded state. Recreational beaches may be temporarily closed during cleanup and displace and inconvenience recreational users for up to 1 year. Smaller spills would be subject to weathering and dispersion and would dissipate before landfall.

A discussion of impacts on recreational resources from OCS activity is provided in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 4.2.1.12), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapters 4.2.1.12 and 4.2.1.13), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 4.3.3.2 and 4.3.3.3). These discussions are incorporated into this SEA by reference.

Conclusion

The proposed Independence Hub project is expected to have no significant impact on recreational resources. The risk of a large condensate spill occurring during Hub operations is very small. The displacements, inconvenience, or closure of beaches or other recreational resources caused by a spill is below the level of social and economic concern. While some accidental loss of solid wastes may occur from the Independence Hub project or service vessels, existing mitigations and regulations that control the handling of offshore trash and debris would be expected to restrict and limit these inputs so that they have a negligible impact on recreational resources.

4.3.1.3. Impacts on Archaeological Resources

The impact-producing factors associated with installation, production, and decommissioning of the Independence Hub project in Mississippi Canyon Block 920 that could affect archaeological resources include (1) direct contact or disturbance by the installation rig and Hub anchors or mooring chains, (2) ferromagnetic structures or debris on the seabed, (3) onshore development in support of the project, and

(4) oil spills. Chapter 4.2.1.13 (Impacts on Archaeological Resources) in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; page 4-118) contains a discussion of impacts from OCS activity and is incorporated into this SEA by reference.

The MMS's operational regulation at 30 CFR §250.194 requires that an archaeological survey be conducted prior to development of leases within the high-probability zones for historic and prehistoric archaeological resources. As of July 1, 2005, all lease blocks in the Mississippi Canyon area were determined to have a high probability for the occurrence of historic shipwrecks.

4.3.1.3.1. Prehistoric

Lease blocks with a high probability for prehistoric archaeological resources may only be found landward of a line that roughly follows the 60-m (197-ft) bathymetric contour. The MMS recognizes both the 12,000 B.P. date and 60-m (197 ft) water depth as the seaward extent for prehistoric archaeological potential on the OCS. Because of the water depths in the Independence Hub project area (8,000-9,000 ft; 2,438-2,743 m), there is no potential for prehistoric archaeological resources in the area. The development activities for the Independence Hub project cannot impact prehistoric archaeological resources.

4.3.1.3.2. Historic

There are areas of the northern GOM that are considered by MMS to have a high probability for historic period shipwrecks (Garrison et al., 1989; Pearson et al., 2002). Statistical analysis of the shipwreck location data identified two specific types of high-probability areas: (1) within 10 km (6 mi) of the shoreline and (2) proximal to historic ports, barrier islands, and other loss traps. Additionally, MMS has created high-probability search polygons associated with individual shipwrecks to afford protection to wrecks located outside the two high-probability areas.

According to Garrison et al. (1989) and Pearson et al. (2002), the shipwreck database lists two shipwrecks that are presumed to lie within the Independence Hub project area (Table 3-6). Neither of these vessels has been located on the seafloor. The locational reliability for the vessel *Nokomis* is rated as 3 out of 4, meaning the vessel was reported to have sunk somewhere in the vicinity of the coordinates provided in the MMS database. The locational reliability for the vessel B-1 is rated as 4 out of 4, meaning "unreliable or vague."

The specific locations of archaeological sites cannot be known without first conducting a remote-sensing survey of the seabed and near-surface sediments. The latest NTLs referring to archaeological survey requirements, NTL 2005-G07 and NTL 2005-G10, were issued by MMS with an effective date of July 1, 2005. These revised NTLs continue to require a 50-m (164-ft) line-spacing density for historic shipwreck remote-sensing surveys in water depths less than 200 m (656 ft), and also identify the deepwater approach to the Mississippi River as having a high probability for containing historic shipwrecks. For lease blocks identified as having a high probability for historic resources in water depths greater than 200 m (656 ft), a line spacing of 300 m (984 ft) is required.

Several OCS-related, impact-producing factors may cause adverse impacts to unknown historic archaeological resources. Offshore development activities that could result in the most severe impacts to an unknown historic shipwreck would be contact with the installation barge or Hub anchors and mooring chains, and the installation of subsea production infrastructure, such as manifolds, flowlines, and umbilicals. Direct physical contact with a shipwreck site could destroy fragile remains, such as the hull and wooden or ceramic artifacts, and could disturb the site context. The result would be the loss of archaeological data on ship construction, cargo, and the social organization of the vessel's crew, as well as the loss of information on maritime culture for the time period from which the ship dates. The likelihood of impacts on a historic archaeological resource from anchoring of the Independence Hub or the installation of seabed production infrastructure for the Independence Hub project is extremely small.

Offshore operations can introduce tons of ferromagnetic structures, components, and debris onto water that if dropped or accidentally lost without recovery have the potential to mask the magnetic signatures of historic shipwrecks. Current requirements for site clearance in NTL 98-26 (*Minimum Interim Requirements for Site Clearance (and Verification) of Abandoned Oil and Gas Structures in the Gulf of Mexico*) apply to debris and structures in water <300 ft (91 m) deep. The decommissioning and site-clearance requirements for projects in deep water, such as the Independence Hub, will likely evolve and change over time. The OCS infrastructure installed on the seabed in deep water may not be cut or explosively removed below the mudline and could be abandoned in place. The task of locating historic resources via an archaeological survey would be made more difficult as a result of operational practices that leave ferromagnetic debris from OCS activity on the seabed.

No onshore development in support of the proposed action is expected; therefore, no impact to onshore historic sites, such as forts, lighthouses, cemeteries, or buildings, from any onshore development in support of the Independence Hub project would be expected. Cumulative impacts may occur, however, manifested as subsidence.

Should spilled condensate contact a coastal historic site, such as a fort or a lighthouse, oil would be in a weathered and degraded state. The major impact would be visual petroleum contamination of the site and surroundings. Impacts to coastal historic sites are not expected to occur, and if a spill does occur, impacts would be temporary and reversible.

A discussion of impacts on archaeological resources from OCS activity is provided in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 4.2.1.13), the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 4.2.1.14), and the PEA for exploration in the EPA sale area (USDOI, MMS, 2003b; Chapter 4.3.3.4). These discussions are incorporated into this SEA by reference.

In the event that an archaeological resource is discovered in the area of the proposed Independence Hub, all operations within 1,000 ft (305 m) of the discovery must cease immediately. Steps must be taken to ensure that the site is not disturbed in any way, and the Regional Supervisor, Leasing and Environment, must be contacted within 48 hours of its discovery.

Conclusion

There is no possibility that the proposed Independence Hub project will impact prehistoric archaeological resources because of the extreme water depth.

The Independence Hub project is expected to have no direct or indirect impact on the inventory of known or unknown historical shipwrecks located in the Independence Hub project area. Impacts are possible on a historic shipwreck because of incomplete knowledge about the location of shipwrecks in the Gulf, but they are not likely. Direct contact between anchors and mooring lines for the Hub topsides, or the emplacement of sea-bottom production structures could destroy or disturb important historic archaeological artifacts or information. Other impact-producing factors would not be expected to adversely affect historic archaeological resources.

4.3.2. Impacts on Human Resources and Economic Activity

The impacts on human resources and economic activity including (1) population and education, (2) infrastructure and land use, (3) navigation and port use, (4) employment and economic activity, and (5) environmental justice are discussed in the following sections. Discussion of impacts on land use, coastal infrastructure, demographics, economic factors, and environmental justice from OCS activity can be found in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 4.2.1.14) and the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 4.2.1.15). These discussions are incorporated into this SEA by reference.

The Independence Hub project is expected to have negligible economic impact throughout all 10 of the coastal subareas identified in Chapter 3.3.1.1 (Socioeconomic Impact Area). Most of the probable changes in population, labor, and employment resulting from the Independence Hub project would likely occur in the 24 counties in Texas and the 26 parishes in Louisiana because the oil and gas industry is best established in this region. Some of the likely changes in population, labor, and employment resulting from the Independence Hub project would also occur in the six Alabama and Mississippi counties because of their established oil and gas industry and proximity to the Independence Hub project area. Changes in economic factors (in minor service and support industries) from the project would occur, to a much lesser extent or not at all, in the 24 counties of the Florida Panhandle because their economy only marginally supports industries in oil and gas development.

4.3.2.1. Impacts on Population and Education

The impact region's population will continue to grow slowly (<2% per year) according to regional trends (Table B-1). Minimal effects on population are projected from activities associated with the project. While some of the labor force is expected to be local to the service base at Port Fourchon or

Venice, most of the additional employees associated with the Independence Hub project are not expected to require local housing specifically as a result of this project. Local housing requirements may result for some individuals that participate on this project as well as other serial or overlapping contracts that extend over longer periods of time. The Independence Hub project is not expected to significantly affect the region's educational level profile.

Conclusion

The proposed Independence Hub project is expected to have a minimal impact on the region's population or educational level.

4.3.2.2. Impacts on Infrastructure and Land Use

While OCS-related servicing should increase in Port Fourchon, Louisiana, no expansion of the physical facilities there are expected to result from the Independence Hub project. Changes in land use throughout the region as a result of the proposed activity would be contained and minimal. While land use in the impact area will change over time, the majority of this change is estimated as general regional growth. Increased OCS deepwater activity is expected to impact Port Fourchon and other OCS ports with deepwater capability. Incremental change may occur in the Barataria or Terrebonne basin as a result of wetland restoration or barrier island stabilization projects over the next 10 years that are contemplated in the Louisiana Coastal Area (LCA) Plan (USCOE, 2004).

Conclusion

The proposed Independence Hub project is expected to have minimal impact on the region's existing infrastructure or land-use patterns. No substantive changes will occur to existing infrastructure or land use patterns. No new facilities will be built and no existing structures will be modified except as a result of ongoing maintenance.

4.3.2.3. Impacts on Navigation and Port Use

The proposed action would use the existing onshore support base located at Port Fourchon, Louisiana, for completion, facility installation, commissioning, and production support activities. The APC intends to use onshore facilities located in Port Fourchon as a port of debarkation for supplies and equipment. The shore base at Venice, Louisiana, would be used as a backup for support. Both bases operate 24 hours. Each is capable of providing the services necessary for the project. No onshore expansion or construction is anticipated with respect to the proposed action at either base

Three round-trip supply boat trips and two crewboat trips per week would be expected for the completion and development phases of the project over a 16-month period. The same frequency of servicing is expected during the 20-year operational lifetime of the Hub. Four helicopter trips per week would be expected for the project's completion and development phase of activity. The same frequency of servicing is expected during 20 years of Hub operation. The proposed activity is expected to impact Port Fourchon and Venice because dredging programs are likely to be needed to maintain navigational channels, turning basins, and other docking and harbor areas for deeper draft service vessels. Insofar as this Hub project contributes to overall OCS usage, it has a small incremental impact.

Conclusion

The proposed Independence Hub project is expected to have a minimal impact on navigation and port use. No substantive changes will occur to existing navigation and port infrastructure as a result of the Hub project. No new facilities will be built and no existing structures will be modified except as a result of ongoing maintenance.

4.3.2.4. Impacts on Employment and Economic Activity

Employment impacts can be broken down in to the construction and operation phase of the project. The construction phase is defined as the construction of the platform hull and topside facilities, drilling of the wells, and installation of the pipelines and subsea equipment. The platform hull will be fabricated at

Jurong Shipyard in Singapore; therefore, no local capital expenditures or employment impacts are expected. However, the topsides will be constructed at Kiewet Yard in Ingleside, Texas, which is in San Patricio County (TX-1). Independence Hub LLC estimates that the construction of the topsides will require 400 employees over a period of 18 months (November 2004 through April 2006). Most of these people, however, simply transfer from one contract to another and do not represent net employment gains to the local region. Of the small number of new employees, only a fraction would be expected to establish permanent local housing.

The 21 wells intended for production by the Hub will be completed using a DP drillship, the *Deepwater Millennium* or an equivalent drillship. The *Deepwater Millenium* has a crew capacity of 130. The APC estimates that the installation of the proposed offshore pipelines will require about 250 workers over a 12-month period (November 2005 through October 2006). The MMS estimates 60 crew members are needed to operate one supply boat and one crewboat supporting the drilling and pipeline activities. During the construction period, the majority of workers will remain offshore and will reside on the drill rig or support vessels. A small percentage of workers may require temporary onshore housing, but few if any are expected to relocate and require permanent housing. Some importation of skilled labor may be required on a temporary basis. While maintenance, supplies, and services purchased at Port Fourchon, Louisiana, will benefit commercial vendors located there and in nearby areas, the overall benefit in new job growth for local population will be minimal, and few new net jobs will result.

First production from the Independence Hub is expected in the first quarter of 2007. The APC estimates that a 40-person crew will be used to operate the Hub facility, along with 30 people who crew one service boat and one crewboat to support the facility. A 20-year production lifetime for the Independence Hub is expected. The following stimulating effects to the local economy are expected: (1) spending by the operator to purchase goods and services in support of the proposed activity; (2) spending by the people estimated to be directly employed by the proposed actions; (3) spending by people indirectly employed as the Hub's expenditures reverberate through the local economies; and (4) spending by the households who have breadwinners receiving paychecks as a result of these direct and indirect expenditures. In summary, these sources will have a very minor stimulating effect on the local economy.

The landfall of Hurricane Katrina on August 29, 2005, caused widespread destruction of homes, businesses, roads, bridges, oil and gas infrastructure, and service base support facilities in Louisiana. The economic impacts and the increase in employment from rebuilding these homes and facilities are likely to be a major stimulus to the area, but the effects are not yet quantifiable.

The resource costs of cleaning up an oil spill, both on- and offshore, are not significant for two reasons: (1) the resources involved in the cleanup of an oil spill, in the absence of that spill, would produce other goods and services; and (2) the occurrence of a spill is not a certainty.

A discussion of impacts on employment, including oil-spill cleanup, is provided in the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 4.2.1.14.3 and Chapter 4.4.3.14.3) and the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 4.2.1.15.3 and Chapter 4.4.14.3). These discussions are incorporated into this SEA by reference.

Conclusion

The proposed Independence Hub project is expected to have minimal impacts on employment and economic activity, including those that could result from a blowout and related spill cleanup scenario.

4.3.2.5. Impacts on Environmental Justice

Environmental justice policy is based on Executive Order 12898 of February 11, 1994. This policy requires Federal agencies to determine whether their proposed actions will result in disproportionately high and adverse environmental effects on minority and low-income populations. In Louisiana the routine operations of the onshore facilities supporting the Independence Hub project will not result in impacts of environmental justice concern. Should an accident occur, the habitat land of minority populations in south Lafourche Parish could be potentially affected. This is unlikely, however, as the area around Port Fourchon is sparsely populated (Hemmerling and Colten, 2003). In addition, while associated with potential risks, Port Fourchon has not had a facility report a toxic release to the USEPA (Hemmerling and Colten, 2003). San Patricio County, Texas, where the Keiwit topsides fabrication yard is located, is an area of potential environmental justice concern because it contains a significant minority population (50% Hispanic) and has an active Superfund site in the City of Ingleside.

Conclusion

The proposed Independence Hub project is not expected to contribute significantly to environmental justice concerns.

4.4. CUMULATIVE EFFECTS

In analyses of environmental impacts in EIS's for OCS lease sales, MMS uses a time period of 40 years as the life cycle over which the typical activities of industry exploration, development, and production occur. The Hub design lifetime is intended to be 20 years. The Independence Hub constitutes one development project among many that were anticipated for the CPA and EPA and for which cumulative effects were examined in a succession of EIS's for multiple lease sales. Table 4-3 shows the EIS's within which the cumulative effects for each OCS block proposed to be developed by Independence Hub was originally considered.

Table 4-3

Hub Prospects and Associated EIS's Analyzing Cumulative Effects

Prospect	Planning Area	Sale #	Protraction Area and Block #	Original NEPA Document
Atlas NW	EPA	181	Lloyd Ridge 5	(USDOI, MMS, 2001a)
Atlas	EPA	181	Lloyd Ridge 50	(USDOI, MMS, 2001a)
Spiderman	EPA	181	DeSoto Canyon 620, 621	(USDOI, MMS, 2001a)
Cheyenne	EPA	181	Lloyd Ridge 399	(USDOI, MMS, 2001a)
San Jacinto	EPA	181	DeSoto Canyon 618	(USDOI, MMS, 2001a)
Mondo NW	EPA	116	Lloyd Ridge 1, 2	(USDOI, MMS, 1987)
Merganser	CPA	175	Atwater Valley 37	(USDOI, MMS, 1997)
Vortex	CPA	157	Atwater Valley 261	(USDOI, MMS, 1995)
Jubilee	CPA	166	Atwater Valley 305, 349	(USDOI, MMS, 1996)

Documentation of cumulative effects for more recent lease sales would include the EPA Multisale Final EIS (USDOI, MMS, 2003a; Chapter 4.5) and the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002; Chapter 4.6). Look to these more recent Final EIS's for the most up-to-date evaluation of the cumulative effects for Independence Hub. The incremental contribution of cumulative impacts attributable to the Independence Hub project would be negligible for all of the physical, environmental, socioeconomic, and human resources discussed in Chapters 4.1, 4.2, and 4.3 of this SEA.

Cumulative rates of subsidence on the Mississippi River delta platform make vulnerable shore facilities upon which OCS activity is dependent. The degree to which oil and gas extraction activities have caused or aggravated subsidence rates is debated routinely. It has yet to be separated from natural sediment dewatering and mud compaction that is acknowledged to be the principle contributor to Mississippi River delta subsidence. On an oil or gas field scale, extraction may be a significant contributor to overall subsidence of the delta platform. The effects of listric normal faulting with down-to-the-basin displacement and extraction or freshwater are also suspected contributors to deltaic subsidence.

The Corps of Engineers (COE) released a Final Programmatic EIS (PEIS) for the Louisiana Coastal Area Ecosystem Restoration Plan (LCA Plan) in November 2004 (USCOE, 2004). The LCA Plan is designed to be a coordinated approach to alleviate and arrest the chronic and severe loss of wetlands along the Louisiana coastal area. The Draft PEIS envisions a range of "restoration opportunities" over the next 10 years that fall into two categories: those that divert Mississippi River water and sediment to naturally replenish threatened areas and habitats, and those that reconstruct or enhance geomorphic barriers that dampen storm waves and tidal surge, such as barrier islands and levee systems. The COE's preferred alternative, or Tentatively Selected Plan, is an ambitious synergistic combination of projects undertaking both river diversions and geomorphic restorations estimated to cost $1.9 billion over the initial 10 years. If this plan is approved by the Bush Administration and funded by Congress, the restoration projects contemplated in it have the potential of having numerous favorable cumulative impacts on the Mississippi River delta platform. Among these are (1) add new net wetland areas on the delta platform, (2) reduce fresh-to salt wetland conversions and restore converted salt marsh and wetland to freshwater habitats, (3) stabilize Louisiana Highway 1, the main road and overpasses that link the busy service base at Port Fourchon to the mainland, and (4) increase nutrient capture in wetlands and reduce deleterious impacts caused by hypoxic zones on the OCS continental shelf. Among the first projects to be considered is an EIS for the Caminada Headland and Shell Island Restoration Feasibility Study and for which scoping hearings were held on June 2005. The headlands make up the western boundary of the Barataria Basin and protect Grand Isle and Port Fourchon, the most important shore base in the central GOM. Erosion and subsidence there threatens Port Fourchon and the feasibility study explores options for restoring the tattered Caminada Headlands by planting marsh grass and nourishing beaches.

In 2005, the Mississippi and Louisiana coasts and coastal counties and parishes were severely impacted by the landfall of Hurricane Katrina on August 29. Katrina made landfall with sustained wind velocities in Slidell, Louisiana, of 176 mph, with tidal surges of 23-26 ft (7-8 m) (City of Slidell, 2005). Complete destruction of homes and businesses from tidal surge and wind took place many miles inland along the coastline between Gulfport and Biloxi, Mississippi. Heavy wind damage and severe flooding took place in the Louisiana coastal parishes of St. Bernard, Plaquemines, and New Orleans. Katrina's landfall is likely to make a significant contribution to cumulative effects on physical, biological, socioeconomic, and human resources in southeastern Louisiana and coastal Mississippi. The socioeconomic and human impacts resulting from rebuilding these areas are also likely to be very substantial.

Three weeks after Katrina, Hurricane Rita made landfall near Cameron, Louisiana, near the Texas-Louisiana border. Rita was a Category 3 hurricane that caused a 4- to 5-ft storm surge in southeastern Louisiana and additional flooding in parts of levee-damaged New Orleans, an area already ravaged by Katrina. The cumulative influence of these storms on the Mississippi River delta platform is likely to be very substantial.

5. CONSULTATION AND COORDINATION

The development activities proposed by APC for Mississippi Canyon Block 920 constitute part of OCS activity that was considered by the CPA/WPA Multisale Final EIS (USDOI, MMS, 2002) and the EPA Multisale Final EIS (USDOI, MMS, 2003a) as part of a defined development scenario. During preparation of these EIS's, the MMS conducted early coordination with appropriate Federal and State agencies and other concerned parties to discuss and coordinate the prelease process for lease sales in the CPA and WPA proposed between 2003 and 2007. Consultation and coordination efforts for the CPA/WPA Multisale Final EIS identified the environmental resources considered in this SEA. Key agencies and organizations with which MMS consulted during the EIS process included NOAA Fisheries, FWS, DOD, USCG, USEPA, State Governors' offices and other State agencies, and industry groups.

The States of Louisiana, Mississippi, Alabama, and Florida have approved Coastal Zone Management (CZM) Programs. The operator is required to obtain Certificates of Coastal Zone Consistency from these states before the Hub project may proceed. The APC, Dominion, and Kerr-McGee began submitting pipeline ROW applications and DOCD's in April 2005. The MMS's review of these documents determined that supplemental information was required from the operators to fully comply with the requirements of NTL 2002-G15 (*Coastal Zone Management Program Requirements for OCS ROW Pipeline Applications*) and NTL 2003-G17 (*Guidance for Submitting Exploration Plans and Development Operations Coordination Documents*). The MMS requested additional information from the operators. On July 11 and 12, 2005, MMS mailed the public copies of the DOCD's and other required and necessary information to the appropriate State agencies of Louisiana, Alabama, Mississippi, and Florida that are responsible for managing CZM programs. Approval of these DOCD's and the pipeline ROW applications cannot take place until concurrence with APC's CZM consistency certification has been received by MMS. All the required CZM approvals from these States were not received by MMS prior to completion of this SEA, but their receipt is a condition for approval for the Hub. Tables 5-1 and 5-2 show notifications of CZM concurrence that were received prior to completion of this SEA.

Table 5-1

CZM Approvals for DOCD's

Gas Field	DOCD Control Number	Mississippi	Louisiana	Alabama	Florida
Atlas Northwest	N-8411	N/A	8/2/05	8/17/05	R
Atlas	N-8411	N/A	8/2/05	8/17/05	R
Spiderman	N-8402	N/A	8/2/05	8/16/05	R
Cheyenne	N-8419	N/A	8/17/05	8/25/05	R
San Jacinto	N-8430	N/A	8/2/05	8/22/05	R
Mondo Northwest	N-8415	N/A	8/17/05	8/17/05	R
Merganser	N-8407	N/A	6/6/05	6/13/05	N/A
Vortex	N-8458	N/A	8/2/05	8/2/05	N/A
Jubilee (includes Hub)	N-8385	N/A	8/2/05	8/16/05	N/A

Note: N/A = Not applicable.
R = Required, but concurrence not yet received at time of completion of this SEA.

Table 5-2

CZM Approvals for Pipeline ROW Applications

Pipeline Linkages to Hub	Pipeline ROW Control Number*	Mississippi	Louisiana	Alabama	Florida
Atlas/Atlas Northwest Mondo Northwest	P-15146	N/A	6/1/05	N/A	R
Spiderman	P-15099, P-15100	4/12/05	4/26/05	N/A	R
Cheyenne/Jubilee/Vortex	P-15149, P-15152	N/A	6/1/05	N/A	R
San Jacinto/Spiderman	P-15166	N/A	6/15/05	N/A	R
Merganser	P-15199	N/A	7/14/05	N/A	N/A
Independence Trail	P-15153	R	6/22/05	N/A	N/A

Note: * Flowline control numbers only; associated umbilical lines not indicated.
N/A = Not applicable.
R = Required, but concurrence not yet received at the time of completion of this SEA.

On October 7, 2005, the Florida Department of Environmental Protection sent a letter to MMS stating that they required additional time to undertake a review for concurrence with their CZMP for all of the DOCD's that are part of the Hub proposal. Their request extends the CZM review period for Florida an additional 90 days.

The DOCD's were also sent to the Eglin Air Force Base (EAFB) Encroachment Committee in June 2005 to coordinate the well completion, Hub installation, and production activity in this proposed action with the Air Force as required by lease stipulation. In a letter received on July 19, 2005, EAFB informed MMS that they saw no need to establish a formal operating agreement for APC's proposed operations in the EPA and requested that APC establish a point of contact knowledgeable about electromagnetic transmissions originating from the proposed operations to Mr. Joe Giangrosso at (850) 882-4416.

Public involvement specifically for this SEA included a scoping comment period. A Notice of Preparation of the EA was published in several newspapers that outlined the activities APC proposed for the Independence Hub project. The newspaper notices described the environmental resources and impact-producing factors expected to be considered and also requested comments from the public regarding issues to be included in EA. The notices specified a 30-day scoping comment period. The newspaper notices were published on or about July 12 in the following papers: the *The Times-Picayune* (southeast Louisiana coverage), the *Mobile Register* (southern Mississippi and southern Alabama coverage), the *Daily Comet* in Plaquemines and Terrebonne Parishes, Louisiana (southeast Louisiana coverage in the area of the proposed service bases), and the *Pensacola News Journal* (Florida panhandle coverage). The newspaper announcements specified four means by which an interested party could furnish scoping comments to MMS: (1) hand delivery; (2) U.S. mail; (3) e-mail to environment@mms.gov; and (4) Internet access to MMS's OCS Public Connect system. No comments were received during the comment period, which ended 30 days following publication of the newspaper notices.

Several weeks later, a summary of the Independence Hub project was posted on the MMS website (USDOI, MMS, 2005c) and on OCS Public Connect. A 30-day scoping period was also specified in OCS Public Connect, with comments being due by September 2, 2005. The eight DOCD's that constitute this project, the five pipeline ROW applications for connecting flowlines between the gas fields and the Hub, and the ROW application for the Independence Trail export trunk line were also posted on OCS Public Connect. One comment was received on August 23, 2005, from Mr. Jason Poe from Lewiston, Idaho. Mr. Poe stated that any advancement towards the U.S. independence from foreign resources should be pursued for a stable future for America and requested that the "interior" public's thoughts be considered. Hurricane Katrina made landfall on August 29, 2005, damaging the MMS GOM Regional Office in Jefferson Parish, Louisiana. The OCS Public Connect System became inoperable at 12:30 a.m. on August 29. To the best of our knowledge, as of that time, no additional comments had been received. In addition, no comments were received by hand delivery, U.S. mail, or e-mail, the other three means to provide scoping comments to MMS.

6. REFERENCES

Advanced Research Projects Agency. 1995. Final environmental impact statement/environmental impact report (EIS/EIR) for the California Acoustic Thermometry of Ocean Climate (ATOC) Project and its associated Marine Mammal Research Program (MMRP) (Scientific Research Permit Application [P557A]), Vol. 1.

Aharon, P., D. Van Gent, B. Fu, and L.M. Scott. 2001. Fate and effects of barium and radium-rich fluid emissions from hydrocarbon seeps on the benthic habitats of the Gulf of Mexico offshore Louisiana. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2001-004. 142 pp.

Albers, P.H. 1979. Effects of Corexit 9527 on the hatchability of mallard eggs. Bull. Environ. Contam. and Toxicol. 23:661-668.

Albers, P.H. and M.L. Gay. 1982. Effects of a chemical dispersant and crude oil on breeding ducks. Bull. Environ. Contam. and Toxicol. 9:138-139.

Alexander, S.K. and J.W. Webb. 1983. Effects of oil on growth and decomposition of *Spartina alterniflora*. In: Proceedings, 1983 Oil Spill Conference . . . February 28-March 3, 1983, San Antonio, TX. Washington, DC: American Petroleum Institute. Pp. 529-532.

Alexander, S.K. and J.W. Webb. 1985. Seasonal response of *Spartina alterniflora* to oil. In: Proceedings, 1985 Oil Spill Conference, February 25-28, 1985, Los Angeles, CA. Washington, DC: American Petroleum Institute. Pp. 355-357.

Alexander, S.K. and J.W. Webb. 1987. Relationship of *Spartina alterniflora* growth to sediment oil content following an oil spill. In: Proceedings, 1987 Oil Spill Conference. April 6-9, 1988, Baltimore, MD. Washington, DC: American Petroleum Institute. Pp. 445-450.

Amos, A.F. 1989. The occurrence of hawksbills (*Eretmochelys imbricata*) along the Texas coast. In: Proceedings of the Ninth Annual Workshop on Sea Turtles Conservation and Biology, February 7-11, 1989, Jekyll Island, GA. NOAA-TM-NMFS-SEFC-232. Miami, FL.

Anderson, C.M. and R.P. Labelle. 2000. Update of comparative occurrence rates for offshore oil spills. Spill Science and Technology Bulletin 6(5/6):303-321.

Anderson, D.W., F. Gress, and D.M. Fry. 1996. Survival and dispersal of oiled brown pelicans after rehabilitation and release. Mar. Poll. Bull. 32:711-718.

Anuskiewicz, R.J. 1989. A study of maritime and nautical sites associated with St. Catherines Island, Georgia. Ph.D. dissertation presented to the University of Tennessee, Knoxville, TN. 90 pp.

Aten, L.E. 1983. Indians of the upper Texas coast. New York, NY: Academic Press.

Avanti Corporation. 1993. Environmental analysis of the final effluent guideline, offshore subcategory, oil and gas industry. Volume II. Prepared for the U.S. Environmental Protection Agency, Water Management Division, Region VI. USEPA Contract No. 68-C9-0009.

Baker, J.M., R.B. Clark, and P.F. Kingston. 1991. Two years after the spill: Environmental recovery in Prince William Sound and the Gulf of Alaska. Institute of Offshore Engineering, Heriot-Watt University, Edinburgh, EH14 4AS, Scotland. 31 pp.

Bakus, R.H., J.E. Craddock, R.L. Haedrich, and B.H. Robison. 1977. Atlantic mesopelagic zoogeography. In: Gibbs, R.H. Jr., ed. Fishes of the Western North Atlantic. Pp. 266-287.

Ballachey, B.E., J.L. Bodkin, and A.R. DeGange. 1994. An overview of sea otter studies. In: Loughlin, T.R., ed. Marine mammals and the *Exxon Valdez*. San Diego, CA: Academic Press. Pp. 47-59.

Basan, P.B., C.K Chamberlain, R.W. Frey, J.D. Howard, A. Seilacher, and J.E. Warme. 1978. Trace fossil concepts. Society of Economic Tulsa, OK: Paleontologists and Mineralogists, Short Course No. 5. 181 pp.

Baumgartner, M.F. 1995. The distribution of select species of cetaceans in the northern Gulf of Mexico in relation to observed environmental variables. M.Sc. Thesis, University of Southern Mississippi.

Bent, A.C. 1926. Life histories of North American marsh birds. New York: Dover Publications.

Boehm, P., D. Tuton, A. Raval, D. Caudle, D. French, N. Rabalais, R. Spies, J. Johnson. 2001. Environmental risks of chemical products used in Gulf of Mexico deepwater oil and gas operations. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2001-011. 326 pp.

Boersma, P.D. 1995. Prevention is more important than rehabilitation: Oil and penguins don't mix. In: Proceedings, The Effects of Oil on Wildlife, 4th International Conference, April, Seattle, WA.

Boland, G.S. 2000. Personal communication. Observations of two new chemosynthetic communities (Blocks GB 535 and GC 354) from the Johnson Sea Link submersible as part of an MMS funded Coastal Marine Institute Study with Louisiana State University, Harry Roberts, project manager, contract #17801.

Brongersma, L. 1972. European Atlantic turtles. Zool. Verh. Mus., Leiden. 121:1-3.

Brooks, J.M., M.C. Kennicutt II, and R.R. Bidigare. 1986. Final cruise report for Offshore Operators Committee study of chemosynthetic marine ecosystems in the Gulf of Mexico. Geophysical and Environmental Research Group, Department of Oceanography, Texas A&M University, College Station, TX. 102 pp.

Butler, R.G., A. Harfenist, F.A. Leighton, and D.B. Peakall. 1988. Impact of sublethal oil and emulsion exposure on the reproductive success of Leach's storm-petrels: Short- and long-term effects. Journal of Applied Ecology 25:125-143.

Byles, R., C. Caillouet, D. Crouse, L. Crowder, S. Epperly, W. Gabriel, B. Gallaway, M. Harris, T. Henwood, S. Heppell, R. Marquez-M., S. Murphy, W. Teas, N. Thompson, and B. Witherington. 1996. A report of the turtle expert working group: Results of a series of deliberations held in Miami, FL, June 1995-June 1996.

Carney, R. 1993. Presentation at the Thirteenth Gulf of Mexico Information Transfer Meeting. Sponsored by the U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA, December 4-6, 1993.

Carney, R.S., R.L. Haedrich, and G. T. Rowe. 1983. Zonation of fauna in the deep sea. In: Rowe, G.T., ed. Deep Sea Biology. New York, NY: John Wiley & Sons. Pp. 371-398.

Carr, A. 1987. Impact of nondegradable marine debris on the ecology and survival outlook of sea turtles. Mar. Poll. Bull. 18:352-356.

Carr, A. and D.K. Caldwell. 1956. The ecology and migration of sea turtles. I. Results of field work in Florida, 1955. Amer. Mus. Novit. 1793:1-23.

Chambers, J.R. 1992. Coastal degradation and fish population losses. In: Proceedings of the National Symposium of Fish Habitat Conservation, March 7-9, 1991, Baltimore, MD. 38 pp.

Chan, E.H. and H.C. Liew. 1988. A review on the effects of oil-based activities and oil pollution on sea turtles. In: Proceedings, 11th Annual Seminar of the Malaysian Society of Marine Sciences. Pp. 159-167.

Chan, E.I. 1977. Oil pollution and tropical littoral communities: Biological effects at Florida Keys oil spill. In: Proceedings, 1977 Oil Spill Conference. March 8-10, 1977, New Orleans, LA. Washington, DC: American Petroleum Institute. Pp. 539-542.

City of Slidell. Internet website, http://www.slidell.la.us

Clapp, R.B., R.C. Banks, D. Morgan-Jacobs, and W.A. Hoffman. 1982. Marine birds of the southeastern United States and Gulf of Mexico. U.S. Dept. of the Interior, Fish and Wildlife Service, Office of Biological Services, Washington, DC. FWS/OBS-82/01. 3 vols.

Clark, R.B. 1984. Oiled seabird rescue and conservation. Journal of the Fisheries Research Board of Canada, 35:675-678.

Clarke, M.R. 1996. Cephalopods as prey. III. Cetaceans. Phil. Trans. R. Soc. Lond. B: Biol. Sci. 351:1053-1065.

Clugston, J.P. 1991. Gulf sturgeon in Florida prey on soft-bodied macroinvertebrates. U.S. Dept. of the Interior, Fish and Wildlife Service. Research Information Bulletin No. 90-31. 2 pp.

Coastal Environments, Inc. (CEI). 1977. Cultural resources evaluation of the Northern Gulf of Mexico Continental Shelf. Prepared for Interagency Archaeological Services, Office of Archaeology and Historic Preservation, National Park Service, U.S. Dept. of the Interior. Baton Rouge, LA.

Coastal Environments, Inc. (CEI). 1986. Prehistoric site evaluation on the Northern Gulf of Mexico Outer Continental Shelf: Ground truth testing of the predictive model. Prepared for the U.S. Dept. of the Interior, Minerals Management Service, New Orleans, LA.

Collard, S.B. and L.H. Ogren. 1990. Dispersal scenarios for pelagic post-hatchling sea turtles. Bull. Mar. Sci. 47:233-243.

Collum, L.A. and T.H. Fritts. 1985. Sperm whales (*Physeter catodon*) in the Gulf of Mexico. Southw. Natural. 30:101-104.

Continental Shelf Associates, Inc. (CSA). 2000. Deepwater Gulf of Mexico environmental and socioeconomic data search and literature synthesis. Volume I: Narrative report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-049. 340 pp.

Corliss, J.B., J. Dymond, L.I. Gordon, J.M. Edmond, R.P. von Herzen, R.D. Ballard, K. Green, D. Williams, A. Bainbridge, K. Crane, and T.H. van Andel. 1979. Submarine thermal springs on the Galapagos Rift. Science 203:1073-1083.

Council on Environmental Quality. 1947. Environmental Justice: Guidance Under the National Environmental Policy Act. Executive Office of the President, Old Executive Office Building, Room 360. Washington D.C. 20502. http://ceq.eh.doe.gov/nepa/regs/ej/ej.pdf

Cranswick, D. 2001. Brief overview of Gulf of Mexico OCS oil and gas pipelines: Installation, potential impacts, and mitigation measures. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 2001-067. 19 pp.

Cruz-Kaegi, M. 1998. Latitudinal variations in biomass and metabolism of benthic infaunal communities. College Station, TX, Texas A&M University, Ph.D. dissertation.

Dahl, T.E. 1990. Wetlands losses in the United States 1780's to 1980's. U.S. Dept. of the Interior, Fish and Wildlife Service, Washington, DC. 21 pp.

Dahlheim, M.E. and C.O. Matkin. 1994. Assessment of injuries to Prince William Sound killer whales. In: Loughlin, T.R., ed. Marine mammals and the *Exxon Valdez*. San Diego, CA: Academic Press. Pp. 163-171.

Darnell, R.M. and Kleypas, J. A. 1987. Eastern Gulf shelf bio-atlas: a study of the distribution of demersal fishes and penaeid shrimp of soft bottoms of the continental shelf from the Mississippi River Delta to the Florida Keys. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA: OCS Study MMS 86-0041. 548 pp.

Davis, R.W. and G.S. Fargion, eds. 1996. Distribution and abundance of cetaceans in the north-central and western Gulf of Mexico: Final report. Volume II: Technical Report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 96-0027. 357 pp.

Davis, R.W., G.S. Fargion, N. May, T.D. Leming, M. Baumgartner, W.E. Evans, L.J. Hansen, and K. Mullin. 1998. Physical habitat of cetaceans along the continental slope in the north-central and western Gulf of Mexico. Mar. Mamm. Sci. 14:490-507.

Davis, R.W., W.E. Evans, and B. Würsig. 2000. Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. U.S. Dept. of the Interior, Geological Survey, Biological Resources Division, USGS/BRD/CR-1999-0006 and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-003. 346 pp.

Delaune, R.D., W.H. Patrick, and R.J. Bureh. 1979. Effect of crude oil on a Louisiana *Spartina alterniflora* salt marsh. Environ. Poll. 20:21-31.

Deming, J. and J. Baross. 1993. The early diagenesis of organic matter: Bacterial activity. In: Engel, M. and S. Macko, eds. Organic Geochemistry. New York, NY: Plenum. Pp. 119-144.

Dodd, C.K., Jr. 1988. Synopsis of the biological data on the loggerhead sea turtle *Caretta caretta* (Linnaeus 1758). U.S. Dept. of the Interior, Fish and Wildlife Service. Biological Report 88(14). Gainesville, FL: National Ecology Research Center. 119 pp. Available from NTIS: PB89-109565.

Durako, M.J., M.O. Hall, F. Sargent, and S. Peck. 1992. Propeller scars in sea grass beds: an assessment and experimental study of recolonization in Weedon Island State Preserve, Florida. In: Web, F., ed. Proceedings, 19th Annual Conference of Wetland Restoration and Creation. Hillsborough Community College, Tampa, FL. Pp. 42-53.

Eadie, B.J., J.A. Robbins, P. Blackwelder, S. Metz, J.H. Trefry, B. McKee, and T.A. Nelson. 1992. A retrospective analysis of nutrient enhanced coastal ocean productivity in sediments from the Louisiana continental shelf. In: Nutrient Enhanced Coastal Ocean Productivity Workshop Proceedings, TAMU-SG-92-109, Technical Report. Pp. 7-14.

Eckdale, A.A., R.G. Bromley, and S.G. Pemberton. 1984. Ichnology: The use of trace fossils in sedimentology and stratigraphy. Tulsa, OK: Society of Economic Paleontologists and Mineralogists, Short Course No. 15. 317 pp.

Eckert, S.A., D.W. Nellis, K.L. Eckert, and G.L. Kooyman. 1986. Diving patterns of two leatherback sea turtles (*Dermochelys coriacea*) during internesting intervals at Sandy Point, St. Croix, U.S. Virgin Islands. Herpetologica 42:381-388.

Farr, A.J., C.C. Chabot, and D.H. Taylor. 1995. Behavioral avoidance of flurothene by flathead minnows (*Pimephales promelas*). Neurotoxicology and Teratology 17(3):265-271.

Federal Register. 1985. Endangered and threatened wildlife and plants; removal of the brown pelican in the southeastern United States from the list of endangered and threatened wildlife. 50 FR 23.

Federal Register. 1995. Endangered and threatened wildlife and plants; final rule to reclassify the bald eagle from endangered to threatened in all of the lower 48. 60 FR 133. Pp. 36,000-36,010.

Federal Register. 2004. Final NPDES General Permit for New and Existing Sources and New Dischargers in the Offshore Subcategory of the Oil and Gas Extraction Category for the Western Portion of the Outer Continental Shelf of the Gulf of Mexico (GMG290000). 69 FR 194. Pp. 60150-60151.

Fischel, M., W. Grip, and I.A. Mendelssohn. 1989. Study to determine the recovery of a Louisiana marsh from an oil spill. In: Proceedings, 1989 Oil Spill Conference . . . February 13-16, 1989, San Antonio, TX. Washington, DC: American Petroleum Institute.

Fisher, C.R. 1990. Chemoautotrophic and methanotrophic symbioses in marine invertebrates. Reviews in Aquatic Sciences 2:399-436.

Florida A&M University. 1988. Meteorological database and synthesis for the Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 88-0064. 486 pp.

Fonteneau, A., P. Pallares, and R. Pianet. 2000. A worldwide review of purse seine fisheries on fish attracting devices. In: J.Y. Le Gall, P. Cayre, and M. Taquet , eds.. Pêche thonière et dispositifs de concentration de poissons. Actes Colloque IFREMER, 28. (Tuna fishing and fish aggregation devices). IFREMER, Brest Cedex. Pp. 15-35

Frey, R.W. 1975. The study of trace fossils; a synthesis of principles, problems, and procedures in ichnology. New York, NY: Springer-Verlag. 562 pp.

Frink, L. 1994. Rehabilitation of contaminated wildlife. In: Burger, J., ed. Before and after and oil spill: The Arthur Kill. New Brunswick, NJ: Rutgers University Press. Pp. 82-98.

Fritts, T.H. and R.P. Reynolds. 1981. Pilot study of the marine mammals, birds and turtles in OCS areas of the Gulf of Mexico. U.S. Dept. of the Interior, Fish and Wildlife Service, Biological Services Program. FWS/OBS-81/36.

Fritts, T.H., W. Hoffman, and M.A. McGehee. 1983. The distribution and abundance of marine turtles in the Gulf of Mexico and nearby Atlantic waters. Journal of Herpetology 17:327-344.

Frost, K.J., C-A. Manen, and T.L. Wade. 1994. Petroleum hydrocarbons in tissues of harbor seals from Prince William Sound and the Gulf of Alaska. In: Loughlin, T.R., ed. Marine mammals and the *Exxon Valdez*. San Diego, CA: Academic Press. Pp. 331-358.

Fu, B. and P. Aharon. 1998. Sources of hydrocarbon-rich fluids advecting on the seafloor in the northern Gulf of Mexico. Gulf Coast Association of Geological Societies Transactions 48:73-81.

Fuller, D.A. and A.M. Tappan. 1986. The occurrence of sea turtles in Louisiana coastal waters. Baton Rouge, LA: Louisiana State University, Center for Wetland Resources. LSU-CFI-86-28.

Gales, R.S. 1982. Effects of noise of offshore oil and gas operations on marine mammals − an introductory assessment. Technical Report 844. Naval Ocean Systems Center, San Diego, CA.

Gallaway, B.J. and M.C. Kennicutt II. 1988. Chapter 2. The characterization of benthic habitats of the northern Gulf of Mexico. In: Gallaway, B.J., ed. Northern Gulf of Mexico Continental Slope Study, Final Report: Year 4. Vol. III: Appendices. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 88-0054. Pp. 2-1 to 2-45.

Gallaway, B.J., L.R. Martin, and R.L. Howard, eds. 1988. Northern Gulf of Mexico continental slope study: Annual report, year 3. Volume I: Executive summary. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 87-0059. 154 pp.

Gallaway, B.J., J.G. Cole, and L.R. Martin. 2000. The deep sea Gulf of Mexico: An overview and guide. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2001-065. 27 pp.

Gallaway, B.J., J.G. Cole, and R.G. Fechhelm. 2003. Selected aspects of the ecology of the continental slope fauna of the Gulf of Mexico: A synopsis of the Northern Gulf of Mexico Continental Slope

Study, 1983-1988. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2003-072. 38 pp + appendices.

Gambell, R. 1985. Sei whale—*Balaenoptera borealis*. In: Ridgway, S.H. and R. Harrison, eds. Handbook of marine mammals. Vol. 3: The sirenians and baleen whales. San Diego, CA: Academic Press. Pp. 155-170.

Garrison, E.G., C.P. Giammona, F.J. Kelly, A.R. Tripp, and G.A. Wolf. 1989. Historic shipwrecks and magnetic anomalies of the northern Gulf of Mexico: Reevaluation of archaeological resource management zone 1. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 89-0024. 241 pp.

Gartner, J.V., Jr. 1993. Patterns of reproduction of the dominant lanternfish species (Pisces: Myctophidae) of the eastern Gulf of Mexico, with a review of reproduction among tropical-subtropical Myctophidae. Bull. Mar. Sci. 52(2):721-750.

Gartner, J.V., Jr., T.L. Hopkins, R.C. Baird, and D.M. Milliken. 1987. The lanternfishes of the eastern Gulf of Mexico. Fish. Bull. 85(1):81-98.

Gramling, R. 1984. Housing in the coastal zone parishes. In: Gramling, R.B. and S. Brabant, eds. The role of outer continental shelf oil and gas activities in the growth and modification of Louisiana's coastal zone. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration; Louisiana Dept. of Natural Resources, Layfayette, LA. Interagency Agreement NA-83-AA-D-CZ025; 21920-84-02. Pp. 127-134.

Griffin, R.B. 1999. Sperm whale distributions and community ecology associated with a warm-core ring off Georges Bank. Mar. Mamm. Sci. 15: 33-51.

Handley, L.R. 1995. Seagrass distribution in the northern Gulf of Mexico. In: LaRoe, E.T., G.S. Farris, C.E. Puckett, P.D. Doran, and M.J. Mac, eds. Our Living Resources. A Report to the Nation on the Distribution, Abundance, and Health of U.S. Plants, Animals, and Ecosystems. U.S. Dept. of the Interior, National Biological Service, Washington, DC. Pp. 273-275.

Harvey, J.T. and M.E. Dahlheim. 1994. Cetaceans in oil. In: Loughlin, T.R., ed. Marine mammals and the *Exxon Valdez*. San Diego, CA: Academic Press. Pp. 257-264.

Hayman, P., J. Marchant, and T. Prater. 1986. Shorebirds: an identification guide to the waders of the world. Boston, MA: Houghton Mifflin Co. 412 pp.

Heezen, B.C. 1957. Whales entangled in deep sea cables. Deep-Sea Research 4:105-115

Hemmerling, S.A. and C.E. Colten. 2003. Environmental justice considerations in Lafourche Parish, Louisiana. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study. MMS 2003-038. 348 pp.

Hendrickson, J.R. 1980. The ecological strategies of sea turtles. Amer. Zool. 20:597-608.

Henfer, L.M., B.O. Wilen, T.E. Dahl, and W.E. Frayer. 1994. Southeast wetlands: Status and trends, mid-1970's to mid-1980's. U.S. Dept. of the Interior, Fish and Wildlife Service, Atlanta, GA. 32 pp.

Hess, N.A. and C.A. Ribic. 2000. Seabird ecology. Chapter 8. In: Davis, R.W., W.E. Evans, and B. Wursig, eds. Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. U.S. Dept. of the Interior, Geological Survey, Biological Resources Division, USGS/BRD/CR-1999-0006 and the Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-003.

Hiett, R.L. and J.W. Milon. 2002. Economic impact of recreational fishing and diving associated with offshore oil and gas structures in the Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2002-010.

Hildebrand, H.H. 1982. A historical review of the status of sea turtle populations in the western Gulf of Mexico. In: Bjorndal, K.A., ed. Biology and conservation of sea turtles. Washington, DC: Smithsonian Institution Press. Pp. 447-453.

Hirth, H.F. 1997. Synopsis of the biological data on the green turtle *Chelonia mydas* (Linnaeus 1758). U.S. Dept. of the Interior, Fish and Wildlife Service. Biological Report 97(1).

Holland America. 2005. Environmental Policy. Internet website (accessed November 9, 2005) http://www.hollandamerica.com/pdfs/media/factsheets/EnvironmentalCommitment_FactSheet.pdf

Hopkins T.L. and T.M. Lancraft. 1984. The composition and standing stock of mesopelagic micronekton at 27°N 86°W in the eastern Gulf of Mexico. Contrib. Mar. Sci. 27:143-158.

Hopkins, T.L. and R.C. Baird. 1985. Feeding ecology of four hatchetfishes (Sternoptychidae) in the eastern Gulf of Mexico. Bull. Mar. Sci. 36(2):260-277.

Hughes, G.R., P. Luschi, R. Mencacci, and F. Papi. 1998. The 7000-km oceanic journey of a leatherback tracked by satellite. J. Ecper. Mar. Bio. Ecol. 229:209-217.

Jefferson, T.A. and A.J. Schiro. 1997. Distributions of cetaceans in the offshore Gulf of Mexico. Mammal Review 27(1):27-50.

Jefferson, T.A., S. Leatherwood, and M.A. Webber. 1993. FAO species identification guide, marine mammals of the world: Food and Agriculture Organization of the United Nations, Rome. 320 pp.

Johansen, O., H. Rye, and C. Cooper. 2001. DeepSpill JIP—Field study of simulated oil and gas blowouts in deep water. In: Proceedings from the Fifth International Marine Environment Modeling Seminar, October 9-11, 2001, New Orleans, LA. 377 pp.

Johnsgard, P.A. 1975. Waterfowl of North America. Bloomington and London: Indiana University Press.

Kennicutt, M.C., J.M. Brooks, R.R. Bidigare, R.R. Fay, T.L. Wade, and T.J. McDonald. 1985. Vent-type taxa in a hydrocarbon seep region on the Louisiana slope. Nature 317:351-353.

Kennicutt, M.C., J. Sericano, T. Wade, F. Alcazar, and J.M. Brooks. 1987. High-molecular weight hydrocarbons in the Gulf of Mexico continental slope sediment. Deep-Sea Research. v. 34, page 403-424.

Kennicutt, M.C., J.M. Brooks, E.L. Atlas, and C.S. Giam. 1988. Organic compounds of environmental concern in the Gulf of Mexico: A review. Aquatic Toxicology, 11:191-212.

Koike, B.G. 1996. News from the bayous—Louisiana Sea Turtle Stranding and Salvage Network. Proceedings, 15th Annual Workshop on Sea Turtle Conservation and Biology. NOAA Tech. Memo. NMFS-SEFSC-387.

Landry, A.M, Jr. and D. Costa. 1999. Status of sea turtle stocks in the Gulf of Mexico with emphasis on the Kemp's ridley. In: Kumpf, H., K. Steidinger, and K. Sherman, eds. The Gulf of Mexico Large Marine Ecosystem: Assessment, Sustainability, and Management. Blackwell Science. Pp. 248-268.

Laska, S.B., V.K. Baxter, R. Seydlitz, R.E. Thayler, S. Brabant, and C.J. Forsyth, eds. 1993. Impact of offshore oil exploration and production on the social institutions of coastal Louisiana. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 93-0007. 246 pp.

Leighton, F.A. 1990. The toxicity of petroleum oils to birds: An overview. Oil Symposium, Herndon, VA.

Linden, O., J.R. Sharp, R. Laughlin, Jr., and J.M. Neff. 1979. Interactive effects of salinity, temperature, and chronic exposure to oil on the survival and development rate of embryos of the estuarine killifish *Fundulus heteroclitus*. Mar. Biol. 51:101-109.

Lipscomb, T.P., R.K. Harris, A.H. Rebar, B.E. Ballachey, and R.J. Haebler. 1994. Pathology of sea otters. In: Loughlin, T.R., ed. Marine mammals and the *Exxon Valdez*. San Diego, CA: Academic Press. Pp. 265-279.

Lohoefener, R.R., W. Hoggard, K.D. Mullin, C.L. Roden, and C.M. Rogers. 1990. Association of sea turtles with petroleum platforms in the north-central Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 90-0025. 90 pp.

Longwell, A.C. 1977. A genetic look at fish eggs and oil. Oceanus. 20(4):46-58.

Loughlin, T.R. 1994. Tissue hydrocarbon levels and the number of cetaceans found dead after the spill. In: Loughlin, T.R., ed. Marine mammals and the *Exxon Valdez*. San Diego, CA: Academic Press. Pp. 359-369.

Louisiana Dept. of Wildlife and Fisheries (LDWF). 1994. A fisheries management plan for Louisiana penaeid shrimp fishery: Summary and action items. November 1992, Baton Rouge, LA. 16 pp.

Lowery, G.H. 1974. The mammals of Louisiana and its adjacent waters. Baton Rouge, LA: Louisiana State University. 565 pp.

Lowry, L.F., K.J. Frost, and K.W. Pitcher. 1994. Observations of oiling of harbor seals in Prince William Sound. In: Loughlin, T.R., ed. Marine mammals and the *Exxon Valdez*. San Diego, CA: Academic Press. Pp. 209-225.

Lutcavage, M.E., P.G. Bushnell, and D.R. Jones. 1990. Oxygen transport in the leatherback sea turtle, *Dermochelys coriacea*. Physiol. Zool. 63:1012-1024.

Lutcavage, M.E., P.L. Lutz, G.D. Bossart, and D.M. Hudson. 1995. Physiologic and clinicopathologic effects of crude oil on loggerhead sea turtles. Arch. Environ. Contam. Toxicol. 28:417-422.

Lutz, P.L. and M. Lutcavage. 1989. The effects of petroleum on sea turtles: Applicability to Kemp's ridley. In: Caillouet, C.W., Jr. and A.M. Landry, Jr., comps. Proceedings of the First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation, and Management. TAMU-SG-89-105.

Lytle, J.S. 1975. Fate and effects of crude oil on an estuarine pond. In: Proceedings, Conference on Prevention and Control of Oil Pollution, San Francisco, CA. Pp. 595-600.

Maccarone, A.D. and J.N. Brzorad. 1994. Gulf and waterfowl populations in the Arthur Kill. In: Burger, J., ed. Before and after an oil spill: The Arthur Kill. New Brunswick, NJ: Rutgers University Press. Pp. 595-600.

MacDonald, I.R., ed. 1992. Chemosynthetic ecosystems study literature review and data synthesis: Volumes I-III. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 92-0033 through 92-0035.

MacDonald, I.R., ed. 1998. Stability and change in Gulf of Mexico chemosynthetic communities: interim report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 98-0034. 114 pp.

MacDonald, I.R., N.L. Guinasso, Jr., J.F. Reilly, J.M. Brooks, W.R. Callender, and S.G. Gabrielle. 1990. Gulf of Mexico hydrocarbon seep communities: VI. Patterns in community structure and habitat. Geo-Marine Letters 10:244-252.

MacDonald, I.R., N.L. Guinasso Jr., S.G. Ackleson, J.F. Amos, R. Duckworth, R. Sassen, and J.M. Brooks. 1993. Natural oil slicks in the Gulf of Mexico visible from space. J. Geophys. Res. 98(C9):16,351-16,364.

Madge, S. and H. Burn. 1988. Waterfowl: An identification guide to the ducks, geese, and swans of the world. Boston, MA: Houghton Mifflin. 298 pp.

Malins, D.C., S. Chan, H.O. Hodgins, U. Varanasi, D.D. Weber, and D.W. Brown. 1982. The nature and biological effects of weathered petroleum. Environmental Conservation Division, Northwest and Alaska Fisheries Center, National Marine Fisheries Service, Seattle, WA. 43 pp.

Manzella, S., J. Williams, B. Schroeder, and W. Teas. 1991. Juvenile head-started Kemp’s ridleys found in floating grass mats. Marine Turtle Newsletter, No. 52:5-6.

Márquez-M., R. 1990. FAO species catalogue. Volume 11: sea turtles of the world. An annotated and illustrated catalogue of sea turtle species known to date. FAO Fisheries Synopsis. FAO, Rome.

Márquez-M., R. 1994. Synopsis of biological data on the Kemp's ridley turtle, *Lepidochelys kempi*, (Garman, 1880). U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 94-0023. 91 pp.

Martin, R.P. 1991. Regional overview of wading birds in Louisiana, Mississippi, and Alabama. In: Proceedings of the Coastal Nongame Workshop. U.S. Dept. of the Interior, Fish and Wildlife Service, Region 4 and the Florida Game and Fresh Water Fish Commission. Pp. 22-33.

Martin, R.P., and G.D. Lester. 1991. Atlas and census of wading bird and seabird nesting colonies in Louisiana: 1990. Special Publication No. 3, Louisiana Dept. of Wildlife and Fisheries, Louisiana Natural Heritage Program.

Matkin, C.O. and D. Sheel. 1996. Comprehensive killer whale investigation in Prince William Sound. Abstract, Draft 1996 Restoration Workshop, *Exxon Valdez* Oil Spill Trustee Council, January 16-18, Anchorage, AK.

Menzies, R., R. George, and G. Rowe. 1973. Abyssal environment and ecology of the world oceans. New York, NY: Wiley and Sons.

Miller, J.E. and D.L. Echols. 1996. Marine debris point source investigation: Padre Island National Seashore, March 1994-September 1995. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 96-0023. 35 pp.

Mitchell, R., I.R. MacDonald, and K.A. Kvenvolden. 1999. Estimation of total hydrocarbon seepage into the Gulf of Mexico based on satellite remote sensing images. Transactions, American Geophysical Union 80(49), Ocean Sciences Meeting, OS242.

Moore, D.R. and H.R. Bullis, Jr. 1960. A deep-water coral reef in the Gulf of Mexico. Bull. Mar. Sci. 10(1):125-128.

Moore, J.C. and E. Clark. 1963. Discovery of right whales in the Gulf of Mexico. Science 141:269.

Morreale, S.J., E.A. Standora, J.R. Spotila, and F.V. Paladino. 1996. Migration corridor for sea turtles. Nature 384:319-320.

Mullin, K. 1998. Personal communication. U.S. Dept. of Commerce, National Marine Fisheries Service, Pascagoula, MS.

Mullin, K., W. Hoggard, C. Roden, R. Lohoefener, C. Rogers, and B. Taggart. 1991. Cetaceans on the upper continental slope in the north-central Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 91-0027. 108 pp.

Mullin, K.D., L.V. Higgins, T.A. Jefferson, and L.J.Hansen. 1994. Sightings of the Clymene dolphin (*Stenella clymene*) in the Gulf of Mexico. Marine Mammal Science 10(4):464-470.

Murray, S.P. 1998. An observational study of the Mississippi/Atchafalaya coastal plume: Final report, U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 98-0040. 513 pp.

Nation, L. 2003. Another day that lives in infamy. American Association of Petroleum Geologists, Tulsa, OK. Explorer 24(6):43.

National Geographic Society. 1983. Field guide to the birds of North America. Washington, DC: The National Geographic Society. 464 pp.

National Research Council (NRC). 1985. Oil in the sea: Inputs, fates, and effects. Washington, DC: National Academy Press. 601 pp.

National Research Council (NRC). 1990. The decline of sea turtles: Causes and prevention. Washington, DC: National Academy Press. 183 pp.

National Research Council (NRC). 2003. Oil in the sea III: Inputs, fates, and effects. Washington, DC: National Academy Press. 265 pp.

Neff, M.J. 1997. Metals and organic chemicals associated with oil and gas well produced water: Bioaccumulation, fates, and effects in the marine environment. Report prepared for Continental Shelf Associates, Inc., Jupiter, FL, to Offshore Operators Committee, New Orleans, LA. April 14, 1997.

Nelson, H.F. and E.E. Bray. 1970. Stratigraphy and history of the Holocene sediments in the Sabine-High Island Area, Gulf of Mexico. In: Morgam, J.P., ed. Deltaic Sedimentation; Modern and Ancient. Special Publn. No. 15. Tulsa, OK: Society of Economic Paleontologists and Mineralogists.

NERBC (New England River Basins Commission). 1976. Factbook. In: Onshore facilities related to offshore oil and gas development. Boston, MA.

Newman, J.R. 1979. Effects of industrial air pollution on wildlife. Biol. Conserv. 15:181-190.

Nicholls, J.L. and G.A. Baldassarre. 1990. Habitat associations of piping plovers wintering in the United States. Wilson Bulletin 102:581-590.

Nowlin, W.D., Jr. 1972. Winter circulation patterns and property distributions. In: Capurra, L.R.A. and J.L. Reid, eds. Contributions on the Physical Oceanography of the Gulf of Mexico. Houston, TX: Gulf Publishing Company. Pp. 3-51.

Nowlin, W.D., Jr., A.E. Jochens, R.O. Reid, and S.F. DiMarco. 1998. Texas-Louisiana shelf circulation and transport processes study: Synthesis report. Volume II: Appendices. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 98-0036. 288 pp.

O'Connor, T.P. and B. Beliaeff. 1995. Recent trends in coastal environmental quality: Results from the mussel watch project (National Status and Trends Program, Marine Environmental Quality). U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Silver Spring, MD. 40 pp.

Ogren, L.H. 1989. Distribution of juvenile and subadult Kemp's ridley turtles: Preliminary result from the 1984-1987 surveys. In: Proceedings of the First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation and Management, October 1-4, 1985, Galveston, TX. TAMU-SG-89-105. Sea Grant College Program, Texas A&M University. Pp. 116-123.

Oilneregy. 2005. Internet website. http://www.oilnergy.com. November 9, 2005.

Olds, W.T., Jr. 1984. In: U.S. Congress, House Committee on Merchant Marine Fisheries, Offshore Oil and Gas Activity and Its Socioeconomic and Environmental Influences, 98th Cong., 2d session. Pp. 54-55.

Ortega, J. 1998. Personal communication. Texas A&M University at Galveston, Marine Mammal Research Program, Galveston, TX.

O'Shea, T.J., B.B. Ackerman, and H.F.Percival, eds. 1995. Population biology of the Florida manatee: Information and Technology Report 1, August 1995. U.S. Dept. of the Interior, National Biological Service, Washington, DC. 289 pp.

Owens, D. 1983. Oil and sea turtles in the Gulf of Mexico: A proposal to study the problem. In: Keller, C.E. and J.K. Adams, eds. Proceedings, Workshop on cetaceans and sea turtles in the Gulf of Mexico: Study planning for effects of outer continental shelf development. Prepared by the U.S. Dept. of the Interior, Fish and Wildlife Service, for the U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. Pp. 34-39.

Paladino, F.V., M.P. O'Connor, and J.R. Spotila. 1990. Metabolism of leatherback turtles, gigantothermy, and thermoregulation of dinosaurs. Nature 344:859-860.

Parnell, J.F., D.G. Ainley, H. Blokpoel, B. Cain, T.W. Custer, J.L. Dusi, S. Kress, J.A. Kushlan, W.E. Southern, L.E. Stenzel, and B.C. Thompson. 1988. Colonial waterbird management in North America. Colonial Waterbirds 11:129-345.

Pashley, D.N. 1991. Shorebirds, gulls, and terns: Louisiana, Mississippi, Alabama. In: Proceedings of the coastal nongame workshop. U.S. Dept. of the Interior, Fish and Wildlife Service, Region 4, and Florida Game and Fresh Water Fish Commission. Pp. 79-83.

Patrick, L. 1997. Personal communication. U.S. Dept. of the Interior, Fish and Wildlife Service, Panama City, FL.

Payne, J.F., J. Kiceniuk, L.L. Fancey, U. Williams, G.L. Fletcher, A. Rahimtula, and B. Fowler. 1988. What is a safe level of polycyclic aromatic hydrocarbons for fish: Subchronic toxicity study on winter flounder (*Pseudopleuronectes americanus*). Can. J. Fish. Aquat. Sci. 45:1983-1993.

Pearson, C.E., S.R. James, Jr., S.D. El Darragi, and M.C. Krivor. In press. Refining and revising the Gulf of Mexico Outer Continental Shelf Region high probability model for historic shipwrecks. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico Region, New Orleans, LA.

Pequegnat, W.E. 1983. The ecological communities of the continental slope and adjacent regimes of the northern Gulf of Mexico. Final report to the U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. Contract No. AA851-CT1-12.

Pequegnat, W.E., B.J. Gallaway, and L. Pequegnat. 1990. Aspects of the ecology of the deepwater fauna of the Gulf of Mexico. American Zoologist 30:45-64.

Pew Oceans Commission (POC). 2003. Major threats to our oceans. Internet website (last updated December 14): http://www.pewoceans.org/oceans/oceans_pollution.asp

Plotkin, P.T., M.K. Wicksten, and A.F. Amos. 1993. Feeding ecology of the loggerhead sea turtle *Caretta caretta* in the northwestern Gulf of Mexico. Mar. Biol. 115: 1-15.

Power, J.H. and L.N. May, Jr. 1991. Satellite observed sea-surface temperatures and yellowfin tuna catch and effort in the Gulf of Mexico. Fish. Bull. 89:429-439.

Preen, A. 1991. Report on the die-off of marine mammals associated with the Gulf War oil spill. Report prepared for The National Commission for Wildlife Conservation and Development. 8 pp.

Pristas, P.H., A.M. Avrigian, and M.I. Farber. 1992. Big game fishing in the northern Gulf of Mexico during 1991. NOAA Tech. Mem. NMFS-SEFC-312. 16 pp.

Rabalais, N.N. 2005. Relative contribution of produced water discharge in the development of hypoxia. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2005-044. 56 pp.

Raymond, P.W. 1984. Sea turtle hatchling disorientation and artificial beachfront lighting: A review of the problem and potential solutions. Washington, DC: Center for Environmental Education. 72 pp.

Reeves, R.R., B.S. Stewart, and S. Leatherwood. 1992. The Sierra Club handbook of seals and sirenians. San Francisco, CA: Sierra Club Books. 359 pp.

Regg, J.B., S. Atkins, B. Hauser, J. Hennessey, B.J. Kruse, J. Lowenhaupt, B. Smith, and A. White. 2000. Deepwater Development: A reference document for the deepwater environmental assessment Gulf of Mexico OCS (1998-2007). U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 2000-015.

Rester, J. and R. Condrey. 1996. The occurrence of the hawksbill turtle, *Eretmochelys imbricata*, along the Louisiana coast. Gulf Mex. Sci. 1996:112-114.

Rice, D.W. 1989. Sperm whale—*Physeter macrocephalus* (Linnaeus, 1758). In: Ridgway, S.H., and R. Harrison, eds. Handbook of marine mammals. V. 4: River dolphins and larger toothed whales. London: Academic Press. Pp. 177-234.

Richards, W.J., T. Leming, M.F. McGowan, J.T. Lamkin, and S. Kelley-Farga. 1989. Distribution of fish larvae in relation to hydrographic features of the Loop Current boundary in the Gulf of Mexico. Rapp. P.-v. Reun. Cons. Int. Explor. Mer. 191:169-176.

Richardson, W.J., C.R. Greene, C.I. Malme, and D.H. Thomson. 1995. Marine mammals and noise. San Diego, CA: Academic Press.

Ripley, S.D. and B.M. Beechler. 1985. Rails of the world, a compilation of new information, 1975-1983, (Aves: Rallidae). Smithsonian Contributions to Zoology, No. 417. Washington, DC: Smithsonian Institute Press.

Roberts, H.H. and R.S. Carney. 1997. Evidence of episodic fluid, gas, and sediment venting on the northern Gulf of Mexico continental slope. Economic Geology 92:863-879.

Roberts, H.H., P. Aharon, R. Carney, J. Larkin, and R. Sassen. 1990. Sea floor responses to hydrocarbon seeps, Louisiana continental slope. Geo-Marine Letter 10(4):232-243.

Robineau, D. and P. Fiquet. 1994. Cetaceans of Dawhat ad-Dafi and Dawhat al-Musallamiya (Saudi Arabia) one year after the Gulf War oil spill. Courier Forsch.-Inst. Senckenberg 166:76-80.

Rosman, I., G.S. Boland, L.R. Martin, and C.R. Chandler. 1987. Underwater sightings of sea turtles in the northern Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 87-0107. 37 pp.

Rudloe, J., A. Rudloe, and L. Ogren. 1991. Occurrence of immature Kemp's ridley turtles, *Lepidochelys kempi*, in coastal waters of northwest Florida. Short Papers and Notes. Northeast Gulf Sci. 12:49-53.

Sammarco, P.W., A.D. Atchison, D.A. Brazeau, G.S. Boland, and D.F. Gleason. 2004. Expansion of coral communities within the northern Gulf of Mexico via offshore oil and gas platforms. Marine Ecology Progress Series. 280:129-143.

Sassen, R., J.M. Brooks, M.C. Kennicutt II, I.R. MacDonald, and N.L. Guinasso, Jr. 1993a. How oil seeps, discoveries relate in deepwater Gulf of Mexico. Oil and Gas Journal 91(16):64-69.

Sassen, R., H.H. Roberts, P. Aharon, J. Larkin, E.W. Chinn, and R. Carney. 1993b. Chemosynthetic bacterial mats at cold hydrocarbon seeps, Gulf of Mexico continental slope. Organic Geochemistry 20(1):77-89.

Schmidly, D.J. 1981. Marine mammals of the southeastern United States coast and the Gulf of Mexico. U.S. Dept. of the Interior, Fish and Wildlife Service, Office of Biological Services, Washington, DC. FWS/OBS-80/41. 163 pp.

Schmidly, D.J., C.O. Martin, and G.F. Collins. 1972. First occurrence of a black right whale (*Balaena glacialis*) along the Texas coast. Southw. Natural. 17:214-215.

Schmidt, K. and R. Long. 2000. Petition to the USEPA to identify and take regulatory action to address pollution by cruise ships. Letter. to C.M. Browner, Administrator, USEPA, March 17, 2000. 13 pp. Internet website: http://www.bluewaternetwork.org/reports/rep_ss_cruise_petition.pdf

Sharp, B.E. 1995. Does the cleaning and treatment of oiled seabirds mean that they are rehabilitated—what about post-release survival? In: Proceedings, The Effects of Oil on Wildlife, 4th International Conference, April 1995, Seattle, WA.

Sharp, B.E. 1996. Post-release survival of oiled, cleaned seabirds in North America. Ibis 138:222-228.

Shoop, C., T. Doty, and N. Bray. 1981. Sea turtles in the region between Cape Hatteras and Nova Scotia in 1979. In: Shoop, C., T. Doty, and N. Bray. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf: Annual report for 1979; Chapter IX. Kingston: University of Rhode Island. Pp. 1-85.

Shoop, C.R. and R.D. Kenney. 1992. Seasonal distributions and abundance of loggerhead and leatherback sea turtles in waters of the northeastern United States. Herpetological Monographs No. 6.

Spies, R.B., J.S. Felton, and L. Dillard. 1982. Hepatic mixed-function oxidases in California flatfishes are increased in contaminated environments and by oil and PCB ingestion. Mar. Biol. 70:117-127.

Spraker, T.R., L.F. Lowry, and K.J. Frost. 1994. Gross necropsy and histopathological lesions found in harbor seals. In: Loughlin, T.R., ed. Marine mammals and the *Exxon Valdez*. San Diego, CA: Academic Press. Pp. 281-311.

Stroud, R.H. 1992. Stemming the tide of coastal fish habitat loss. In: Proceedings of a Symposium on Coastal Fish Habitat, March 7-9, 1991, Baltimore, MD. National Coalition for Marine Conservation, Inc., Savannah, GA. Pp. 73-79.

Terres, J.K. 1991. The Audubon Society encyclopedia of North American birds. New York: Wing Books. 1,109 pp.

Thompson, N.B. 1988. The status of loggerhead, *Caretta caretta*; Kemp's ridley, *Lepidochelys kempi*; and green, *Chelonia mydas* sea turtles in U.S. waters. Mar. Fish. Rev. 50:16-23.

U.S. Commission on Ocean Policy. 2004. An ocean blueprint for the 21st century. Final report. Washington, DC. 676 pp. Internet website: http://www.oceancommission.gov.

U.S. Dept. of the Army. Corps of Engineers (USCOE). 2004. Louisiana Coastal Area (LCA) Ecosystem Restoration Study. U.S. Dept. of the Army, Corps of Engineers. New Orleans District. Final Environmental Impact Statement.

U.S. Dept. of Commerce. Bureau of the Census. 2001. Current population survey. Internet website: http://www.census.gov.

U.S. Dept. of Commerce. Bureau of the Census. 2005. Areas with concentrated poverty: 1999. U.S. Dept. of Commerce, Bureau of the Census. 11 pp. http://www.census.gov/prod/2005pubs/censr-16.pdf

U.S. Dept. of Commerce. National Marine Fisheries Service. 1990. Recovery plan for U.S. population of Atlantic green turtle (*Chelonia mydas*). U.S. Dept. of Commerce, National Marine Fisheries Service, St. Petersburg, FL.

U.S. Dept. of Commerce. National Marine Fisheries Service. 1991. Recovery plan for the northern right whale (*Eubalaena glacialis*). Prepared by the Right Whale Recovery Team for the U.S. Dept. of Commerce, National Marine Fisheries Service, Silver Spring, MD. 86 pp.

U.S. Dept. of Commerce. National Marine Fisheries Service. 1998. Recovery plan for the blue whale (*Balaenoptera musculus*). Prepared by Reeves R.R., P.J. Clapham, R.L. Brownell, Jr., and G.K. Silber for the U.S. Dept. of Commerce, National Marine Fisheries Service, Silver Spring, MD. 42 pp.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2003. NOAA Fisheries 2002 Report to Congress. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Washington, DC. 96 pp.

U.S. Dept. of Commerce. National Marine Fisheries Service and U.S. Dept. of the Interior, Fish and Wildlife Service. 1990. Recovery plan for U.S. population of Atlantic green turtle (*Chelonia mydas*). U.S. Dept. of Commerce, National Marine Fisheries Service, St. Petersburg, FL.

U.S. Dept. of Commerce, National Marine Fisheries Service and U.S. Dept. of the Interior, Fish and Wildlife Service. 1992a. Recovery plan for leatherback turtles in the U.S. Caribbean, Atlantic, and Gulf of Mexico. U.S. Dept. Commerce, National Marine Fisheries Service, Washington, DC. 65 pp.

U.S. Dept. of Commerce, National Marine Fisheries Service and U.S. Dept. of the Interior, Fish and Wildlife Service. 1992b. Recovery plan for the Kemp's ridley sea turtle (*Lepidochelys kempi*). U.S. Dept. of Commerce, National Marine Fisheries Service, St. Petersburg, FL. 40 pp.

U.S. Dept. of Commerce, National Marine Fisheries Service and U.S. Dept. of the Interior, Fish and Wildlife Service. 1993. Recovery plan for hawksbill turtles in the U.S. Caribbean Sea, Atlantic Ocean, and Gulf of Mexico. U.S. Dept. of Commerce, National Marine Fisheries Service, St. Petersburg, FL. 52 pp.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 1992. Agricultural pesticide use in coastal areas: A national summary, September 1992. 111 pp.

U.S. Dept. of the Interior. Fish and Wildlife Service. 1984. Southeastern states bald eagle recover plan. U.S. Dept. of the Interior, Fish and Wildlife Service, Southeast Region, Atlanta, GA.

U.S. Dept. of the Interior. Fish and Wildlife Service. 1994. Whooping crane recovery plan (second revision) Southeastern states bald eagle recover plan. U.S. Dept. of the Interior, Fish and Wildlife Service, Albuquerque, NM. 92 pp.

U.S. Dept. of the Interior, Fish and Wildlife Service and U.S. Dept. of Commerce, National Marine Fisheries Service. 1992. Recovery plan for the Kemp's ridley sea turtle (*Lepidochelys kempii*). U.S. Dept. of Commerce, National Marine Fisheries Service, St. Petersburg, FL. 242 pp.

U.S. Dept. of the Interior. Minerals Management Service. 1987. Gulf of Mexico OCS oil and gas lease Sales 113, 115, and 116: Western, Central, and Eastern Planning Areas, final environmental impact statement. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS MMS 87-0077.

U.S. Dept. of the Interior. Minerals Management Service. 1995. Gulf of Mexico OCS oil and gas lease Sales 157 and 161: Central and Western Planning Areas, final environmental impact statement. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 95-0058.

U.S. Dept. of the Interior. Minerals Management Service. 1996. Gulf of Mexico OCS oil and gas lease Sales 166 and 168: Central and Western Planning Areas, final environmental impact statement. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 96-0058.

U.S. Dept. of the Interior. Minerals Management Service. 1997. Gulf of Mexico OCS oil and gas lease Sales 169, 172, 175, 178 and 182: Central Planning Area, final environmental impact statement. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 97-0033. Available from NTIS, Springfield, VA: PB98-116916.

U.S. Dept. of the Interior. Minerals Management Service. 2000. Gulf of Mexico deepwater operations and activities; environmental assessment. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MS 2000-001. 264 pp.

U.S. Dept. of the Interior. Minerals Management Service. 2001a. Gulf of Mexico OCS oil and gas lease Sale 181: Eastern Planning Area—final environmental impact statement. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2001-051.

U.S. Dept. of the Interior. Minerals Management Service. 2001b. Proposed use of floating production, storage, and offloading systems on the Gulf of Mexico outer continental shelf; Western and Central Planning Areas; final environmental impact statement. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2000-090.

U.S. Dept. of the Interior. Minerals Management Service. 2002. Gulf of Mexico OCS oil and gas lease sales: 2003-2007; Central Planning Area Sales 185, 190, 194, 198, and 201; Western Planning Area Sales 187, 192, 196, and 200 − final environmental impact statement. 2 vols. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2002-052.

U.S. Dept. of the Interior. Minerals Management Service. 2003a. Gulf of Mexico OCS oil and gas lease sales 189 and 197, Eastern Planning Area—final environmental impact statement. 2 vols. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA 2003-020.

U.S. Dept. of the Interior. Minerals Management Service. 2003b. Exploration activities in the Eastern sale area: Eastern Planning Area, Gulf of Mexico OCS—programmatic environmental assessment. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2003-008.

U.S. Dept. of the Interior. Minerals Management Service. 2005a. Structure-removal operations on the Outer Continental Shelf of the Gulf of Mexico—Programmatic environmental assessment. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2005-013.

U.S. Dept. of the Interior. Minerals Management Service. 2005b. Notices to Lessees and Operators (Chronological Order). Internet website (last updated April 21): http://www.gomr.mms.gov/homepg/regulate/regs/ntls/ntl_lst2.html

U.S. Dept. of the Interior. Minerals Management Service. 2005c. Independence Hub. Internet Website (last updated August 19). http://www.gomr.mms.gov/homepg/offshore/egom/independence_hub.html

U.S. Environmental Protection Agency. 1993a. Development document for effluent limitation guidelines and standards for the offshore subcategory of the oil and gas extraction point source category. EPA 821-R-93-003.

U.S. Environmental Protection Agency. 1993b. Supplemental information for effluent limitation guidelines and new source performance standards for the offshore subcategory of the oil and gas extraction point source category (49 CFR 435); Office of Water, Washington, DC. Also supportive documents produced by the Office of Water Regulations and Standards, Washington, DC. Economic impact analysis of proposed effluent limitation guidelines and standards for the offshore oil and gas industry. Prepared by Eastern Research Group, Inc. EPA 440/2-91-001. Regulation published in the *Federal Register*, Vol. 58, No. 41, pages 12,453-12,512 (March 4, 1993).

U.S. Environmental Protection Agency. 1999a. The ecological conditions of estuaries in the Gulf of Mexico, Gulf Breeze, FL. 71 pp.

U.S. Environmental Protection Agency. 1999b. Final guidance for consideration of environmental justice in Clean Air Act 309 reviews. U.S. Environmental Protection Agency, Office of Federal Activities [2252A]. P. 7.

U.S. Environmental Protection Agency. 2001a. National Coastal Condition Report. Office of Research and Development, Office of Water, Washington, D.D. EPA-600/R-01/005. Internet website: http://www.epa.gov/owow/oceans/nccr/downloads.html

U.S. Environmental Protection Agency. 2001b. Oceans, coasts, and estuaries: invasive species in ballast water. Internet website (last updated July): http://www.epa.gov/owow/invasive_species/

U.S. Environmental Protection Agency. 2004. National Coastal Condition Report II. Office of Research and Development, Office of Water, Washington, DC. December 2004. Internet website: http://www.epa.gov/owow/oceans/nccr2/%20EPA-620/R-03/002

Valade, J. 2001. Written communication. U.S. Fish and Wildlife Service, Jacksonville, FL. E-mail to B. Lang, MMS, dated October 22, 2001. Manatee sighting in Mississippi Canyon Block 85.

Vargo, S., P. Lutz, D. Odell, E. Van Vleet, and G. Bossart. 1986. Study of the effects of oil on marine turtles: A final report. U.S. Dept. of the Interior, Minerals Management Service, Atlantic OCS Region. OCS Study MMS 86-0070. 3 vols. 360 pp.

Waring, G.T., D.L. Palka, K.D. Mullin, J.H.W. Hain, L.J. Hansen, and K.D. Bisack. 1997. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments—1996. NOAA Tech. Memo. NMFS-NE-114.

Waring, G.T., D.L. Palka, P.J. Clapham, S. Swartz, M.C. Rossman, T.V.N. Cole, L.J. Hansen, K.D. Bisack, K.D. Mullin, R.S. Wells, D.K. Odell, and N.B. Barros. 1999. U.S. Atlantic marine mammal stock assessments - 1999. U.S. Dept. of Commerce, NOAA Tech. Memo. NMFS-NE-153.

Watkins, W.A. and W.E. Schevill. 1976. Right whale feeding and baleen rattle. J. Mammal. 57:58-66.

Webb, J.W. 1988. Establishment of vegetation on oil-contaminated dunes. Shore and Beach, October. Pp. 20-23.

Webb, J.W., G.T. Tanner, and B.H. Koerth. 1981. Oil spill effects on smooth cordgrass in Galveston Bay, Texas. Contributions in Marine Science 24:107-114.

Webb, J.W., S.K. Alexander, and J.K. Winters. 1985. Effects of autumn application of oil on *Spartina alterniflora* in a Texas salt marsh. Environ. Poll., Series A. 38(4):321-337.

Weller, D.W., A.J. Schiro, V.G. Cockcroft, and W. Ding. 1996. First account of a humpback whale (*Megaptera novaeangliae*) in Texas waters, with a re-evaluation of historic records from the Gulf of Mexico. Mar. Mamm. Sci. 12:133-137.

Weller, D.W., B. Würsig, S.K. Lynn, and A.J. Schiro. 2000. Preliminary findings on the occurrence and site fidelity of photo-identified sperm whales (*Physeter macrocephalus*) in the northern Gulf of Mexico. Gulf of Mexico Science 18:35-39.

Williams, S.J., S. Penland, and A.H. Sallenger, Jr., eds. 1992. Louisiana barrier island study: Atlas of shoreline changes in Louisiana from 1853 to 1989. U.S. Dept. of the Interior, Geological Survey, Miscellaneous Investigations Series I-2150-A.

Winn, H.E., and N.E. Reichley. 1985. Humpback whale—*Megaptera novaeangliae*. In: Ridgway, S.H., and R. Harrison, eds. Handbook of marine mammals. V. 3: The sirenians and baleen whales. London: Academic Press. 241-274 pp.

Witherington, B.E. 1997. The problem of photopollution for sea turtles and other nocturnal animals. In: Clemmons, J.R. and R. Buchholz, eds. Behavioral approaches to conservation in the wild. Cambridge University Press. Pp. 303-328.

Witherington, B.E. and R.E. Martin. 1996. Understanding, assessing, and resolving light-pollution problems on sea turtle nesting beaches. Florida Marine Research Institute Technical Report TR-2, Florida Dept. of Environmental Protection. 73 pp.

Wolfe, S.H., J.A. Reidenauer, and D.B. Means. 1988. An ecological characterization of the Florida Panhandle. U.S. Dept. of the Interior, Fish and Wildlife Service Biological Report 88(12) and U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA, OCS Study MMS 88-0063. 278 pp.

Würsig, B., T.A. Jefferson, and D.J. Schmidly. 2000. The marine mammals of the Gulf of Mexico. College Station, TX: Texas A&M University Press. 232 pp.

Yochem, P.K. and S. Leatherwood. 1985. Blue whale—*Balaenoptera musculus*. In: Ridgway, S.H. and R. Harrison, eds., Handbook of marine mammals. V. 3: The sirenians and baleen whales. London: Academic Press. 193-240 pp.

Zieman, J.C., R. Orth, R.C. Phillips, G. Thayer, and A. Thornhaug. 1984. The effects of oil on seagrass ecosystems. In: Cairns, J. and A. Buikema, eds. Recovery and Restoration of Marine Ecosystems. Stoneham, MA: Butterworth Publications. Pp. 37-64.

7. PREPARERS

NEPA Coordinator

Thomas Bjerstedt	Physical Scientist—Geoscience Issues

Reviewers and Contributors

Pat Adkins	Information Management Specialist
David Ball	Archaeologist—Archaeological Issues
Greg Boland	Biologist—Fisheries, Deepwater Benthic Issues
Darice Breeding	Physical Scientist—Hydrocarbon Spill Issues
Kimberley Cook	Anthropologist—Environmental Justice Issues
Janet Diaz	Environmental Protection Assistant
Bonnie Laborde Johnson	Environmental Scientist—CZM Issues
Herb Leedy	Biologist—Shoreline and Wetlands Issues
Margaret Metcalf	Physical Scientist—Water Quality Issues
Deborah Miller	Technical Publication Editor
Dave Moran	Biologist—Protected Species Issues
James Sinclair	Biologist—Shelf Benthic Issues
Kristen Strellec	Economist—Socioeconomic Issues
Fred Times	GIS/Visual Information Specialist

Reviewers and Supervisors

Dennis Chew	Chief, Environmental Assessment Section
Jack Irion	Supervisor, Social Sciences Unit
Elizabeth Peuler	Supervisor, Physical Sciences Unit
Robert Rogers	Supervisor, Biological Sciences Unit

8. APPENDICES

Appendix A—Accidental Oil-Spill Review
Appendix B—Economic Impact Tables

Appendix A

Accidental Oil-Spill Review

APPENDIX A

ANALYSIS OF THE POTENTIAL FOR AN ACCIDENTAL OIL SPILL FROM THE INDEPENDENCE HUB (MISSISSIPPI CANYON BLOCK 920)

Introduction

The National Environmental Policy Act (NEPA) requires Federal agencies to consider potential environmental impacts (direct, indirect, and cumulative) of proposed actions as part of agency planning and decisions. The NEPA analyses address many issues relating to potential impacts, including issues that may have a very low probability of occurrence, but which are of concern to the public or for which the environmental consequences could be significant.

The past several decades of spill data show that accidental oil spills ≥1,000 bbl associated with oil and gas exploration and development are low probability events in Federal Outer Continental Shelf (OCS) waters of the Gulf of Mexico (GOM). This appendix presents information about the probability of accidental spills from the Independence Hub project.

Proposed Action

Independence Hub LLC proposes to install a tension-legged platform in Mississippi Canyon Block 920 and to produce predominantly dry gas from nine gas discoveries using subsea "smart well" technology. Approximately 95 mi (153 km) of 8- to 10-in diameter (20-25 cm) gathering flow lines would collect gas and condensate from seven gas fields located in the current sale area of the EPA and two gas fields from the CPA in the Atwater Valley protraction area (Table A-2). A new 24-in diameter (61 cm) export trunk line called the Independence Trail (GulfTerra Field Services) will carry product approximately 135 mi (217 km) from the Hub to a junction platform located in West Delta Block 68. Tie in to the existing Tennessee Gas line that landfalls in Plaquemines Parish, Louisiana, would take place from the junction platform. Chapter 1.3.2 of this SEA explains the subsea production equipment proposed for this project in greater detail. There are no new wells to be drilled as part of this proposal; however, 19 temporarily plugged and abandoned exploratory wells will be completed. Completions, though not technically a drilling operation, do involve reentering the well, drilling through concrete plugs, and installing production tubing and other down-hole equipment. Blowouts can occur during completions, which are a form of workover, when well pressure controls become unbalanced.

The proposed action includes the activities listed in Tables A-1 and A-2.

Spill Prevention

The MMS has comprehensive pollution prevention requirements that include redundant levels of safety devices, as well as inspection and testing requirements to confirm that these devices work. Many of these requirements have been in place since about 1980. Spill trends analysis for the GOM OCS show that spills from facilities have decreased over time, indicating that MMS engineering and safety requirements have minimized the potential for spill to occur and thereby avoid associated impacts.

OCS Spills in the Past

This summary of past OCS spills presents data for the period 1985-1999. The period 1985-1999 was chosen to reflect more modern engineering and regulatory requirements and because OCS spill rates are available. For the period 1985-1999 there were no spills ≥1,000 bbl from OCS platforms, eight spills ≥1,000 bbl from OCS pipelines, and no spills ≥1,000 bbl from OCS blowouts (Tables A-5 through A-7).

Estimating Future Potential Spills

The MMS estimates the risk of future potential spills by multiplying variables to result in a numerical expression of risk. These variables include the potential of a spill occurring based on historical OCS spill rates and a variable for the potential for a spill to be transported to environmental resources based on trajectory modeling. The following subsections describe the spill occurrence and transport variables used to estimate risk and the risk calculation for the proposed action.

Spill Occurrence Variable (SOV) Representing the Potential for a Spill

The SOV is derived based on past OCS spill frequency. That is, data from past OCS spills are used to estimate future potential OCS spills. The MMS has estimated spill rates for spills from facilities, pipelines, and blowouts.

Spill rates for facilities and pipelines in the Gulf of Mexico (GOM) have been presented in the MMS's Multisale EIS's (USDOI, MMS 2002 and 2003b) and Anderson and LaBelle (2000). Data for this recent period reflect the influence of more modern spill prevention requirements. Spill rates for facilities and pipelines are based on the number of spills per volume of oil handled. Spill rates for the period 1985-1999 are shown in Table A-8. It should be noted that there were no platform or blowout spills ≥1,000 bbl for the period 1985-1999. Use of "zero" spills would result in a zero spill rate. To allow for conservative future predictions of spill occurrence, a spill number of one was "assigned" to provide a nonzero spill rate for blowouts. The spill period was expanded to 1980 to include a spill for facilities. While there were no facility or blowout spills during 1985-1999 for which data are available, spills could occur in the future. In fact, a pipeline spill ≥1,000 bbl was reported subsequent to this period, so it is reasonable to include a spill to provide a nonzero spill rate. Spill rates are combined with site-specific data on production or pipeline volumes, pipeline and reservoir lifetime, or number of wells being drilled to result in a site-specific SOV.

Transport Variable (TV) Representing the Potential for a Spill to be Transported to Important Environmental Resources

The TV is derived using an oil-spill trajectory model. This model predicts the direction that winds and currents would transport spills. The model uses an extensive database of observed and theoretically computed ocean currents and fields that represent a statistical estimate of winds and currents that would occur over the life of an oil and gas project, which may span several decades. This model produces the TV that can be combined with other variables, such as the SOV, to estimate the risk of future potential spills and impacts.

Risk Calculation for the Proposed Action

Tables A-9 through A-16 present estimates of spill risk for coastline resources using two variables − the SOV and the TV. The coastal counties that could be impacted are indicated in these tables. The final column in these tables presents the result of combining the SOV's and TV's. The TV and Spill Risk are given for time periods of 3, 10, and 30 days for each spill launch area because of the range in the physical and chemical properties of the oil to be produced. For example, the API estimated for the production ranges from 32.6 to 58. The SOV for the facilities was determined using a spill rate of 0.13 from Table A-8, the estimated production rate for each facility, and the estimated life years of the reserves proposed to be produced. The SOV for the associated pipelines was determined using a spill rate of 1.38 from Table A-8, the volume of oil proposed to be transported, and the estimated design life of the pipeline. The risk of a coastal spill impact from the facility could be considered to be so low as to be near zero. The most recent Multisale Final EIS's provide additional information on spills and potential impacts (USDOI, MMS, 2002 and 2003b).

Spill Response

The MMS has extensive requirements both for the prevention of spills and preparedness to respond to a spill in the event of an accidental spill. The MMS spill prevention requirements and the low incidence of past OCS spills was addressed earlier in this document. This section presents information on MMS requirements for spill response preparedness.

MMS Spill Response Program

The MMS Oil Spill Program oversees the review of oil-spill response plans, coordinates inspection of oil-spill response equipment, and conducts unannounced oil-spill drills. This program also supports continuing research to foster improvements in spill prevention and response. Studies funded by MMS address issues such as spill prevention and response, *in-situ* burning, and dispersant use.

In addition, MMS works with the U.S. Coast Guard and other members of the multiagency National Response System to further improve spill response capability in the GOM. The combined resources of these groups and the resources of commercially contracted oil-spill response organizations result in extensive equipment and trained personnel for spill response in the GOM.

Spill Response for this Project

The operators of the proposed Independence Hub have oil-spill response plans on file with MMS and have current contracts with offshore oil-spill response organizations. Potential spill sources for this project include an accidental blowout, a spill of liquid oil stored on the Hub topsides (Platform A) in Mississippi Canyon Block 920, a spill from a support vessel during completion or pipeline lay barge activities, or a spill from one of the project's associated pipelines. Tables A-3 and A-4 provide estimates for the worst-case volume estimate that could potentially be spilled from each of the Independence Hub surface and subsea facilities and pipelines. In addition, the API gravity of the condensate anticipated to be produced or transported is also identified for each location.

The MMS will continue to verify the operators' capability to respond to oil spills via the MMS Oil Spill Program. The operators are required to keep their oil-spill response plans up to date in accordance with MMS regulations. The operators must also conduct an annual drill to demonstrate the adequacy of their spill preparedness. The MMS also conducts unannounced drills to further verify the adequacy of an operator's spill response preparedness.

Table A-1

Proposed Production Wells and Platforms

Control No.	Operator	Project Name	Leases	Blocks	No. of Wells	Surface Structure
RUE OCS-G 23648	Anadarko	Independence Hub Topsides	G 21191 Unleased Unleased G 20010 Unleased	MC 876 MC 919 MC 920 MC 921 MC 964	N/A	Yes
N-8385	Anadarko	Jubilee	G 18556 G 18577	AT 305 AT 349	5	No
N-8402	Anadarko	Spiderman	G 23528 G 23529	DC 620 DC 621	3	No
N-8407	Kerr-McGee	Merganser	G 21826	AT 37	2	No
N-8411	Anadarko	Atlas & Atlas NW	G 23450 G 23458	LL 5 LL 50	2	No
N-8415	Anadarko	Mondo NW	G 10486 G 10487	LL 1 LL 2	3	No
N-8419	Anadarko	Cheyenne	G 23480	LL 399	4	No
N-8430	Dominion	San Jacinto	G 23526	DC 618	3	No
N-8458	Anadarko	Vortex	G 16890	AT 261	3	No

RUE = right of use and easement, MC = Mississippi Canyon, AT = Atwater Valley, LL = Lloyd Ridge, DC = DeSoto Canyon

Table A-2

Proposed Right-of-Way Pipelines

Application No.	Pipeline Segment Nos.	Type of Installation	Operator	Flowline Routing	Originating Block
P-15099	15099	8-in flowline	Anadarko	Spiderman to Hub	DC 621
P-15100	15100 15101	10-in flowline 6-in umbilical	Anadarko	Spiderman to Hub	DC 621
P-15146	15146 15147 15148	8-in flowline 6-in umbilical 6-in umbilical	Anadarko	Atlas, Atlas NW, Mondo NW to Hub	LL 50
P-15149	15149 15150	10-in flowline 6-in umbilical	Anadarko	Cheyenne, Jubilee, Vortex to Hub	LL 399
P-15166	15166 15167	8-in flowline 6-in umbilical	Dominion	San Jacinto to Spiderman	DC 618
P-15199	15199 15200	8 5/8-in flowline 6-in umbilical	Kerr McGee	Merganser to Hub	AT 37
P-15152	15152	8 5/8-in flowline	Anadarko	Cheyenne, Jubilee, Vortex to Hub	LL 399
P-15153	15153	24-in flowline	GulfTerra Field Services	Independence Trail (Export Trunk Line)	MC 920

ROW = Right-of-Way, MC = Mississippi Canyon, AT = Atwater Valley, LL = Lloyd Ridge, DC = DeSoto Canyon

Table A-3

Estimated Worst-Case Discharge Volumes for the Proposed Wells and Platform
(see Tables A-1 or A-2 for operator information)

Project Name	Blocks	Volume of Tanks/ Pipelines	Blowout Volume (bbl/day)	Total WCD	API of Produced Oil	Type of Rig/Largest Tank on Drilling Unit (bbl) /Product Type	Distance from Shore (mi)
Independence Hub, Platform A	MC 876, 919, 920, 921, 964	455 bbl - tanks on Hub 85 bbl - pipelines at Hub	N/A	540	35	N/A	90
Jubilee	AT 305, 349	1 bbl from pipeline, Subsea location no tanks	391	392	43	DP drillship 13,812 bbl, 32.4 API diesel	110
Spiderman	DC 620, 621	6 bbl from pipeline, Subsea location no tanks	456	462	58	DP drillship 13,812 bbl, 32.4 API diesel	97
Merganser	AT 37	37 bbl from pipeline, Subsea location no tanks	60	97	36.1	No completion activities	90
Atlas & Atlas NW	LL 50, 5	7 bbl from pipeline, Subsea location no tanks	174	181	35.2 to 46.5	DP drillship 13,812 bbl, 32.4 API diesel	113
Mondo	LL 1, 2	6 bbl from pipeline, Subsea location no tanks	130	136	43.1	DP drillship 13,812 bbl, 32.4 API diesel	106
Cheyenne	LL 399	7 bbl from pipeline, Subsea location no tanks	217	224	32.1 to 33.4	DP drillship 13,812 bbl, 32.4 API diesel	128
San Jacinto	DC 618	1 bbl from pipeline, Subsea location no tanks	2,000	2,001	35	Moored semisubmersible 4,451 bbl, 32.4 API diesel	90
Vortex	AT 261	1 bbl from pipeline, Subsea location no tanks	109	110	32.6 to 44.7	DP drillship 13,812 bbl, 32.4 API diesel	120

MC = Mississippi Canyon, AT = Atwater Valley, LL = Lloyd Ridge, DC = DeSoto Canyon,
DP = dynamically positioned, N/A = not applicable, WCD = worst-case discharge,
API = American Petroleum Institute

Table A-4

Estimated Worst-Case Discharge Volumes for the Proposed Right-of-Way Pipelines

Application No.	Pipeline Segment Nos.	Condensate Design Capacity (bbl/day)	WCD (bbl)	Operator	Associated Prospect or Project(s)	Associated Block(s)
P-15099	15099	300	5	Anadarko	Spiderman	DC 621
P-15100	15100 15101	420	6	Anadarko	Spiderman	DC 621
P-15146	15146 15147 15148	600	6	Anadarko	Atlas Atlas NW Mondo NW	LL 50 LL 5 LL 1, 2
P-15149	15149 15150	420	6	Anadarko	Cheyenne Jubilee Vortex	LL 399 AT 305 AT 261
P-15166	15166	120	6	Dominion	San Jacinto	DC 618
P-15199	15199 15200	550	37	Kerr McGee	Merganser	AT 37
P-15152	15152	300	6	Anadarko	Cheyenne Jubilee Vortex	LL 399 AT 305 AT 261
P-15153	15153	4,896	Varies from 600-6,580 bbl*	GulfTerra Field Services	Independence Trail (export trunk line)	MC 920 to WD 68

MC = Mississippi Canyon, AT = Atwater Valley, LL = Lloyd Ridge, DC = DeSoto Canyon,
WD = West Delta, BCD = bbl condensate per day, WCD = worst-case discharge

* The worst case discharge (WCD) for the Gulfterra pipeline would vary depending on the steady state gas flowrate of the line and the location along the pipeline that a spill may occur. At the base of the deepwater riser, the WCD estimates range from 0 bbl at a steady state gas flowrate of 900 MMSCFD to 6,580 bbl at a steady state gas flowrate of 300 MMSCFD. At the midpoint of the line the WCD estimate ranges from 600 bbl at a steady state gas flowrate of 900 MMSCFD to 910 bbl at a steady state gas flowrate of 300 MMSCFD. At the base of the shallow riser in West Delta 68, the WCD estimate ranges from 890 bbl at a steady state gas flowrate of 900 MMSCFD to 1,300 bbl at a steady state gas flowrate of only 300 MMSCFD.

Table A-5

Historical Record of OCS Spills ≥1,000 Barrels from OCS Facilities, 1985—1999

Spill Date*	Area and Block (water depth and distance from shore)	Volume Spilled (bbl)	Cause of Spill

* No OCS facility spills ≥1,000 bbl during the period 1985-1999.

Table A-6

Historical Record of OCS Spills ≥1,000 Barrels from OCS Pipelines, 1985-1999

Spill Date	Area and Block (water depth and distance from shore)	Volume Spilled (barrels)	Cause of Spill
February 7, 1988	South Pass 60 (75 ft, 3.4 mi)	15,576	Service vessel's anchor damaged pipeline
January 24, 1990	Ship Shoal 281 (197 ft, 60 mi)	*14,423	Anchor drag, flange and valve broke off
May 6, 1990	Eugene Island 314 (230 ft, 78 mi)	4,569	Trawl drag pulled off valve
August 31, 1992	South Pelto 8 (30 ft, 6 mi)	2,000	Hurricane Andrew, loose drilling rig's anchor drag damaged pipeline
November 22, 1994	Ship Shoal 281 (197 ft, 60 mi)	*4,533	Trawl drag
January 26, 1998	East Cameron 334 (264 ft, 105 mi)	*1,211	Service vessel's anchor drag damaged pipeline during rescue operation
September 29, 1988	South Pass 38 (110 ft, 6 mi)	8,212	Hurricane Georges, mudslide parted pipeline
July 23, 1999	Ship Shoal 241 (133 ft, 50 mi)	3,189	Jack-up barge sat on pipeline

*condensate

Table A-7

Historical Record of OCS Spills ≥1,000 bbl from OCS Blowouts, 1985-1999

Spill Date*	Area and Block (water depth and distance from shore)	Volume Spilled (bbl)	Cause of Spill

* No OCS blowout spills ≥1,000 bbl during the period 1985-1999.

Table A-8

Spill Rates Used to Estimate the Future Potential for Spills

Spill Source	Volume of Oil Handled in Billion bbl	Number of Wells Drilled	No. of Spills ≥1,000 bbl	Risk of Spill from Facilities or Pipelines per Billion bbl	Risk of Spill from Drilling Blowout per Well
Facilities	7.41 [a]	Not Applicable	1[a]	>0 to <0.13[c]	Not Applicable
Pipelines	5.81	Not Applicable	8	1.38	Not Applicable
Drilling	Not Applicable	14,067	1[b]	Not Applicable	>0 to <0.00007[c]

[a] There were actually zero spills ≥1,000 bbl from facilities during the period 1985-1999. The data shown represent 1980-1999. The spill period for facility spills was expanded to 1980 to include a spill for facilities to result in a nonzero risk.

[b] There have been no spills ≥1,000 bbl from blowouts during the period 1985-1999. One spill was "assigned" to provide a nonzero spill rate.

[c] There were no facility or blowout spills ≥1,000 bbl for the period 1985-1999; however, a nonzero spill rate was calculated by expanding the facility period to 1980 and by "assigning" a blowout spill. Therefore, the spill rates for these categories are presented as greater than zero but below the rates calculated by expanding the data period and assigning a spill.

Table A-9

Spill Risk Estimate for the Mississippi Block 920 endpoint of the Trunk Pipeline and the Independence Hub Platform (Platform A) Located in MMS Oil Spill Launch Area C-059

Environmental Resource Counties and Parishes[1]	Spill Occurrence Variable[2] (%)	Transport Variable[3] within 3/10/30 Days (%)	Spill Risk[4,5] within 3/10/30 Days (%)
Matagorda, TX	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Galveston, TX	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Jefferson, TX	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Cameron, LA	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Vermilion, LA	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Iberia, LA	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Terrebonne, LA	7.1	<0.5/<0.5/2	<0.5/<0.5/<0.5
Lafourche, LA	7.1	<0.5/1/2	<0.5/<0.5/<0.5
Jefferson, LA	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Plaquemines, LA	7.1	<0.5/5//11	<0.5/<0.5/1
St. Bernard, LA	7.1	<0.5/<0.5/2	<0.5/<0.5/<0.5
Hancock and Harrison, MS	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Jackson, MS	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Baldwin, AL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Mobile, AL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Escambia, FL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Santa Rosa, FL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Okaloosa, FL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Walton, FL	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Bay, FL	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Gulf, FL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Franklin, FL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5

[1] Counties with all values less than 0.5% are not shown.

[2] The percent chance of a spill event occurring from the proposed action. The calculated SOV for the GulfTerra pipeline was 7.1%. Because there is no proposed development and production being handled by this platform, besides minor storage on this facility, the greatest chance for a spill to occur from this facility would result from a pipeline leak. The largest source of which would be the export pipeline. Therefore, the SOV for this source will be used to determine the largest spill risk estimate from Mississippi Canyon Block 920 Platform A.

[3] The percent chance that winds and currents will move a point projected onto the surface of the Gulf beginning within the Lloyd Ridge area and ending at specified shoreline segments or environmental resources. These results are the results of a numerical model that calculates the trajectory of a drifting point projected onto the surface of the water using temporally and spatially varying winds and ocean current fields. These probabilities do not factor in the risk of spill occurrence, consideration of the spill size, any spill response or cleanup actions, or any dispersion and weathering of the slick with time.

[4] The probability of a spill occurring and contacting identified environmental features represents the weighted risk that accounts for both the risk that a large spill will occur and the risk that it will contact locations where the resources occur, given the assumptions already described in footnotes 2 and 3.

[5] < 0.5 = less than 0.5%.

Table A-10

Spill Risk Estimate for the Jubilee, Merganser, and Vortex Wells and Associated Pipelines Located in MMS Oil Spill Launch Area C-061

Environmental Resource Counties and Parishes[1]	Spill Occurrence Variable[2] (%)	Transport Variable[3] within 3/10/30 Days (%)	Spill Risk[4,5] within 3/10/30 Days (%)
Galveston, TX	1.9	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Jefferson, TX	1.9	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Cameron, LA	1.9	<0.5/<0.5/1	<0.5/<0.5/<0.5
Vermilion, LA	1.9	<0.5/<0.5/1	<0.5/<0.5/<0.5
Terrebonne, LA	1.9	<0.5/<0.5/2	<0.5/<0.5/<0.5
Lafourche, LA	1.9	<0.5/<0.5/1	<0.5/<0.5/<0.5
Plaquemines, LA	1.9	<0.5/1//6	<0.5/<0.5/<0.5
St. Bernard, LA	1.9	<0.5/<0.5/1	<0.5/<0.5/<0.5
Hancock and Harrison, MS	1.9	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Jackson, MS	1.9	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Baldwin, AL	1.9	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Mobile, AL	1.9	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Escambia, FL	1.9	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Okaloosa, FL	1.9	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Walton, FL	1.9	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Bay, FL	1.9	<0.5/<0.5/1	<0.5/<0.5/<0.5
Gulf, FL	1.9	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Franklin, FL	1.9	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5

[1] Counties with all values less than 0.5% are not shown.

[2] The percent chance of a spill event occurring from the proposed action. The calculated SOV for the Merganser wells was 0.002%, for the Jubilee wells it was 0.02%, for the Vortex wells it was 0.002%, and for the Merganser pipeline the SOV was calculated as 0.6%; and for the 10- and 8 5/8-in Cheyenne, Vortex, and Jubilee pipelines the SOV's were calculated to be 1.9 and 1.4%, respectively. Therefore, the SOV for the 10-in Cheyenne, Jubilee, and Vortex pipeline will be used to determine the largest spill risk estimate from any of these locations in Spill Launch Area C-061.

[3] The percent chance that winds and currents will move a point projected onto the surface of the Gulf beginning within the Lloyd Ridge area and ending at specified shoreline segments or environmental resources. These results are the results of a numerical model that calculates the trajectory of a drifting point projected onto the surface of the water using temporally and spatially varying winds and ocean current fields. These probabilities do not factor in the risk of spill occurrence, consideration of the spill size, any spill response or cleanup actions, or any dispersion and weathering of the slick with time.

[4] The probability of a spill occurring and contacting identified environmental features represents the weighted risk that accounts for both the risk that a large spill will occur and the risk that it will contact locations where the resources occur, given the assumptions already described in footnotes 2 and 3.

[5] <0.5 = less than 0.5 percent.

Table A-11

Spill Risk Estimate for the Spiderman and San Jacinto Wells and Associated Pipelines Located in MMS Oil Spill Launch Area E-135

Environmental Resource Counties and Parishes[1]	Spill Occurrence Variable[2] (%)	Transport Variable[3] within 3/10/30 Days (%)	Spill Risk[4,5] within 3/10/30 Days (%)
Terrebonne, LA	2.0	<0.5/<0.5/1	<0.5/<0.5/<0.5
Lafourche, LA	2.0	<0.5/<0.5/1	<0.5/<0.5/<0.5
Jefferson, LA	2.0	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Plaquemines, LA	2.0	<0.5/2//8	<0.5/<0.5/<0.5
St. Bernard, LA	2.0	<0.5/<0.5/2	<0.5/<0.5/<0.5
Hancock and Harrison, MS	2.0	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Jackson, MS	2.0	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Baldwin, AL	2.0	<0.5/<0.5/1	<0.5/<0.5/<0. 5
Mobile, AL	2.0	<0.5/<0.5/1	<0.5/<0.5/<0.5
Escambia, FL	2.0	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Okaloosa, FL	2.0	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Walton, FL	2.0	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Bay, FL	2.0	<0.5/<0.5/1	<0.5/<0.5/<0.5
Gulf, FL	2.0	<0.5/<0.5/1	<0.5/<0.5/<0.5
Franklin, FL	2.0	<0.5/<0.5/1	<0.5/<0.5/<0.5

[1] Counties with all values less than 0.5% are not shown.

[2] The percent chance of a spill event occurring from the proposed action. The calculated SOV for the San Jacinto wells was 0.002%, for the Spiderman wells it was 0.03% and for the pipeline between the San Jacinto and Spiderman wells the SOV was calculated to be 0.5%. For the 8- and 10-in pipelines between the Independence Hub platform and the Spiderman wells, the SOV's were calculated to be 1.4 and 2.0%, respectively. Therefore, the SOV for the 10-in pipeline between the Independence Hub platform and the Spiderman wells will be used to determine the largest spill risk estimate from any of the locations in Spill Launch Area E-135.

[3] The percent chance that winds and currents will move a point projected onto the surface of the Gulf beginning within the Lloyd Ridge area and ending at specified shoreline segments or environmental resources. These results are the results of a numerical model that calculates the trajectory of a drifting point projected onto the surface of the water using temporally and spatially varying winds and ocean current fields. These probabilities do not factor in the risk of spill occurrence, consideration of the spill size, any spill response or cleanup actions, or any dispersion and weathering of the slick with time.

[4] The probability of a spill occurring and contacting identified environmental features represents the weighted risk that accounts for both the risk that a large spill will occur and the risk that it will contact locations where the resources occur, given the assumptions already described in footnotes 2 and 3.

[5] <0.5 = less than 0.5%.

Table A-12

Spill Risk Estimate for the Atlas, Atlas NW, Mondo NW, and Cheyenne Wells and Associated Pipelines Located in MMS Oil Spill Launch Area E-137

Environmental Resource Counties and Parishes[1]	Spill Occurrence Variable[2] (%)	Transport Variable[3] within 3/10/30 Days (%)	Spill Risk[3,4] within 3/10/30 Days (%)
Terrebonne, LA	2.7	<0.5/<0.5/1	<0.5/<0.5/<0.5
Lafourche, LA	2.7	<0.5/<0.5/1	<0.5/<0.5/<0.5
Jefferson, LA	2.7	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Plaquemines, LA	2.7	<0.5/1/6	<0.5/<0.5/<0.5
St. Bernard, LA	2.7	<0.5/<0.5/1	<0.5/<0.5/<0.5
Hancock and Harrison, MS	2.7	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Jackson, MS	2.7	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Baldwin, AL	2.7	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Mobile, AL	2.7	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Escambia, FL	2.7	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Okaloosa, FL	2.7	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Walton, FL	2.7	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Bay, FL	2.7	<0.5/<0.5/1	<0.5/<0.5/<0.5
Gulf, FL	2.7	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Franklin, FL	2.7	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5

[1] Counties with all values less than 0.5% are not shown.

[2] The percent chance of a spill event occurring from the proposed action. The calculated SOV for the Atlas and Atlas NW wells was 0.003%, for the Mondo wells it was 0.003%, for the Cheyenne wells it was 0.004%, and for the pipeline between the Atlas and Mondo wells the SOV was calculated to be 2.7%. For the 10- and 8 5/8-in pipelines departing the Cheyenne wells, the SOV's were calculated to be 1.9 and 1.4%, respectively. Therefore, SOV for the Atlas and Mondo pipeline will be used to determine the largest spill risk estimate from any of the locations in Spill Launch Area E-137.

[3] The percent chance that winds and currents will move a point projected onto the surface of the Gulf beginning within the Lloyd Ridge area and ending at specified shoreline segments or environmental resources. These results are the results of a numerical model that calculates the trajectory of a drifting point projected onto the surface of the water using temporally and spatially varying winds and ocean current fields. These probabilities do not factor in the risk of spill occurrence, consideration of the spill size, any spill response or cleanup actions, or any dispersion and weathering of the slick with time.

[4] The probability of a spill occurring and contacting identified environmental features represents the weighted risk that accounts for both the risk that a large spill will occur and the risk that it will contact locations where the resources occur, given the assumptions already described in footnotes 2 and 3.

[5] < 0.5 = less than 0.5%.

Table A-13

Spill Risk Estimate for the 24-in Trunk Pipeline Located in MMS Oil Spill Launch Area C-057

Environmental Resource Counties and Parishes[1]	Spill Occurrence Variable[2] (%)	Transport Variable[3] within 3/10/30 Days (%)	Spill Risk[4,5] within 3/10/30 Days (%)
Matagorda TX	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Galveston, TX	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Jefferson, TX	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Cameron, LA	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Vermilion, LA	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Iberia LA	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Terrebonne, LA	7.1	<0.5/1/2	<0.5/<0.5/<0.5
Lafourche, LA	7.1	<0.5/1/2	<0.5/<0.5/<0.5
Jefferson, LA	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Plaquemines, LA	7.1	4/14/21	<0.5/1/2
St. Bernard, LA	7.1	<0.5/1/3	<0.5/<0.5/<0.5
Hancock and Harrison, MS	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Jackson, MS	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Baldwin, AL	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Mobile, AL	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Escambia, FL	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Okaloosa, FL	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Walton, FL	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Bay, FL	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Gulf, FL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Franklin, FL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5

[1] Counties with all values less than 0.5% are not shown.

[2] The percent chance of a spill event occurring from the proposed action. The calculated SOV for the GulfTerra pipeline was 7.1%.

[3] The percent chance that winds and currents will move a point projected onto the surface of the Gulf beginning within the Lloyd Ridge area and ending at specified shoreline segments or environmental resources. These results are the results of a numerical model that calculates the trajectory of a drifting point projected onto the surface of the water using temporally and spatially varying winds and ocean current fields. These probabilities do not factor in the risk of spill occurrence, consideration of the spill size, any spill response or cleanup actions, or any dispersion and weathering of the slick with time.

[4] The probability of a spill occurring and contacting identified environmental features represents the weighted risk that accounts for both the risk that a large spill will occur and the risk that it will contact locations where the resources occur, given the assumptions already described in footnotes 2 and 3.

[4] < 0.5 = less than 0.5%.

Table A-14

Spill Risk Estimate for the 24-in Trunk Pipeline Located in MMS Oil Spill Launch Area C-056

Environmental Resource Counties and Parishes[1]	Spill Occurrence Variable[2] (%)	Transport Variable[3] within 3/10/30 Days (%)	Spill Risk[4,5] within 3/10/30 Days (%)
Matagorda TX	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Galveston, TX	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Jefferson, TX	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Cameron, LA	7.1	<0.5/<0.5/3	<0.5/<0.5/<0.5
Vermilion, LA	7.1	<0.5/<0.5/2	<0.5/<0.5/<0.5
Iberia, LA	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Terrebonne, LA	7.1	<0.5/3/5	<0.5/<0.5/<0.5
Lafourche, LA	7.1	1/4/5	<0.5/<0.5/<0.5
Jefferson, LA	7.1	<0.5/1/2	<0.5/<0.5/<0.5
Plaquemines, LA	7.1	6/13/16	<0.5/<0.5/<0.5
St. Bernard, LA	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Hancock and Harrison, MS	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Jackson, MS	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Baldwin, AL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Mobile, AL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Escambia, FL	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Okaloosa, FL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Walton, FL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Bay, FL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Gulf, FL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Franklin, FL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5

[1] Counties with all values less than 0.5% are not shown.

[2] The percent chance of a spill event occurring from the proposed action. The calculated SOV for the GulfTerra pipeline was 7.1%.

[3] The percent chance that winds and currents will move a point projected onto the surface of the Gulf beginning within the Lloyd Ridge area and ending at specified shoreline segments or environmental resources. These results are the results of a numerical model that calculates the trajectory of a drifting point projected onto the surface of the water using temporally and spatially varying winds and ocean current fields. These probabilities do not factor in the risk of spill occurrence, consideration of the spill size, any spill response or cleanup actions, or any dispersion and weathering of the slick with time.

[4] The probability of a spill occurring and contacting identified environmental features represents the weighted risk that accounts for both the risk that a large spill will occur and the risk that it will contact locations where the resources occur, given the assumptions already described in footnotes 2 and 3.

[4] < 0.5 = less than 0.5%.

Table A-15

Spill Risk Estimate for the 24-in Trunk Pipeline Located in MMS Oil Spill Launch Area C-052

Environmental Resource Counties and Parishes[1]	Spill Occurrence Variable[2] (%)	Transport Variable[3] within 3/10/30 Days (%)	Spill Risk[4,5] within 3/10/30 Days (%)
Matagorda TX	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Galveston, TX	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Jefferson, TX	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Cameron, LA	7.1	<0.5/<0.5/3	<0.5/<0.5/<0.5
Vermilion, LA	7.1	<0.5/<0.5/2	<0.5/<0.5/<0.5
Iberia, LA	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Terrebonne, LA	7.1	<0.5/3/5	<0.5/<0.5/<0.5
Lafourche, LA	7.1	2/6/7	<0.5/<0.5/<0.5
Jefferson, LA	7.1	1/2/3	<0.5/<0.5/<0.5
Plaquemines, LA	7.1	18/24/27	1/2/2
St. Bernard, LA	7.1	<0.5/<0.5/3	<0.5/<0.5/<0.5
Hancock and Harrison, MS	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Jackson, MS	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Baldwin, AL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Mobile, AL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Escambia, FL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Okaloosa, FL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Walton, FL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Bay, FL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Gulf, FL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Franklin, FL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5

[1] Counties with all values less than 0.5% are not shown.

[2] The percent chance of a spill event occurring from the proposed action. The calculated SOV for the GulfTerra pipeline was 7.1%.

[3] The percent chance that winds and currents will move a point projected onto the surface of the Gulf beginning within the Lloyd Ridge area and ending at specified shoreline segments or environmental resources. These results are the results of a numerical model that calculates the trajectory of a drifting point projected onto the surface of the water using temporally and spatially varying winds and ocean current fields. These probabilities do not factor in the risk of spill occurrence, consideration of the spill size, any spill response or cleanup actions, or any dispersion and weathering of the slick with time.

[34] The probability of a spill occurring and contacting identified environmental features represents the weighted risk that accounts for both the risk that a large spill will occur and the risk that it will contact locations where the resources occur, given the assumptions already described in footnoes 2 and 3.

[4] < 0.5 = less than 0.5%.

Table A-16

Spill Risk Estimate for the 24-in Trunk Pipeline Located in MMS Oil Spill Launch Area C-051

Environmental Resource Counties and Parishes[1]	Spill Occurrence Variable[2] (%)	Transport Variable[3] within 3/10/30 Days (%)	Spill Risk[4,5] within 3/10/30 Days (%)
Matagorda, TX	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Galveston, TX	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Jefferson, TX	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Cameron, LA	7.1	<0.5/<0.5/3	<0.5/<0.5/<0.5
Vermilion, LA	7.1	<0.5/1/2	<0.5/<0.5/<0.5
Iberia, LA	7.1	<0.5/<0.5/1	<0.5/<0.5/<0.5
Terrebonne, LA	7.1	1/5/6	<0.5/<0.5/<0.5
Lafourche, LA	7.1	9/13/14	1/1/1
Jefferson, LA	7.1	5/7/7	<0.5/<0.5/<0.5
Plaquemines, LA	7.1	16/22/23	1/2/2
St. Bernard, LA	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Hancock and Harrison, MS	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Jackson, MS	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Baldwin, AL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Mobile, AL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Escambia, FL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Okaloosa, FL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Walton, FL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Bay, FL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Gulf, FL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Franklin, FL	7.1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5

[1] Counties with all values less than 0.5% are not shown.

[2] The percent chance of a spill event occurring from the proposed action. The calculated SOV for the GulfTerra pipeline was 7.1%.

[3] The percent chance that winds and currents will move a point projected onto the surface of the Gulf beginning within the Lloyd Ridge area and ending at specified shoreline segments or environmental resources. These results are the results of a numerical model that calculates the trajectory of a drifting point projected onto the surface of the water using temporally and spatially varying winds and ocean current fields. These probabilities do not factor in the risk of spill occurrence, consideration of the spill size, any spill response or cleanup actions, or any dispersion and weathering of the slick with time.

[4] The probability of a spill occurring and contacting identified environmental features represents the weighted risk that accounts for both the risk that a large spill will occur and the risk that it will contact locations where the resources occur, given the assumptions already described in footnotes 2 and 3.

[5] < 0.5 = less than 0.5%.

Appendix B

Economic Impact Tables

Table B-1

Population Forecast from 2000 to 2040 by Year and by Subarea (in thousands)

Year	LA-1	LA-2	LA-3	MA-1	TX-1	TX-2	FL-1	FL-2	FL-3	FL-4	CGOM	WGOM	EGOM	EPA	GOM	Planning Areas
2000	667.12	1009.54	1337.60	920.12	920.58	5158.08	774.39	128.07	3954.32	2340.67	3934.36	6078.66	7197.46	902.46	17210.48	10915.49
2001	672.18	1020.72	1343.62	930.79	930.98	5238.54	787.39	129.53	4022.21	2362.41	3967.32	6169.52	7301.53	916.92	17438.37	11053.76
2002	677.35	1032.14	1350.07	941.63	941.65	5320.26	800.68	131.07	4091.10	2384.86	4001.19	6261.91	7407.70	931.74	17670.81	11194.85
2003	682.66	1043.67	1356.54	952.62	952.51	5402.63	813.99	132.59	4160.34	2408.02	4035.49	6355.14	7514.94	946.59	17905.57	11337.21
2004	688.02	1055.32	1363.04	963.74	963.49	5486.28	827.53	134.14	4230.75	2431.41	4070.11	6449.77	7623.82	961.67	18143.70	11481.55
2005	693.29	1066.73	1369.47	974.61	974.23	5567.43	840.64	135.65	4298.86	2454.36	4104.10	6541.66	7729.51	976.29	18375.26	11622.04
2006	698.71	1078.41	1376.22	985.73	985.31	5650.60	854.05	137.23	4368.64	2478.50	4139.07	6635.91	7838.42	991.28	18613.40	11766.26
2007	704.17	1090.22	1383.00	996.99	996.52	5735.01	867.68	138.82	4439.54	2502.88	4174.37	6731.53	7948.93	1006.50	18854.84	11912.41
2008	709.67	1102.16	1389.81	1008.37	1007.85	5820.69	881.53	140.44	4511.60	2527.50	4210.01	6828.54	8061.07	1021.97	19099.62	12060.52
2009	715.21	1114.23	1396.66	1019.88	1019.32	5907.65	895.60	142.07	4584.83	2552.37	4245.98	6926.96	8174.87	1037.67	19347.81	12210.61
2010	720.38	1125.14	1403.21	1030.25	1029.64	5983.33	907.72	143.54	4647.77	2575.09	4278.97	7012.97	8274.12	1051.26	19566.06	12343.20
2011	726.21	1137.43	1410.76	1041.94	1041.44	6069.89	921.65	145.17	4720.08	2601.27	4316.34	7111.33	8388.17	1066.82	19815.84	12494.49
2012	732.08	1149.86	1418.36	1053.78	1053.37	6157.70	935.79	146.82	4793.52	2627.72	4354.07	7211.07	8503.85	1082.61	20069.00	12647.75
2013	738.01	1162.42	1426.00	1065.74	1065.44	6246.78	950.15	148.48	4868.10	2654.44	4392.16	7312.23	8621.17	1098.63	20325.56	12803.02
2014	743.98	1175.12	1433.67	1077.84	1077.65	6337.16	964.73	150.17	4943.84	2681.43	4430.61	7414.81	8740.17	1114.90	20585.59	12960.32
2015	749.53	1186.60	1440.99	1088.74	1088.63	6416.17	977.37	151.69	5009.36	2706.02	4465.86	7504.81	8844.44	1129.05	20815.11	13099.72
2016	755.66	1199.34	1449.10	1100.88	1100.93	6505.38	991.68	153.38	5083.71	2733.72	4504.98	7606.30	8962.49	1145.06	21073.77	13256.34
2017	761.84	1212.21	1457.26	1113.15	1113.36	6595.82	1006.20	155.09	5159.16	2761.70	4544.46	7709.18	9082.15	1161.29	21335.79	13414.93
2018	768.07	1225.22	1465.47	1125.56	1125.93	6687.53	1020.94	156.82	5235.73	2789.97	4584.32	7813.46	9203.45	1177.75	21601.22	13575.53
2019	774.35	1238.36	1473.73	1138.11	1138.65	6780.51	1035.89	158.56	5313.43	2818.52	4624.55	7919.15	9326.41	1194.45	21870.11	13738.15
2020	780.19	1250.28	1481.58	1149.44	1150.11	6862.28	1048.94	160.14	5381.16	2844.53	4661.48	8012.39	9434.78	1209.09	22108.65	13882.96
2021	786.67	1263.58	1490.31	1162.10	1162.98	6954.79	1063.78	161.94	5461.02	2873.86	4702.66	8117.76	9560.60	1225.72	22381.02	14046.14
2022	793.21	1277.01	1499.10	1174.89	1175.98	7048.54	1078.82	163.76	5539.07	2903.49	4744.23	8224.52	9685.15	1242.58	22653.89	14211.33
2023	799.81	1290.59	1507.95	1187.83	1189.14	7143.55	1094.08	165.60	5618.24	2933.43	4786.18	8332.69	9811.34	1259.68	22930.21	14378.55
2024	806.46	1304.32	1516.84	1200.92	1202.44	7239.84	1109.55	167.46	5698.53	2963.67	4828.53	8442.28	9939.22	1277.01	23210.04	14547.83
2025	812.61	1316.73	1525.25	1212.71	1214.41	7324.63	1123.09	169.14	5765.56	2991.12	4867.31	8539.04	10048.91	1292.22	23455.25	14698.57
2026	819.37	1330.74	1534.25	1226.07	1227.99	7423.36	1138.97	171.04	5847.96	3021.96	4910.42	8651.36	10179.93	1310.00	23741.71	14871.78
2027	826.18	1344.89	1543.30	1239.57	1241.73	7523.43	1155.08	172.96	5931.54	3053.12	4953.93	8765.16	10312.70	1328.03	24031.79	15047.13
2028	833.05	1359.19	1552.40	1253.22	1255.62	7624.84	1171.41	174.90	6016.32	3084.60	4997.86	8880.46	10447.23	1346.31	24325.55	15224.64
2029	839.98	1373.64	1561.56	1267.03	1269.66	7727.63	1187.98	176.87	6102.31	3116.40	5042.20	8997.29	10583.55	1364.84	24623.04	15404.33
2030	846.96	1388.25	1570.77	1280.98	1283.87	7831.79	1204.78	178.85	6189.52	3148.53	5086.96	9115.66	10721.69	1383.63	24924.30	15586.25
2031	854.00	1403.01	1580.03	1295.09	1298.23	7937.37	1221.81	180.86	6277.98	3181.00	5132.13	9235.59	10861.66	1402.68	25229.38	15770.40
2032	861.10	1417.93	1589.35	1309.35	1312.75	8044.36	1239.09	182.89	6367.71	3213.79	5177.74	9357.11	11003.49	1421.99	25538.34	15956.83
2033	868.26	1433.01	1598.73	1323.77	1327.43	8152.80	1256.62	184.95	6458.72	3246.93	5223.77	9480.23	11147.21	1441.57	25851.21	16145.56
2034	875.48	1448.24	1608.16	1338.35	1342.28	8262.70	1274.39	187.03	6551.03	3280.41	5270.24	9604.97	11292.85	1461.42	26168.06	16336.63
2035	882.76	1463.64	1617.64	1353.09	1357.29	8374.08	1292.41	189.13	6644.66	3314.23	5317.14	9731.37	11440.43	1481.54	26488.94	16530.05
2036	890.10	1479.21	1627.18	1368.00	1372.47	8486.96	1310.69	191.25	6739.63	3348.40	5364.49	9859.43	11589.97	1501.94	26813.89	16725.86
2037	897.50	1494.94	1636.78	1383.06	1387.83	8601.36	1329.22	193.40	6835.95	3382.92	5412.29	9989.19	11741.50	1522.62	27142.97	16924.10
2038	904.97	1510.83	1646.44	1398.30	1403.35	8717.31	1348.02	195.58	6933.65	3417.80	5460.53	10120.66	11895.05	1543.60	27476.24	17124.78
2039	912.49	1526.90	1656.15	1413.70	1419.05	8834.81	1367.08	197.77	7032.75	3453.04	5509.23	10253.86	12050.65	1564.86	27813.74	17327.95
2040	920.08	1543.14	1665.92	1429.27	1434.92	8953.91	1386.42	200.00	7133.26	3488.64	5558.40	10388.83	12208.32	1586.41	28155.54	17533.63

Table B-2

Employment Forecast from 2000 to 2040 by Year and Subarea (in thousands)

Year	LA-1	LA-2	LA-3	MA-1	TX-1	TX-2	FL-1	FL-2	FL-3	FL-4	CGOM	WGOM	EGOM	EPA	GOM	Planning Areas
2000	377.47	571.95	781.67	515.20	454.25	3046.85	427.04	44.99	2248.28	1306.73	2246.29	3501.10	4027.03	472.03	9774.42	6219.42
2001	381.65	580.15	787.95	522.71	460.67	3095.53	435.03	45.55	2298.83	1324.75	2272.46	3556.20	4104.15	480.58	9932.81	6309.24
2002	386.15	590.66	793.66	529.89	466.67	3143.66	442.85	46.10	2347.94	1341.81	2300.36	3610.33	4178.69	488.95	10089.39	6399.64
2003	391.14	597.79	799.20	537.23	472.64	3192.81	450.72	46.63	2396.68	1358.42	2325.36	3665.45	4252.45	497.35	10243.26	6488.16
2004	396.19	605.01	804.78	544.66	478.69	3242.72	458.73	47.17	2446.44	1375.24	2350.64	3721.41	4327.58	505.90	10399.63	6577.95
2005	401.12	612.06	810.28	551.90	484.58	3291.14	466.47	47.69	2494.20	1391.66	2375.37	3775.72	4400.02	514.16	10551.11	6665.25
2006	406.59	620.41	816.61	559.63	490.79	3342.62	474.56	48.24	2543.55	1408.55	2403.24	3833.41	4474.90	522.80	10711.54	6759.44
2007	412.13	628.87	822.98	567.47	497.07	3394.92	482.79	48.79	2593.87	1425.65	2431.45	3891.99	4551.10	531.58	10874.54	6855.01
2008	417.75	637.44	829.41	575.42	503.43	3448.03	491.16	49.34	2645.19	1442.96	2460.02	3951.46	4628.65	540.50	11040.13	6951.98
2009	423.44	646.13	835.89	583.48	509.88	3501.97	499.68	49.92	2697.52	1460.48	2488.94	4011.85	4707.59	549.60	11208.38	7050.38
2010	428.46	653.79	841.92	590.56	515.60	3548.60	506.92	50.41	2740.96	1476.14	2514.73	4064.20	4774.43	557.33	11353.35	7136.26
2011	434.20	662.57	849.68	598.72	522.23	3603.56	515.29	50.97	2791.77	1494.06	2545.17	4125.79	4852.09	566.26	11523.05	7237.21
2012	440.01	671.47	857.50	607.00	528.95	3659.37	523.79	51.53	2843.53	1512.20	2575.99	4188.31	4931.06	575.32	11695.36	7339.63
2013	445.91	680.49	865.41	615.39	535.74	3716.04	532.43	52.11	2896.25	1530.56	2607.20	4251.78	5011.35	584.54	11870.33	7443.52
2014	451.89	689.63	873.38	623.89	542.63	3773.59	541.22	52.68	2949.95	1549.15	2638.79	4316.22	5092.99	593.90	12048.01	7548.92
2015	457.17	697.71	880.71	631.38	548.75	3823.42	548.75	53.20	2995.06	1565.76	2666.96	4372.16	5162.78	601.95	12201.90	7641.07
2016	463.11	706.94	889.98	639.95	555.92	3882.64	557.39	53.77	3047.84	1585.15	2699.99	4438.56	5244.15	611.17	12382.71	7749.72
2017	469.13	716.31	899.36	648.65	563.18	3942.79	566.17	54.35	3101.55	1604.77	2733.44	4505.97	5326.85	620.52	12566.25	7859.93
2018	475.24	725.79	908.83	657.46	570.53	4003.86	575.09	54.93	3156.21	1624.64	2767.31	4574.40	5410.87	630.02	12752.58	7971.73
2019	481.42	735.40	918.40	666.39	577.99	4065.89	584.15	55.52	3211.82	1644.76	2801.60	4643.87	5496.25	639.67	12941.73	8085.15
2020	486.90	743.91	927.09	674.27	584.60	4119.61	591.98	56.06	3259.01	1662.71	2832.17	4704.20	5569.74	648.03	13106.11	8184.40
2021	493.06	753.67	937.99	683.30	592.42	4183.89	600.93	56.64	3314.23	1683.97	2868.01	4776.31	5655.77	657.57	13300.09	8301.89
2022	499.29	763.56	949.00	692.45	600.35	4249.17	610.01	57.23	3370.40	1705.50	2904.31	4849.52	5743.14	667.24	13496.97	8421.08
2023	505.60	773.59	960.15	701.72	608.39	4315.47	619.24	57.83	3427.51	1727.31	2941.07	4923.86	5831.88	677.07	13696.81	8542.00
2024	511.99	783.74	971.43	711.12	616.53	4382.81	628.60	58.43	3485.59	1749.39	2978.29	4999.34	5922.02	687.03	13899.65	8664.67
2025	517.67	792.71	981.53	719.41	623.71	4440.89	636.71	58.98	3535.04	1768.97	3011.32	5064.60	5999.70	695.69	14075.62	8771.62
2026	524.21	803.12	993.06	729.04	632.06	4510.19	646.34	59.60	3594.94	1791.59	3049.44	5142.25	6092.47	705.94	14284.15	8897.62
2027	530.84	813.66	1004.73	738.80	640.52	4580.56	656.11	60.22	3655.86	1814.50	3088.04	5221.08	6186.69	716.33	14495.81	9025.45
2028	537.55	824.34	1016.53	748.70	649.09	4652.04	666.03	60.85	3717.81	1837.70	3127.13	5301.13	6282.39	726.88	14710.65	9155.14
2029	544.35	835.16	1028.47	758.73	657.78	4724.63	676.10	61.48	3780.82	1861.20	3166.71	5382.41	6379.60	737.59	14928.72	9286.71
2030	551.23	846.13	1040.56	768.89	666.59	4798.35	686.33	62.13	3844.89	1884.99	3206.80	5464.93	6478.33	748.45	15150.07	9420.19
2031	558.20	857.23	1052.78	779.19	675.51	4873.22	696.70	62.77	3910.04	1909.10	3247.40	5548.73	6578.62	759.48	15374.75	9555.61
2032	565.26	868.49	1065.15	789.62	684.55	4949.26	707.24	63.43	3976.30	1933.51	3288.52	5633.81	6680.48	770.67	15602.81	9693.00
2033	572.41	879.89	1077.66	800.20	693.72	5026.49	717.93	64.09	4043.68	1958.23	3330.15	5720.20	6783.94	782.02	15834.29	9832.38
2034	579.65	891.44	1090.32	810.91	703.00	5104.92	728.79	64.76	4112.21	1983.27	3372.32	5807.92	6889.02	793.55	16069.26	9973.79
2035	586.97	903.14	1103.13	821.77	712.41	5184.57	739.81	65.44	4181.89	2008.63	3415.02	5896.99	6995.76	805.24	16307.77	10117.25
2036	594.40	914.99	1116.09	832.78	721.95	5265.47	750.99	66.12	4252.76	2034.31	3458.26	5987.42	7104.18	817.11	16549.86	10262.80
2037	601.91	927.01	1129.20	843.93	731.62	5347.63	762.35	66.81	4324.82	2060.33	3502.05	6079.25	7214.31	829.16	16795.61	10410.46
2038	609.52	939.17	1142.47	855.24	741.41	5431.07	773.87	67.51	4398.11	2086.67	3546.40	6172.48	7326.16	841.38	17045.05	10560.27
2039	617.23	951.50	1155.89	866.69	751.33	5515.82	785.57	68.22	4472.64	2113.35	3591.31	6267.15	7439.78	853.79	17298.24	10712.25
2040	625.03	963.99	1169.47	878.30	761.39	5601.88	797.45	68.93	4548.43	2140.37	3636.79	6363.28	7555.19	866.38	17555.26	10866.45

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Minerals Revenue Management** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.

MMS Securing Ocean Energy & Economic Value for America