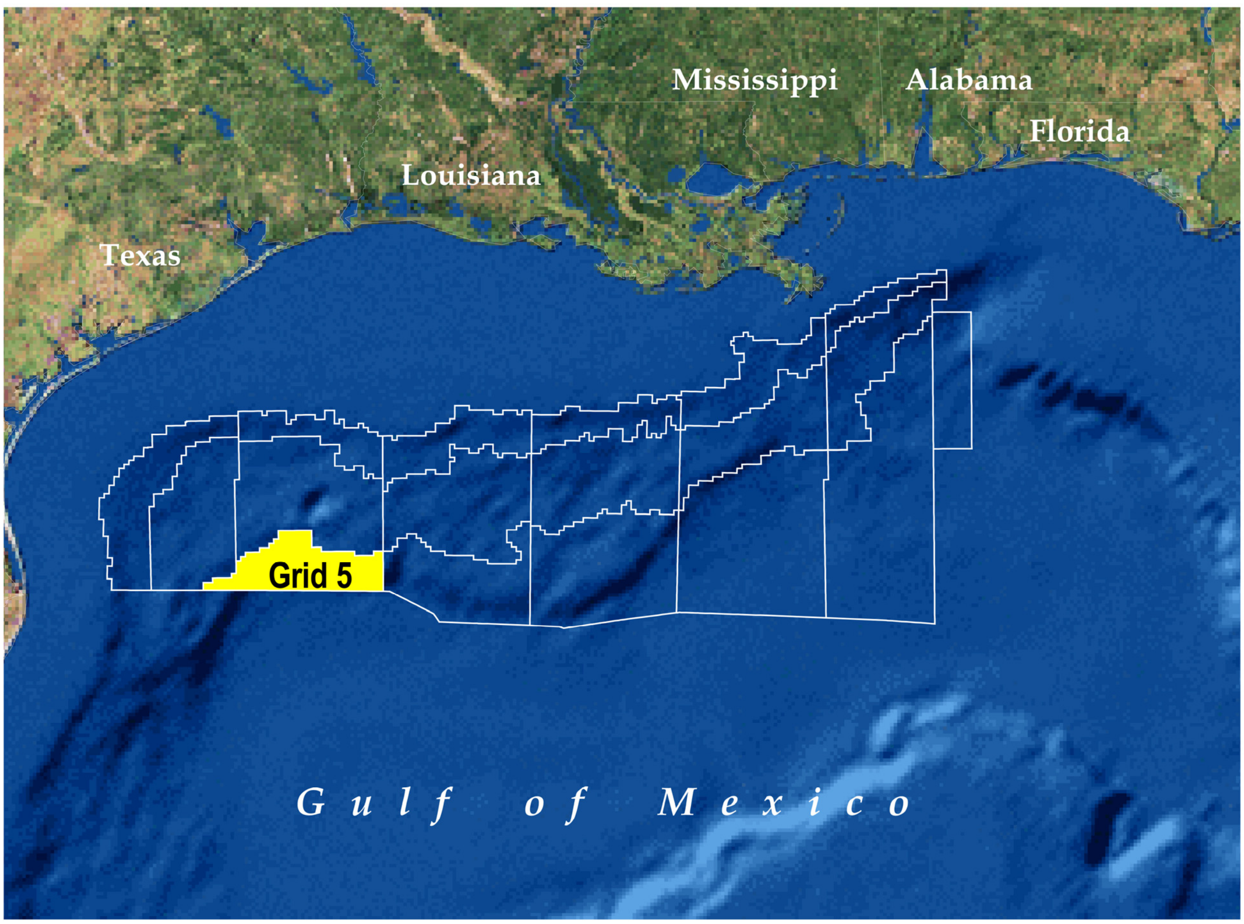
OCS EIS/EA
MMS 2007-027

Programmatic Environmental Assessment for Grid 5

Site-Specific Evaluation of Shell Offshore Inc.'s Initial Development Operations Coordination Document, N-8809

Perdido Project
Alaminos Canyon Blocks 812, 813, 814, and 857



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

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Alaminos Canyon Blocks 812, 813, 814, and 857

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Published by

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

New Orleans
April 2007

PROGRAMMATIC ENVIRONMENTAL ASSESSMENT FOR GRID 5 AND SITE-SPECIFIC EVALUATION FOR SHELL OFFSHORE INC'S PERDIDO PROJECT

FINDING OF NO SIGNIFICANT IMPACT

Shell Offshore Inc's (Shell) Initial Development Operations Coordination Document (DOCD) and its amendments propose to construct and operate the Perdido Developments facility, the Perdido Regional Host (PRH) that is to be located in Alaminos Canyon (AC) Block 857. The Perdido Developments facility involves a phased development of three separate deepwater fields—the Great White, Tobago, and Silvertip—and these fields would be tied to PRH to commence production. Phase I of the project would include installation of PRH, installation of subsea equipment located near the facility, and the batch setting of 19 direct vertical access (DVA) subsea wells (15 producer, 3 water injection, and 1 spare). The PRH would include an anchored truss spar equipped with a drilling rig to conduct drilling, completion, and workover activities on subsea wells and hookups for export pipelines. The truss spar would have a well bay consisting of six slots. One of the slots would be exclusively used for drilling, completion, and workover activities for the 19 DVA subsea wells. Five separator and boosting systems (SBS) would be installed on the seafloor and would be tied back to the host via five top tensioned risers (TTR). These five TTR's would use the remaining five slots of the well bay. Five SBS's installed on the seafloor would receive produced oil and gas from subsurface wells and would separate gas and liquids from the produced fluids at the seafloor. The separated gas would free flow up the annulus of the TTR's and liquids would be pumped up through the tubing using electronic submersible pumps to the host facility for processing and export.

Our programmatic environmental assessment (PEA) and site-specific evaluation of the proposed action (N-8809) is complete and results in a Finding of No Significant Impact (FONSI). Based on this PEA, we have concluded that the proposed action will not significantly affect the quality of the marine and human environments (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

1. The area in which the proposed drilling operations are to be conducted is hereby classified as "H_2S absent," in accordance with 30 CFR 250.417(c). The location and depths of the planned wells are not expected to encounter an H_2S hazard. An H_2S Contingency Plan is not required to be submitted and approved by the MMS prior to Shell conducting the proposed activities. (8.03)

2. In accordance with NTL 2001-G04, the MMS has determined that Shell will not need to conduct the two ROV surveys you proposed in your plan. (19.03)

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4/11/07
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April 11, 2007
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ABBREVIATIONS AND ACRONYMS

AC	Alaminos Canyon
ACP	Area Contingency Plan
AHTS	anchor-handling tug/supply
API	American Petroleum Institute
AUV	autonomous underwater vehicle
B.P.	before present
bbl	barrel(s)
BNWR	Breton National Wildlife Refuge
BOD	biochemical oxygen demand
BOP	blowout preventer
BOPD	barrels of oil per day
Btu	British thermal unit
CEI	Coastal Environments, Inc.
CFR	Code of Federal Regulations
cm	centimeter
CPA	Central Planning Area
CSA	Continental Shelf Associates
CZM	Coastal Zone Management
DCR	drilling and completion riser
DGoMB	Deep Gulf of Mexico Benthos
DOCD	Development Operations Coordination Document
DOI	Department of the Interior (also: USDOI)
DP	dynamically positioned
DVA	direct vertical access
DWOP	Deepwater Operations Plan
E&P	exploration and production
EA	environmental assessment
EB	East Breaks
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
EIS	economic impact area
EIS	environmental impact statement
EP	Exploration Plan
EPA	Eastern Planning Area
ESA	Endangered Species Act
ESP	electronic submersible pump
et al.	and others
FAA	Federal Aviation Administration
FAD	fish attracting device
FMC	Fishery Management Council
FMP	Fishery Management Plan
FNL	from the north line of the block
FONSI	Finding of No Significant Impact
FR	Federal Register
ft	foot
FWL	from the west line of the block
FWS	Fish and Wildlife Service
g	grams
GB	Garden Banks
GMFMC	Gulf of Mexico Fishery Management Council
GOM	Gulf of Mexico
GulfCet	Gulf Cetacean
H2S	hydrogen sulfide
hp	horsepower
in	inch
km	kilometer
l	liter
lb	pounds
LCWCRTF	Louisiana Coastal Wetlands Conservation and Restoration Task Force
LDWF	Louisiana Dept. of Wildlife and Fisheries
LMA	labor market area
MARPOL	International Convention for the Prevention of Pollution from Ships
μg	micrograms (10^{-6} grams)
mg/l	milligrams per liter
mi	mile
MMS	Minerals Management Service
MODU	mobile offshore drilling unit
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
ng	nanograms (10^{-9} grams)
NGMCS	Northern Gulf of Mexico Continental Slope Study
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant and Discharge Elimination System
NRC	National Research Council
NRDC	Natural Resources Defense Council
NSRE	National Survey on Recreation and the Environment
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
OSV	offshore service vessel
PAH	polynuclear aromatic hydrocarbons
PCB	polychlorinated biphenyl
PEA	programmatic environmental assessment
ppb	parts per billion
ppt	parts per thousand
PRH	Perdido Regional Host

PSD	Prevention of Significant Deterioration
ROV	remotely operated vehicle
SBF	synthetic-based drilling fluid
SBM	synthetic-based mud
SBS	separator and boosting system
SFCA	surface flow control assembly
Shell	Shell Offshore Inc.
SOV	spill occurrence variable
SWAMP	Sperm Whale Acoustic Monitoring Program
SWSS	Sperm Whale Seismic Study
TCBA	Texas Coastal Bend Beach Area
TCW	treatment, completion, and workover
THS	tubing head spool
TLP	tension leg platform
TSS	total solids in suspension
TTR	top tensioned riser
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
WBF	water-based fluid
WBM	water-based mud
WCD	worst-case discharge
WPA	Western Planning Area

INTRODUCTION

The Minerals Management Service (MMS) developed a comprehensive strategy for postlease National Environmental Policy Act (NEPA) compliance for development and production projects in deepwater areas (water depths greater than 400 m (1,312 ft) in the Central Planning Area (CPA) and Western Planning Area (WPA) of the Gulf of Mexico (GOM). The strategy led to the development of a biologically-based grid system to ensure broad and systematic analysis of the GOM's deepwater region, which is explained on MMS's website. This strategy divides the deepwater Gulf into 17 areas or "grids" of biological similarity that generally correlate to water depth.

The area for this programmatic environmental assessment (PEA) is Grid 5 in the WPA. Grid 5 is a portion of the OCS in relatively untested water between 2,000 and 3,400 m (6,562 and 11,155 ft) deep. Figure 1 shows the relationship of Grid 5 to the Gulf's coastline and the other 16 grids.

This PEA characterizes the environment of Grid 5 and examines the potential impacts that may result from the site-specific activities proposed by Shell Offshore Inc. (Shell) in an Initial Unit Development Operations Coordination Document (DOCD, Plan Number N-8809) for their proposed Perdido Developments (Perdido) project. Shell proposes to use a spar for its phased development of the area's existing discovered fields. Once installed, the spar would hold the deepwater record for surface development structures in the GOM. The MMS has determined that the Perdido project is a suitable project on which to base this PEA.

The PEA is designed to be comprehensive in terms of (1) characterizing the physical, biological, and socioeconomic resources within the grid, (2) describing the impact-producing factors from this proposed development project, (3) describing the potential impacts from this specific proposal that are representative of the grid, and (4) considering the cumulative impacts from OCS development activity within Grid 5. Figure 2 shows the location of the proposed Perdido project in Alaminos Canyon Blocks 812, 813, 814, and 857 (OCS-G 24593, 17561, 20862, and 17565, respectively) in relationship to the 425 OCS blocks that comprise Grid 5.

The Grid 5 PEA serves as a reference document for the tiering (40 CFR 1502.20) concept detailed in NEPA's implementing regulations and allows subsequent environmental analyses for individual plans proposed within the grid to focus on specific issues and effects within Grid 5. The PEA tiers primarily from the WPA/CPA Final Multisale Environmental Impact Statement (EIS) (USDOI, MMS, 2007). Relevant information from the Final Multisale EIS is incorporated into this PEA by reference.

CURRENT STATUS OF GRID 5

Figure 1 shows the relationship of Grid 5 to the Gulf's coastline and the other 16 grids that have been defined in MMS's comprehensive strategy for postlease NEPA compliance in deepwater areas of the GOM. The nearest land to Grid 5 is in Del Mar, Texas, approximately 142 mi (228.5 km) to the west (Figure 1). Figure 2 shows the OCS protraction areas and blocks within Grid 5 and the location of the Perdido project in Alaminos Canyon Blocks 812, 813, 814, and 857. Table 1 summarizes the statistics for the OCS areas of Alaminos Canyon and Keathley Canyon, which constitute Grid 5.

Table 1

Protraction Areas, Blocks, and Leases in Grid 5

Protraction Area	No. of Grid Blocks	No. of Grid Blocks Leased	Percentage of Grid Blocks Leased
Alaminos Canyon	349	130	37
Keathley Canyon	76	24	32
Grid Totals	425	154	36

Alaminos Canyon constitutes about 82 percent of the total number of blocks in Grid 5 and about 84 percent of the total number of leases. Keathley Canyon contains the remaining 18 percent of the total number of blocks in Grid 5 and 16 percent of the total leases. About 36 percent of all blocks in the grid are leased. Figure 3 shows the bathymetry of Grid 5. Figure 4 shows the location of Military Warning Areas (MWA) relative to Grid 5. About 83 percent of Grid 5 (352 blocks) lies within MWA W-602, including Alaminos Canyon Blocks 812, 813, 814, and 857, where the proposed Perdido project is located. Development activities in Grid 5 that lie within MWA W-602, or service boat traffic traversing it, would be required to contact the Strategic Command Wing 1, Fleet Area Reconnaissance 4, Operations Dept., Tinker AFB, Oklahoma City, Oklahoma, 73145-8704 Telephone: (405) 739-5700/4527, concerning electromagnetic emissions and the use of boats and aircraft.

No known H_2S hazards areas are present in Alaminos Canyon Blocks 812, 813, 814, and 857 nor have other operators within Grid 5 encountered H_2S in drilling operations to date. For additional information regarding H_2S and operational activities, see the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007; Chapter 4.1.1.9, Hydrogen Sulfide and Sulfurous Petroleum).

Operators holding leases in Grid 5 are shown in Figure 5, and the type of lease and the status of plans that have been submitted in Grid 5 are shown in Figure 6. There are 13 blocks in Grid 5 that have Exploration Plans (EP's) approved by MMS, and 5 blocks have approved DOCD's. Thirty-seven blocks have been designated by their operators as unit developments. Figure 7 shows the location of publicly announced industry prospects and the locations of wells drilled within the grid.

Listed below are the current 15 operators and/or leaseholders in Grid 5. These operators include major international oil and gas operators as well as independent companies. This listing reflects MMS's databases at the time the PEA was written. Interest by leasehold may vary over time.

BHP Billiton Petroleum Inc.
BP Exploration and Production Inc.
Chevron U.S.A. Inc.
Devon Energy Production Company L.P.
ENI Petroleum Company Inc.
Hess Corporation
Hydro Gulf of Mexico, L.L.C.
Kerr-McGee Oil and Gas Corporation
Maxus US Exploration Company
Exxon Mobil Corporation
Petrobras America Inc.
Shell Exploration & Production Company
Total E&P USA Inc.
Union Oil Company of California
Woodside Energy LTD.

At this time, there are no surface development structures and pipeline within Grid 5. Figure 8 shows the status of wells drilled within the grid.

Shell has chosen Galveston, Texas, and Port Fourchon, Louisiana, as its primary onshore bases to support its offshore operations for the Perdido project. These two bases are widely used by industry. There are numerous onshore support bases that are available along the Gulf Coast and that could serve as logistical infrastructure for Grid 5. Figure 9 shows the distances from the Perdido project in Alaminos Canyon Block 857 to Shell's chosen shore bases.

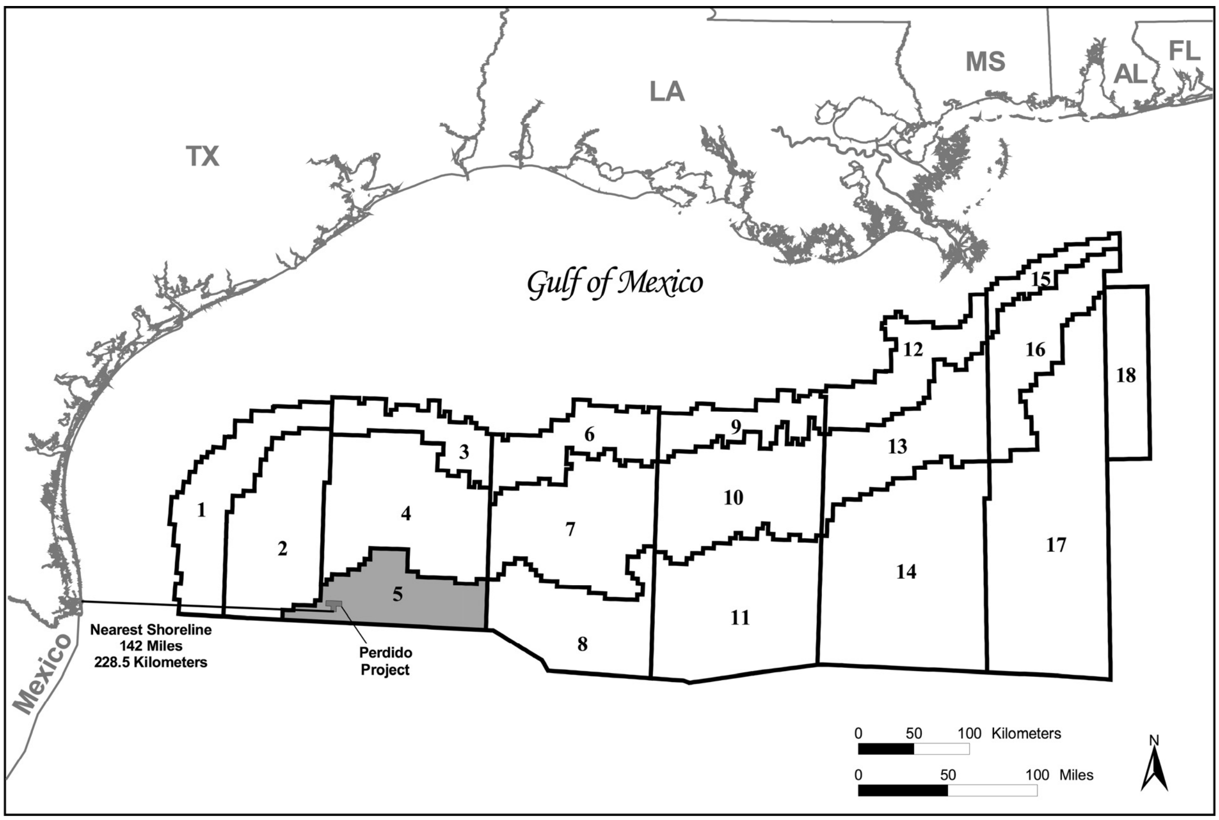

Figure 1. Relationship of Grid 5 to the Gulf Coastline and to Other Grids Defined in MMS's Comprehensive Deepwater Development Strategy.

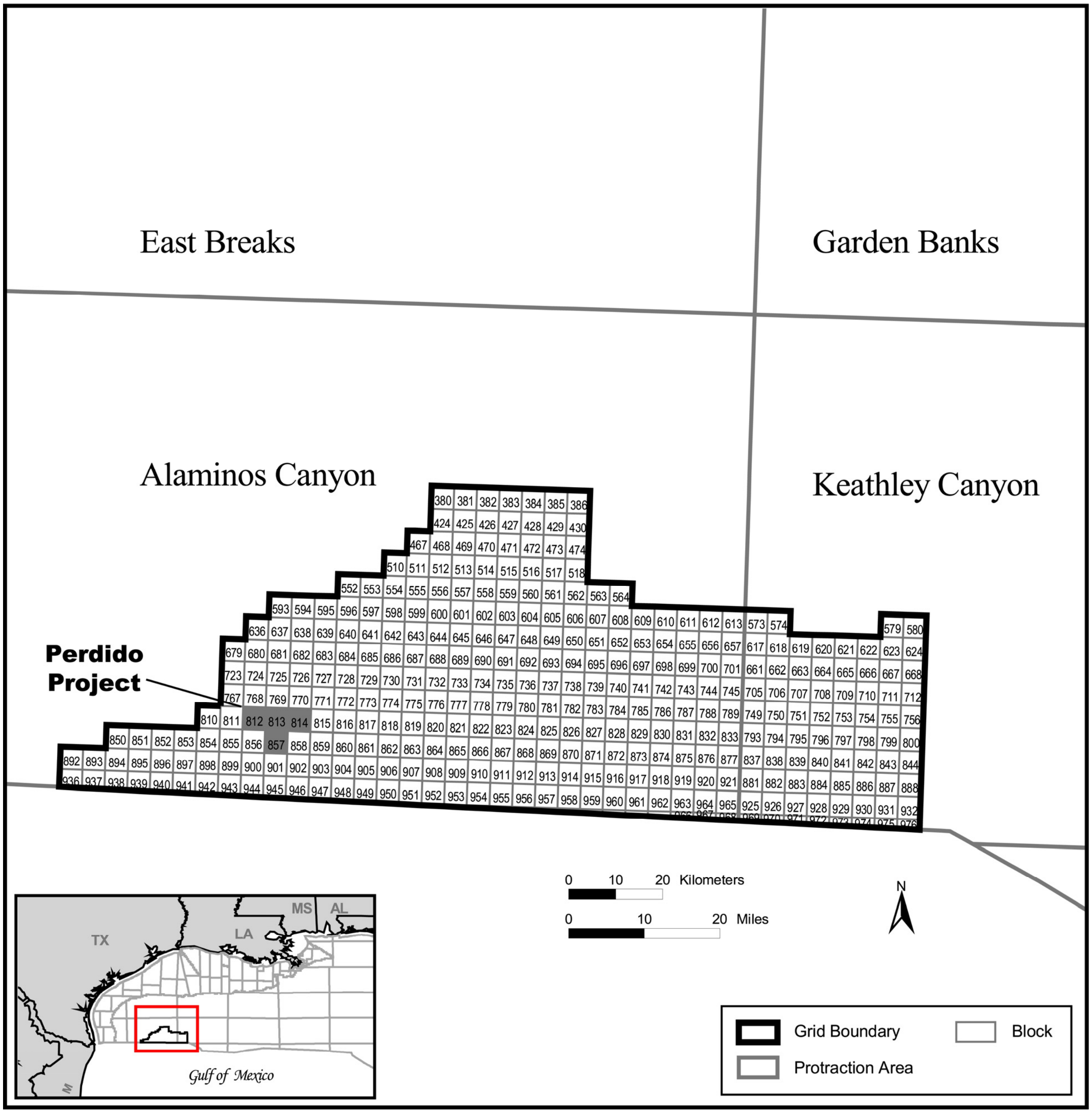

Figure 2. Areas and Blocks in Grid 5 with the Location of the Proposed Perdido Development Project.

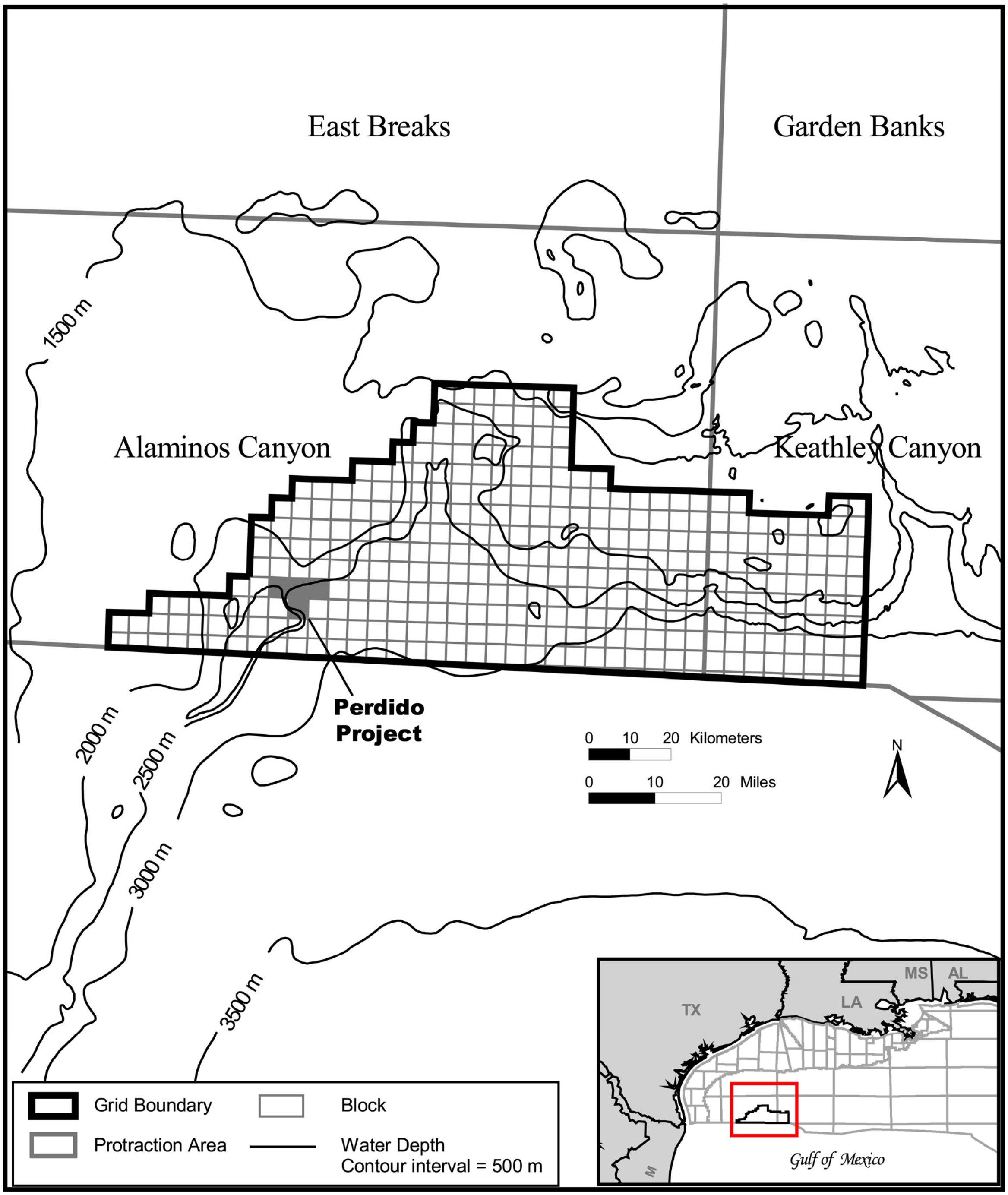

Figure 3. Bathymetric Map of Grid 5.

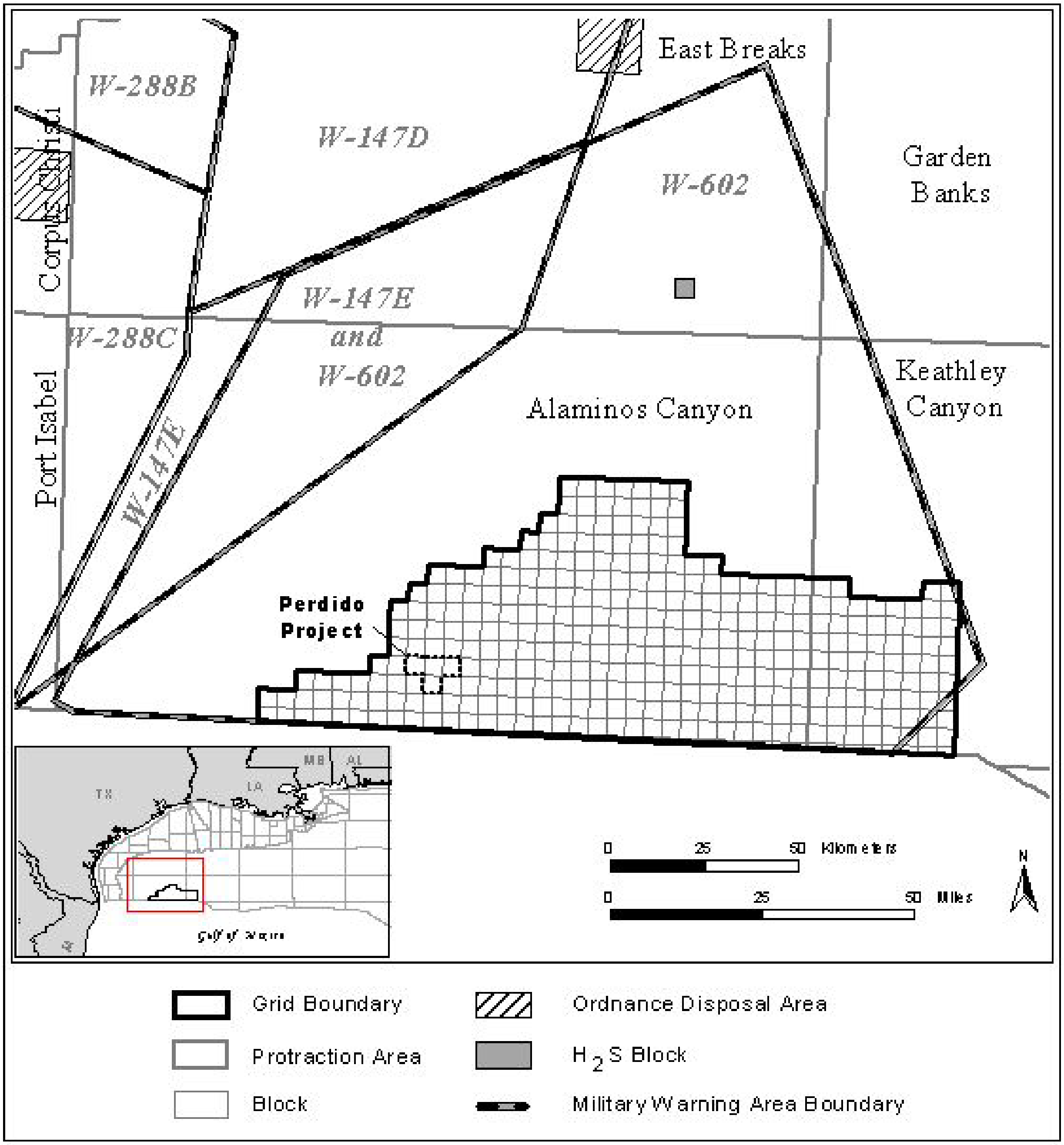

Figure 4. Military Warning Areas Proximal to Grid 5.

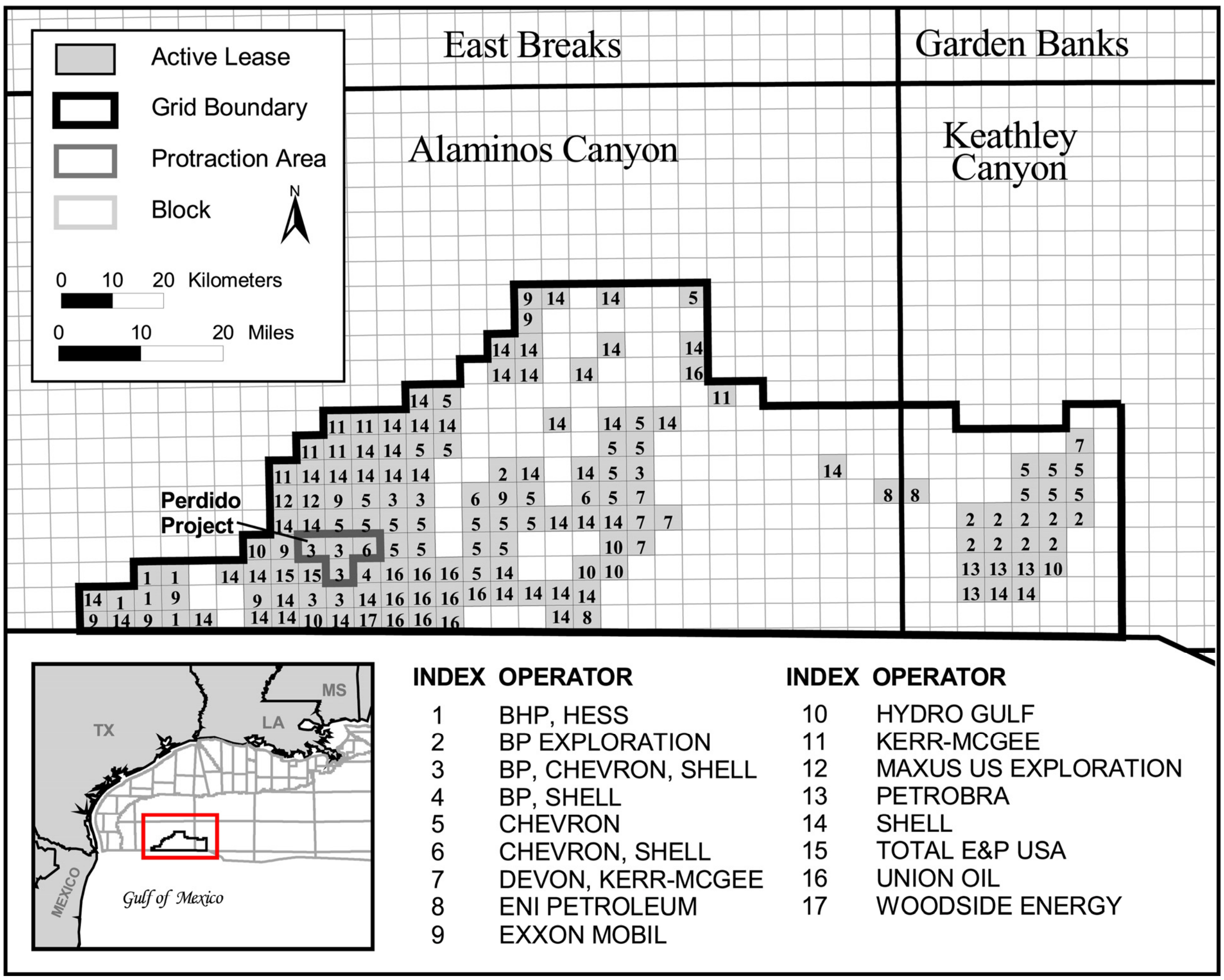

Figure 5. Operators Holding Leases within Grid 5.

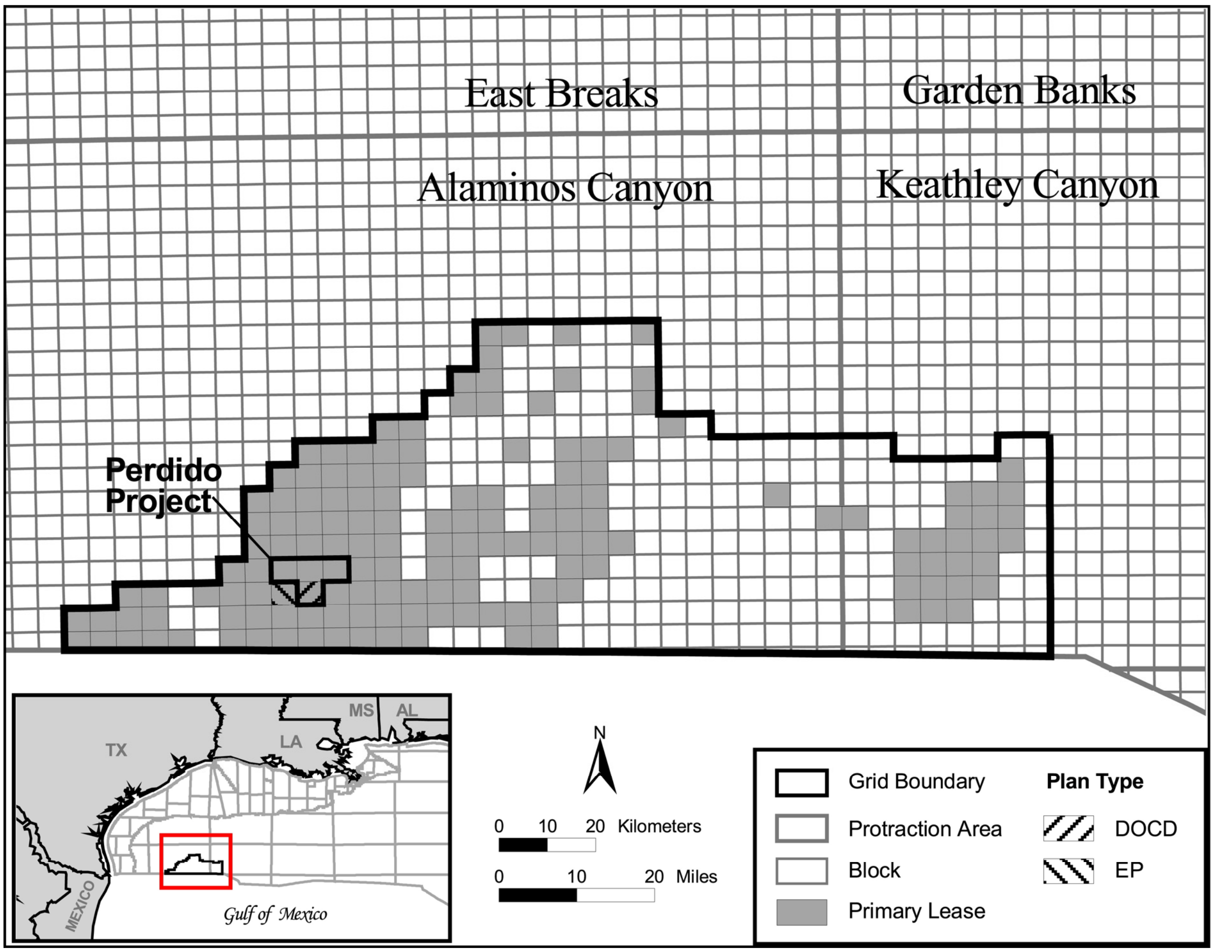

Figure 6. Active Lease Status and Plans Submitted in Grid 5.

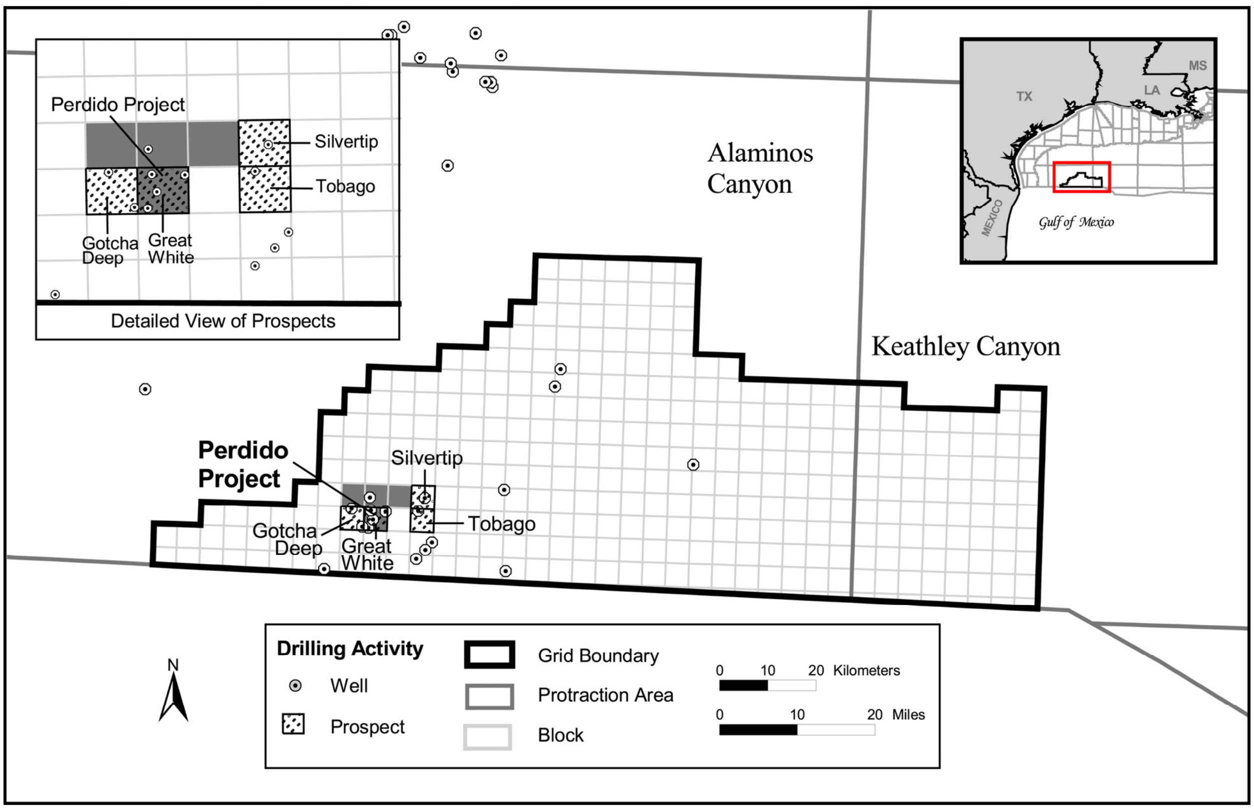

Figure 7. Publicly Announced Prospects and Wells Drilled in Grid 5.

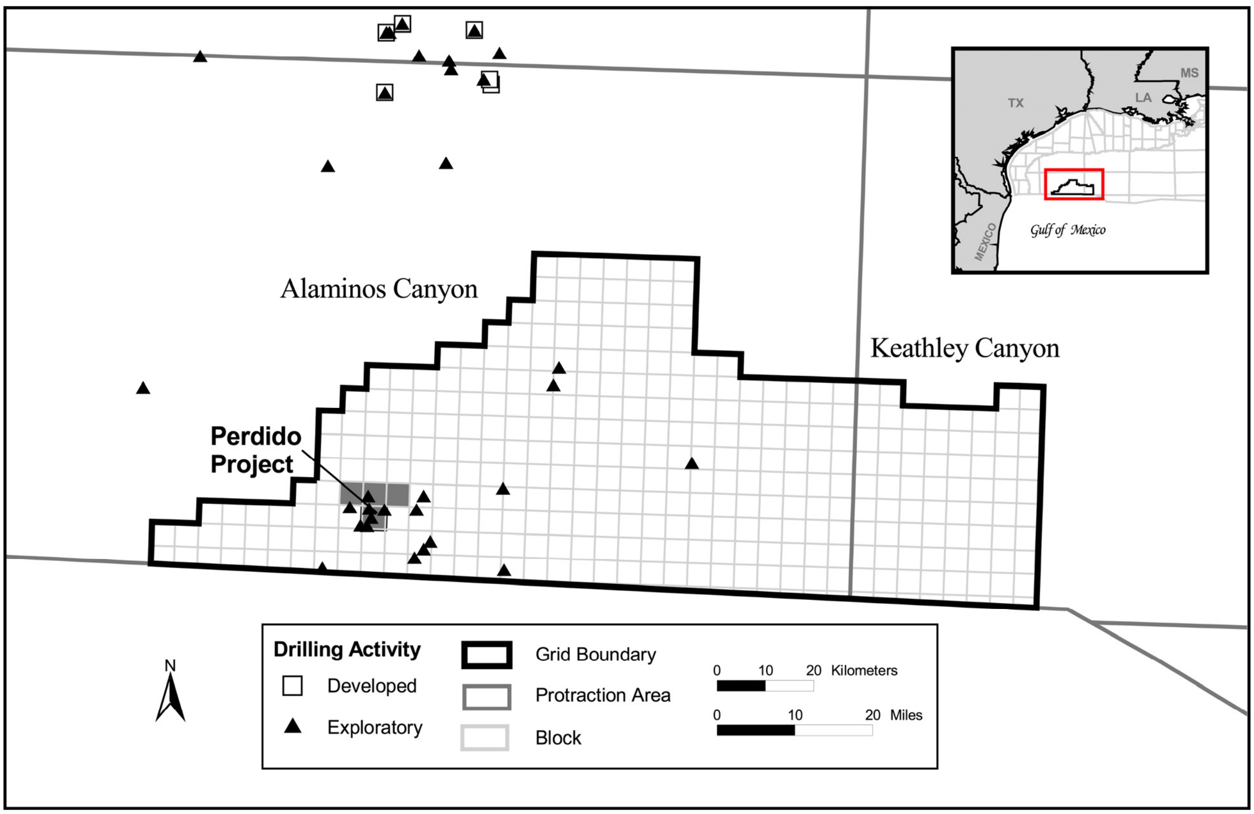

Figure 8. Exploration and Development Drilling Activities Conducted in Grid 5 and Adjacent Areas.

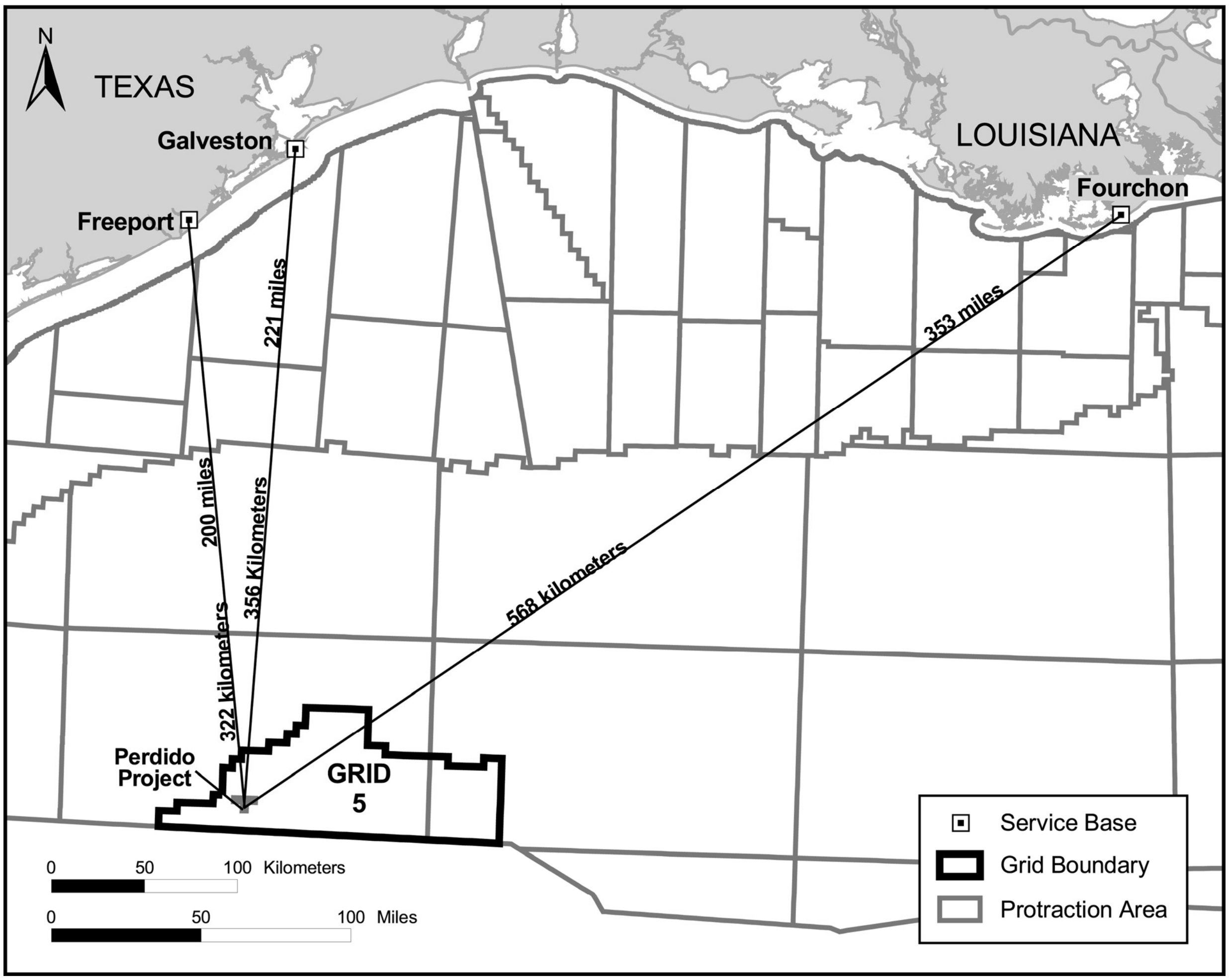

Figure 9. Distances from the Perdido Project in Alaminos Canyon Block 857 to the Primary Shore Bases in Galveston, Texas, and Port Fourchon, Louisiana.

1. PROPOSED ACTION

1.1. PURPOSE OF THE PROPOSED ACTION

The proposed action outlined by Shell in their DOCD is to construct and operate the Perdido Developments facility, the Perdido Regional Host (PRH) that is to be located in Alaminos Canyon Block 857. The perdido developments involves a phased development of three separate deepwater fields, the Great white, Tobago, and Silvertip and these fields would be tied to PRH to commence production. 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 Alaminos Canyon Blocks 812, 813, 814, and 857, Shell has filed a DOCD with MMS consistent with its requirement to file such a plan before production activity commences. The reasons that Shell 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

Shell filed an initial DOCD for the Perdido project on August 31, 2006. Shell subsequently provided additional information regarding the plan that allowed MMS to determine it to be complete. The DOCD proposes a phased development scenario. Phase I of the project, which would include installation of the PRH facility, installation of subsea equipment located near the facility, and the batch setting of 19 direct vertical access (DVA) subsea wells (15 producer, 3 water injection, and 1 spare). The PRH would include an anchored truss spar equipped with a drilling rig to conduct drilling, completion, and workover activities on subsea wells and hookups for export pipelines. The truss spar would have a well bay consisting of six slots. One of the slots would be exclusively used for drilling, completion, and workover activities for the 19 DVA subsea wells. Five separator and boosting systems (SBS's) would be installed on the seafloor that would be tied back to the host via five top tensioned risers (TTR's). These five TTR's would use the remaining five slots of the well bay. Five SBS's installed on the seafloor would receive produced oil and gas from subsurface wells and would separate gas and liquids from the produced fluids at the seafloor. The separated gas would free flow up the annulus of the TTR's and liquids would be pumped up through the tubing utilizing electronic submersible pumps to the host facility for processing and export. Table 1-1 depicts the location of the host spar and the surface locations of the proposed subsea wells in Alaminos Canyon Block 857.

Table 1-1

Proposed Location of the Perdido Regional Host and
Surface Locations of Proposed Subsea Wells in Alaminos Canyon Block 857

Surface Location	Distance From Block Boundary (in ft)	Lambert X-Y Coordinate (in ft)	Latitude/Longitude (in decimal degrees)
Host	2,680′ FNL; 4,099′ FWL	X = 1,017,859 Y = 9,485,480	Latitude : 26.12890071 Longitude : -94.89791489
Well A	2,745′ FNL; 4,209′ FWL	X = 1,017,968.87 Y = 9,485,414.67	Latitude : 26.12872556 Longitude : -94.89757722
Well B	2,826′ FNL; 4,174′ FWL	X = 1,017,934.02 Y = 9,485,334.14	Latitude : 26.1285025 Longitude : -94.89823972
Well C	2,529′ FNL; 3,998′ FWL	X = 1,017,757.87 Y = 9,485,630.69	Latitude : 26.12931111 Longitude : -94.89822972
Well D	2,823′ FNL; 4,133′ FWL	X = 1,017,892.82 Y = 9,485,336.79	Latitude : 26.12850806 Longitude : -94.89780556
Well E	2,621′ FNL; 3,993′ FWL	X = 1,017,753.27 Y = 9,485,539.12	Latitude : 26.12905917 Longitude : -94.89823972
Well F	2,677′ FNL; 3,924′ FWL	X = 1,017,684.35 Y = 9,485,483.3	Latitude : 26.12890278 Longitude : -94.89844722
Well G	2,679′ FNL; 4,094′ FWL	X = 1,017,853.61 Y = 9,485,480.56	Latitude : 26.12890194 Longitude : -94.89793139
Well H	2,715′ FNL; 3,919′ FWL	X = 1,017,678.75 Y = 9,485,444.78	Latitude : 26.12879667 Longitude : -94.8984625
Well I	2,635′ FNL; 3,934′ FWL	X = 1,017,693.9 Y = 9,485,525.42	Latitude : 26.12901917 Longitude : -94.89842
Well J	2,702′ FNL; 4,053′ FWL	X = 1,017,813.07 Y = 9,485,457.59	Latitude : 26.12883722 Longitude : -94.89805389
Well K	2,659′ FNL; 4,030′ FWL	X = 1,017,790.31 Y = 9,485,500.66	Latitude : 26.12895472 Longitude : -94.89812361
Well L	2,516′ FNL; 4,044′ FWL	X = 1,017,803.91 Y = 9,485,643.92	Latitude : 26.129349444 Longitude : -94.89809
Well M	2,785′ FNL; 4,198′ FWL	X = 1,017,958.04 Y = 9,485,375.31	Latitude : 26.128616666 Longitude : -94.89788944
Well N	2,618′ FNL; 4,108′ FWL	X = 1,017,868.3 Y = 9,485,542.15	Latitude : 26.129072222 Longitude : -94.8978894444
Well O	2,725′ FNL; 4,091′ FWL	X = 1,017,850.96 Y = 9,485,434.75	Latitude : 26.128775833 Longitude : -94.8979375
Well P	2,661′ FNL; 4,125′ FWL	X = 1,017,885.03 Y = 9,485,499.35	Latitude : 26.12895417 Longitude : -94.89783639
Well Q	2,663′ FNL; 3,986′ FWL	X = 1,017,745.62 Y = 9,485,496.81	Latitude : 26.12894306 Longitude : -94.89826
Well R	2,640′ FNL; 4,069′ FWL	X = 1,017,829.36 Y = 9,485,519.84	Latitude : 26.129006944 Longitude : -94.89800806
Well S	2,566′ FNL; 3,966′ FWL	X = 1,017,726.26 Y = 9,485,594.19	Latitude : 26.12920889 Longitude : -94.89832528

Note: FNL is from the north line of the block.
FWL is from the west line of the block.

In addition, Shell proposes to install two manifolds and five caissions. Their proposed locations are depicted below in Table 1-2. Shell has drilled five wells in Alaminos Canyon Block 857. Table 1-3 shows surface location of each of these wells.

Table 1-2

Proposed Locations of Subsea Manifolds and Caissons
in Alaminos Canyon Block 857

Surface Location	Lambert X-Y Coordinate (in ft)
North Manifold	X = 1,017,807.56 Y = 9,485,583.65
South Manifold	X = 1,017,920.90 Y = 9,485,450.14
Caisson A	X = 1,017,873.37 Y = 9,485,652.67
Caisson B	X = 1,017,942.37 Y = 9,485,607.58
Caisson C	X = 1,017,942.37 Y = 9,485,623.56
Caisson D	X = 1,018,012.80 Y = 9,485,499.81
Caisson E	X = 1,017,984.85 Y = 9,485,550.21

Table 1-3

Names and Surface Locations of Existing Wells
in Alaminos Canyon Block 857

Surface Location	Lambert X-Y Coordinate (in ft)
Well #1	X = 1,016,891 Y = 9,474,095
Well #2	X = 1,017,102 Y = 9,474,204
Well #3	X = 1,028,374 Y = 9,485,529
Well #4	X = 1,019,766 Y = 9,479,762
Well #5	X = 1,018,183 Y = 9,485,747

1.3.1. Schedule of Activities

Shell provided a tentative schedule of proposed activities for its Perdido project in its DOCD. Table 1-4 reflects this information. Note that first production from the facility is scheduled for November 2009.

Table 1-4

Milestone Dates for the Proposed Perdido Project

Proposed Activity	Start Date	End Date	No. of Days
Batch Set Wells A-D	08/22/07	09/19/07	28
Drill Well E	09/20/07	10/30/07	41
Batch Set Wells F-S	10/30/07	02/05/08	98
Compete Well E	02/10/08	03/04/08	23
Set Production Caissons	03/04/08	04/10/08	37
Drill and Complete Wells A-D and F-S	06/30/09	09/28/14	1,912
Install Hull Mooring Piles	03/12/08	03/24/08	16
Install Gas Export Pipeline	01/26/08	03/15/08	49
Install Oil Export Pipeline	03/16/08	04/18/08	33
Install Hull	07/09/08	08/05/08	27
Install 16-inch Gas Pipeline Riser	08/06/08	08/17/08	14
Install 16-inch Oil Pipeline Riser	08/18/08	08/29/08	12
Install Manifolds	09/04/08	09/07/08	4
Install Topsides, Quarters and Flare	11/06/08	02/05/09	91
Install 5 TTR's with Separation and Artificial Lift System	02/20/09	06/29/09	130
Install Jumpers and Umbillicals	04/01/09	06/12/09	72
First Production for DVA Wells	11/13/09		

1.3.2. Related OCS Facilities, Operations Information, and Pipelines

The Perdido project involves the phased development of three fields—Great White, Tobago and Silvertip Fields, all produced to the PRH. The PRH would be located in Alaminos Canyon Block 857 of the Western GOM. The facility is located approximately 200 mi (322 km) south of Freeport, Texas (Figure 9) in about 7,800 ft (2,380 m) of water and would be the farthest development facility from the shore thus far in the GOM. The selected development concept is a truss spar with complete processing capabilities, including oil and gas separation, oil conditioning, produced water treating, and water injection. The truss spar would have a well bay consisting of six slots to accommodate drilling, completion, workover, and production-related activities; and it also would be the deepest spar production facility in the world (Shell, 2006).

Offshore well drilling and completion activities are carried out from mobile offshore drilling units (MODU's). Shell has indicated that the execution phase of the PRH and Great White facilities would consist of batch setting of 19 wells directly under the host location by the semisubmersible rig, Nobel Clyde Boudreau. The Nobel Clyde Boudreau has a drilling depth capacity of 35,000 ft (10,670 m) and is rated for water depth of 10,000 ft (3,048 m). Crew size of this rig is reported to be 200 (Noble Corporation, 2007). Batch setting includes pre-drilling and installing the 36-in structural pipe, 20-in conductor, and 16-in surface casing for these wells. The MODU will also pre-install the five 42-in conductors at the seafloor associated with the caisson separation and aritifical lift system and would eventually use the five slots of the well bay of the spar. Once the batch set is completed, the hull and its mooring components would be installed, followed by the lifting and hookup of the topsides components and drilling rig. The subsea manifolds, umbillicals, and jumpers would be installed as well as export risers and flowlines. Once topsides commissioning activities are completed, the platform rig would be installed. Shell has proposed to use H&P 205 platform rig and would utilize the sixth available slot of the well bay of the spar for a drilling and completion riser to drill and complete the DVA wells to intitiate production. As mentioned earlier, Five SBS's would be installed on the seafloor and would be tied back to the host via five TTR's. Production from subsea wells would not be directly tied back to the host but are completed with subsea trees. Production would flow from the wells through a jumper to a subsea manifold. From the manifold, production would flow via flowlines into one of the SBS's. The SBS's would provide for the separation of gas from liquids in the produced fluids at the seafloor. The separated gas and liquids are then pumped from the seafloor via five TTR's to the host for processing.

A 70-mi (113-km) long, 18-inch oil export pipeline would be constructed to carry oil production from the PRH to a subsea connection at the ExxonMobil Diana-Hoover spar located in Alaminos Canyon Block 25 and a 106-mi (171-km) long, 18-inch gas export pipeline would be constructed to carry gas production from the PRH to an existing subsea connection point at the Boomvang spar located at East Breaks (EB) Block 599. Shell would submit a different pipeline application at a later date to address the installation of pipelines. The Phase II development of the Great White Field locations away from the spar and the more remote Tobago and Silvertip Fields would be addressed through revisions or supplements to existing EP's and to this DOCD at a later date. It should be noted that some of these operations would be taking place concurrently with the work proposed in this initial DOCD.

Flowlines and umbilicals would be installed by a dynamically positioned (DP) pipelaying barge. A remotely operated vehicle (ROV) may connect the flowlines to the subsea components by attaching a cable to the pipe end. Since there would be no anchoring, the disturbance would be limited to the immediate vicinity where the flowlines and umbilicals are laid.

1.3.3. Support Facilities

Shell has chosen onshore support bases located in Galveston, Texas, and Port Fourchon, Louisiana, to serve as the ports of debarkation for the Perdido project. The existing onshore support base for air transportation would be PHI Heliport in Galveston, Texas located at 2215 Terminal Drive. The existing onshore base for installation water traffic would be the Fourchon Terminal located on Bayou LaFourche, south of Leesville, Louisiana, approximately 3 mi (5 km) from the GOM. Marine support for the drilling operation would be from Halliburton located at 1800 Seawolf Parkway in Galveston, Texas, or Martin Midstream at Pelican Island in Galveston, Texas.

1.3.4. Transportation Operations

Personal vehicles are expected to be the main means of transportation for personnel to drive from their residences to Galveston, Texas. Work crews will assemble at the onshore base and then be transported by helicopters offshore to their designated locations. Helicopters are also expected to periodically transport critical supplies and equipment to the offshore facilities. The most practical and direct air route from the shore base permitted by the weather and traffic conditions will be used. Supply boats will leave their Port Fourchon support base to transport large or bulk supplies to their designated offshore location. Each boat will use the most practical and direct route to and from the project area, considering both weather and vessel traffic conditions. Table 1-3 summarizes the support-vessel travel frequency and aircraft information for various phases of the proposed operations.

Table 1-5

Support Vessel and Aircraft Information

Type	Maximum Number (In Area at Any Time)	Trip Frequency or Duration
MODU Batch Set Wells and Caissons (Noble Clyde Boudreaux)		
Mobile Offshore Drilling Unit	1	232 days
Crew Boats	2	Twice per week
Offshore Support Vessels	3	227 days
Tug Boats	2	227 days
Anchor Handling Vessel	3	11 days
Helicopter	1	Once per day
Install Mooring Piles, Export Pipelines and Risers, Hull, Manifolds, Topsides, Rig, Quarters, Flare, and Jumpers		
Installation Vessel (Solitaire—Pipeline to 25 miles)	1	18 days
Installation Vessel (Balder—Hull & Moorings)	1	69 days
Installation Vessel (ThialfTopsides equipment)	1	19 days
Crewboats	2	Twice per week
Installation Support Vessels	2	106 days
Tug Boats	3	60 days
Facility Commissioning Support Vessel	1	150 days
Subsea Commissioning Support Vessel	1	30 days
Commissioning Supply Vessel	2	Twice per week
Helicopter	1	Once per day
Flowline Jumper Installation Vessel	1	72 days
Drilling and Operations (H&P 205)		
Drilling Supply Vessel	1	2 per week
Drilling Support Helicopter	1	12 per week
Operations Supply Vessel	2	2 per week
Operations Support Helicopter	1	2 per week

1.3.5. New or Unusual Technology

Shell proposes to use several new and unusual technologies in association with the Perdido project.

Subsea Boosting System

The subsea boosting system consists of a caisson separation assembly, which receives multiphase production from the subsea manifolds, and a TTR, through which production is transferred to the topsides facility. The caisson separation assembly is designed to provide two-phase separation and allow the gas to travel up the annulus of the TTR without utilizing pressure from the reservoir as the lift mechanism. Using natural gravity/density separation, the liquid preferentially flows to the bottom of the assembly and is routed through electronic submersible pumps (ESP) that provide the energy to transport the liquid to the topsides facilities.

The MMS has conducted a thorough review of the proposed technology. The use of electronic submersible pumps has been used internationally and in the Pacific OCS Region. This is an extension of known technology to the GOM. The use of a caisson separation assembly has also been used internationally; however, not in U.S. OCS waters. This assembly's proposed implementation does constitute a new use of technology for the Gulf. Gravimetric separation of a well stream has long been used on the OCS with the pressure vessels located above the water line on a production facility. Shell's proposal basically uses the same technology, but locates the separation vessel on the seafloor as a caisson assembly. The MMS believes that this portion of the proposed subsea boosting system does not pose a signficicant risk to the environment when compaired to existing separation technologies routinely used in deepwater processing applications. No further environmental evaluation is needed for these technologies.

Top Tensioned Production Riser

The subsea separator caisson assembly (SSCA) is physically connected to the host via a top tensioned TTR. The separated production exits the SSCA and flows up through the TTR in two separate paths. Liquids flow upward from the ESP through the completion production tubing that connects the ESP to the well bay within the host. Gas flows upward in the annulus between the completion tubing and the outer riser tubular of the TTR.

The TTR's outer tubular will have a 14-in nominal diameter and will be the primary structural member from the seabed to the host. At the lower end, the TTR will be attached to the SSCA at its uppermost end via an 18 ¾-in H4 wellhead connection profile and seal. The TTR will be tensioned utilizing hydraulic tensioners from the spar host. The upper end of the TTR will pass upward to a deck within the well bay where it will terminate at a "surface flow control assembly."

The MMS has evaluated the proposed technology. The proposed flow regime is different from the usual technology with the produced gas flowing up the annular of the TTR. Gas lift systems use a similar technology where gas is pressurized and sent down the annular to gas lift valves that allow gas to enter the liquid flow in the production tubing, thus "lightening" the liquid stream in the tubing. Production pressures are likely to be higher than those used in gas lifting scenarios. The MMS's engineering evaluation of the project during the deepwater operations plan (DWOP) process will address containment of the produced fluids. The MMS believes that the proposed technology does not pose any more risks to the environment than existing deepwater production technologies. No further environmental evaluation is needed for this technology.

Surface Flow Control Assembly

The separated production flow is managed at the host well bay through a series of valves referred to as a surface flow control assembly (SFCA). This assembly is similar to a boarding valve in operation in that it provides on/off actuation of the production flow through utilization of both hydraulic actuated and manual gate valves. The SFCA also serves as the key interface element for feeding through all control, electrical power, and chemical lines from an atmospheric condition to a hydrocarbon-bearing, well pressurized environment.

The SFCA outlets direct the separated liquid and gas flow streams to their respective topsides separators via flexible jumper hoses located in the host well bay.

After thorough review of this technology, MMS has determined that the SFCA is a new technology that is being implemented in the GOM. The MMS believes that this new technology does not represent any more risks to the environment than the currently used technology on existing deepwater facilities. No further environmental evaluation is needed for this technology.

Outflow Assembly

Various mechanical and electrical elements reside inside the TTR to form the SBS outflow assembly. The main function of the outflow assembly is to act as an upward-directing conduit for the separated production liquids exiting the ESP and as a downward-directing conduit for transferring electrical power, instrumentation, chemicals, and a circulation line down to the subsea separator caisson assembly. This circulation line, referred to as a "downcomer," facilitates SBS startup and shutdown operations and allows circulation of makeup fluids to the ESP.

The MMS has evaluated the proposed technology. The "downcomer" in this proposed assembly serves a similar purpose to that of an umbilical to a subsea well—basically providing operational control and support to the subsea equipment. This is a proven technology with the uniqueness of the proposal being the location of the control elements within the TTR. Production aspects (upward-directing flow in the assembly) were discussed in the TTR section above and are apropos here. The MMS has determined that the outflow assembly does not interface with the environment any differently than the existing deepwater control and production flow systems. No further environmental evaluation is needed for this technology.

Hull Storage

Dead oil will be stored within the spar hull. The storage tanks will be located on the highest hull deck for maximum collision protection, as well as to facilitate personnel accessibility and eliminate piping penetrations through void or ballast compartments. The hull compartments will follow rigorous electrical area classification requirements, and all appropriate tanks will be provided with gas detection. A nitrogen inertion system will be provided for the dead oil and methanol tanks.

The MMS has evaluated this proposal. Appendix A, Accidental Oil Spill Review, examines the potential spill aspects from the project. Shell's proposal to store dead oil within the spar hull results in the accumulation of more oil than is usually contained within a production facility in the deepwater areas of the Gulf. Shell has taken the precautions to design the storage to minimize contitions that might result in a spill. The effectiveness of Shell's contingency plans and its implementation of its response is the real key to protecting the environment. The MMS has determined that Shell has an adequate spill and response plan for the project. No further environmental analyses are needed for this proposal.

Well Systems

The subsea configuration consists of a slender wellhead, tubing head spool (THS), and vertical subsea production tree. The proposed spar is a permanently moored production facility, and the well system builds on previous experience on similar dry tree tension leg platforms (TLP) and spars in the GOM. An extension from previous practice is that wells directly below the host platform will be drilled and completed using a dedicated drilling and completion riser (DCR) as described below. As with previous GOM TLP's and spar's, secondary well control will be provided by the blowout preventer (BOP) stack at the surface.

Following drilling, the well will be secured and the DCR removed. The THS will be installed on the wellhead and the DCR installed on top of the THS. The well will be completed and the tubing hanger landed in the THS. A conventional, hydraulically-controlled tubing hanger running tool will be used. During deployment, the tubing hanger running tool will be controlled by hydraulic control lines strapped to the work string and designed to withstand full DCR working pressure. A spanner joint will allow closing of the BOP stack at the surface while testing the tubing hanger or for well control. Following completion, the DCR will be removed and the subsea tree installed.

The MMS has reviewed Shell's proposed extension of existing technology for its well systems. The MMS has determined that the proposed activities would not interact with the environment any differently than the existing technology used in similar deepwater operations in the GOM. No further environmental analyses are needed for this proposal.

Export Pipeline Depth and Proposed Diverless Hot Tap Connection

The Perdido project is located approximately 65 mi (105 km) from the nearest existing deepwater pipeline system and 140 mi (225 km) from the nearest facility with the structural capacity to accommodate the project's gas and oil pipelines. Shell has not finalized its export strategy; however, one alternative being considered is a subsea tie-in to an existing deepwater pipeline system. The tie-in methodology is based on existing diver-installed, hot tap technology and deepwater repair technology. There are two alternatives currently being considered:

- Tie-in spool technology and
- ROV installed hot tap

Since Shell has not finalized its export pipeline strategy for the Perdido spar, MMS will not evaluate the proposed technology described above in this EA. The MMS will address the use of new and unusual technology when the proposed export pipeline application(s) is/are received by MMS. A NEPA evaluation will be conducted on the proposed export pipeline application(s). If new and unusual technololgies are proposed, the appropriate environmental analyses will be conducted with the processing of the pipeline application.

1.3.6. Impacts from Potential Geological Hazards

A geophysical survey was conducted over much of the development area in March and April of 2004, including collection of subottom profiler, sidescan sonar, and multibeam bathymetry data by an autonomous underwater vehicle (AUV) (GEMS, 2005). Additional studies include an ROV video survey and collection of long-barreled piston cores and seafloor box cores. Key seafloor hazards that may affect proposed activities include steep slopes, fluid expulsion features, and production-induced subsidence. Topography in Alaminos Canyon Block 857 is highly variable, with areas that are steep and rugged and other areas that are relatively flat. The proposed PRH center is located on a gently dipping plateau where the seafloor dips approximately 3 degrees to the north, and there is no steep gradient within a distance of 700 ft (213 m). Oil seeps have been identified in the northern half of the block and would be more than 1,500 ft (457 m) from the PRH and would have no effect on the proposed project. Subsidence-related seafloor faulting is possible in the development area. Both reactivation of existing faults and the formation of new faults can result from subsidence-induced change of stress. However, the general consensus based on geomechanical modeling studies is that measurable displacements at the seafloor are unlikely (GEMS, 2005).

1.4. 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 standards required within a National Pollution Discharge Elimination System (NPDES) permit. All of the waste types generated from the proposed development and production activities for Perdido will be either (1) discharged overboard in compliance with 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 1-4 and 1-5, respectively.

Wastes generated during the Phase 1 development of the Perdido project consist of (1) deck drainage; (2) sanitary and domestic wastes; (3) uncontaminated seawater used for cooling, desalinization, and ballast; (4) chemically treated seawater or freshwater; and (5) solid trash and debris. Shell also indicated in the DOCD that first production is expected around November 2009 from Well E and would continue to drill and complete Wells A—D and well F—S up to September 2014. During this period, additional wastes that would be generated are (1) produced water, (2) produced sand, and (3) well treatment, completion, and workover fluids.

Produced water from well testing, if any, and produced water from the approximately 20-year production period would constitute the largest single discharge from this proposed development. Produced water (also known as production water or produced brine) is the total water evolved as a byproduct of oil and gas extraction. It is made up of formation water, injection water, and small quantities of various chemicals entrained with hydrocarbon. 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. Injection water is used to enhance oil production or if secondary oil recovery takes place.

Produced water can have high total solids in suspension (TSS), salinities, levels of organic carbon, and metal content, and the produced water can be very low in dissolved oxygen. Because these waters are closely intermingled with petroleum, they contain variable concentrations of dissolved and dispersed petroleum hydrocarbons and need to be separated from hydrocarbon on the production platform. High concentrations of other soluble organic compounds have been found in production streams, particularly phenols and carboxylic organic acids (Neff, 1997). High levels of toxic metals such as vanadium, copper, and arsenic 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 Gulf of Mexico produced waters.

Table 1-6

Projected Ocean Discharges from the Perdido Project

Type of Waste	Total Amount Discharged	Discharge Rate	Discharge Method
Water-based mud	20,000 bbl/well	1,000 bbl/well[1]	Overboard and seafloor discharge prior to marine rised installation
Washed drill cuttings from synthetic-based hole interval	45,000 bbl	40 bbl/day	Shunt through a downpipe to 515 ft below the water's surface
Synthetic-based drilling fluid adhering to washed cuttings	13,500 bbl/well	15 bbl/day	Shunt through a downpipe to 515 ft below the water's surface
Drill cuttings from water-based drilling interval	1771 bbl/well	50 bbl/hr	Sea bed through riserless drilling and cutting chute to 40 ft below the water's surface
Chemical product waste	50 bbl	2 bbl/day	Treated to meet NPDES limits and discharged overboard
Produced water	3,650,000 bbl	5,000 bbl/day	Treated to meet NPDES limits and discharged overboard
Excess cement	2,250 bbl	50 bbl/well	Discharged at the seafloor during riserless drilling operations
Cooling water	144,857 bbl	8,047 bbl/well	Shunt through a downpipe to 515 ft below the water's surface
Sanitary waste	12,000 bbl	20 gal/person/day	Treated in a marine sanitation device prior to discharge (will meet NPDES permit limits)
Domestic waste	18,000 bbl	30 gal/person/day	Grinded to less than 25 mm mesh size and discharge overboard
Desalination unit brine water	126,000 bbl	400 bbl/day	Shunt through a downpipe to 515 ft below the water's surface
Deck drainage	31,500 bbl	100 bbl/day (dependent on rainfall	Shunt through downpipe to 40 ft below the water's surface
Ballast water	438,000 bbl	60 bbl/day	Shunt through a downpipe to 515 ft below the water's surface
Firewater bypass	3,360,000 bbl	14,000 bbl/month	Shunt through a downpipe to 515 ft below the water's surface

[1] Discharge of water-based fluid left in casing during batch setting operations.

Table 1-7

Wastes for Transport to Shore on the Proposed Perdido Project

Type of Waste—Approximate Composition	Amount	Name/Location of Disposal Facility	Treatment and/or Storage, Transport, and Disposal Method
Synthetic drilling mud	1,200 bbl/well	Newpark Environmental Services Inc., Ingleside, TX	Transport to shore base for pickup and recycling
Produced Sand	200 bbl/yr	Newpark Environmental Services Inc., Ingleside, TX	Transport to shore base for pickup and dispoal
Nonhazardous trash and debris—Nonrecyclable	118 bbl/well	Newpark Environmental Services Inc., Ingleside or Bridge City, TX	Transport to shore base for pickup and Land farming
Nonhazardous trash and debris—recyclable	60 bbl/month	ARC, New Iberia, LA	Transport to shore base for pickup and recycling
Paint, solvents, unused chemicals, etc.	20 bbl/yr	Safety Kleen System Inc., Denton, TX	Transport to shore base for pickup and disposed as a hazardous waste
Used oil and Glycol	250 bbl/yr	U.S. Filter, New Orleans, LA	Transport to shore base for pickup and recycling
Batteries, lamps, glass, mercury	20 bbl/yr	Lamp Environmental Industries, Inc., Hammond, LA	Transport to shore base for pickup and recycling
Oil filters, rags, pads, empty drums, cooking oil	60 bbl/yr	Omega Waste Management Inc., Patterson, LA	Transport to shore base for pickup and recycling

Produced water is disposed of by either overboard discharge or reinjection into geologic formations near the drilling site. Shell's DOCD 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).

Produced sand is sand in the oil that is entrained in the hydrocarbon flow from the produced formations. Produced sand would be transported to shore to a regulated facility for disposal and is not expected to exceed 200 bbl per year.

Well treatment, completion, and workover fluids would be collected in a separator. Aqueous fluids would be routed to the water treatment system for discharge. Nonaqueous fluids would be collected in drums or the slop tank of a supply vessel to be transported to shore for disposal.

Routine sanitary and domestic wastes necessarily arise from people working offshore on drilling rigs, production platforms, and support vessels. Shell estimated that 20 gal/person/day of sanitary waste and 30 gal/person/day of domestic waste would be discharged from the host facility. Estimates of the amounts of sanitary and domestic wastes discharged from associated service-vessel operations were not provided by Shell 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. A maximum for deck drainage during daily operation is estimated by MMS to be 3,000 bbl per month.

1.5. POTENTIAL IMPACT PRODUCING FACTORS

Physical Disturbances to the Seafloor

Physical disturbance of the seafloor will occur during installation, operation, and decommissioning. Seafloor impacts will result from (1) spar installation; (2) installation of subsea production equipment including well trees, manifolds, flowline sleds, etc.; (3) installation of flowlines and umbilicals; and (4) installation of export pipelines. The spar will be moored to the seafloor by a 3 x 3 clustered configuration of nine mooring legs. The top of each mooring leg will be a length of chain connected to the platform. This will be connected to polyester rope, which will span the majority of the water depth to a point above the mudline. Ground chain will connect from the bottom of the polyester rope to the foundation pile, which will consist of either a single steel suction pile or suction deployment anchor for each mooring line. Either anchor handling vessels or a single crane vessel may install the suction piles. Emplacement (and eventual removal during decommissioning) of each anchor is assumed to disturb an area of about 1 ha (2.47 ac), for a total of 9 ha (22.24 ac).

Subsea production equipment is assumed to include 2 manifolds, 19 well trees, and approximately 30 other structures, including flowline sleds and umbilical termination units. The installation and eventual decommissioning of all subsea production equipment will directly disturb the seafloor. The total footprint from all of these structures is estimated to be approximately 0.25 ha (0.62 ac).

The flowlines, umbilicals, and two export pipelines will be installed by a DP pipelaying barge. The total area disturbed during flowline installation for development is therefore about 8 ha (19.77 ac). Umbilical installation is assumed not to result in any additional seafloor disturbance since they will be installed in the same corridors as the flowlines. Because a DP laybarge will be used for the export piplines, there will be no anchoring along the pipeline route. Since the water depth is greater than 61 m (200 ft) for the entire route, burial is not required. Therefore, the area affected by pipelaying is limited to the seafloor immediately beneath the pipe.

Effluent Discharges

Effluent discharges will include discharges from vessels involved in facility installation, discharges during drilling and completion operations, and discharges from support vessels. Estimated waste discharges are quantified in Chapter 1.4 of this EA.

Air Pollutant Emissions

Air pollution emissions occur primarily during installation and operation due to combustion of diesel fuel and natural gas by generators, vessel engines, and equipment. Flaring is another source of air pollution emissions. Air emissions from the proposed activity are addressed in Appendix A.

Presence of Structures

The presence of offshore structures, including noise and lights, can have impacts on marine life including fishes, marine mammals, turtles, and birds. It is well known that offshore structures serve as artificial reefs (Reggio, 1989; LGL Ecological Research Associates, Inc. and Science Applications International Corp., 1998). In addition, offshore drilling and production activities produce a broad array of sounds at frequencies and intensities that may be detected by marine mammals and sea turtles. Brightly lit offshore platforms may attract sea turtle hatchlings, which could be subject to increased predation by birds and fishes that are also attracted to offshore structures.

Vessel and Helicopter Traffic

Vessels will travel back and forth between the Host and the shore base at Galveston, Texas and Port Fourchon, Louisiana. Helicopters will travel back and forth from the PHI Heliport in Galveston, Texas. The boats will normally move to the project area via the most direct route. The helicopter will be used for transporting personnel and small supplies and will normally take the most direct route of travel between the shore base and the project area when air traffic and weather conditions permit. Vessel and helicopter traffic may startle or disturb birds, marine mammals and turtles. There is also a small risk of a supply or crewboat striking a whale or turtle.

Trash and Debris

Potential trash and debris sources include the host facility, construction vessels, and transportation vessels. Ingestion of, or entanglement with, accidentally discarded debris can kill or injure marine mammals, turtles, and birds.

Accidents (oil spills)

Potential spill sources include a blowout, rupture or leak from a fuel tank on the spar or completion rig; a flowline or pipeline leak; or a fuel spill from service vessels. A spill is unlikely and, historically, most spills from offshore operations have been small. The MMS (USDOI, MMS, 2002a) used an average spill size of 6 bbl for small (<1,000 bbl) offshore spills.

The worst-case discharge (WCD) is a crude oil spill of 37,000 barrels per day (BOPD) resulting from a well blowout. Blowouts are rare and usually do not result in a spill. The MMS estimated that one to two blowouts could occur in water depths greater than 2,400 m (7,874 ft) in the WPA between 2003 and 2042 (USDOI, MMS, 2002A). Since 1998, four blowouts in the GOM have resulted in oil spills, with the amount of oil spilled ranging from <1 bbl to 200 bbl (USDOI, MMS, 2003a). There have been no spills ≥ 1,000 bbl from blowouts in the last 30 years (USDOI, MMS, 2003a).

Other potential spill sources during the life of this development project (20 years) would include a spill of liquid oil stored on the platform (approximately 4,100 bbl total storage capacity including flow lines on the platform), a spill of liquid oil stored on the rig (approximately 30,562 total storage capacity), a spill of liquid oil stored on the associated vessels (capacity of the largest vessel is 78,000 bbl), or a spill from the associated oil flowlines or the export pipelines (total worst case for all pipelines is estimated to be approximately 8,302 bbl) (Appendix A).

1.6. 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 WPA/CPA Final Multisale EIS (USDOI, MMS, 2007; Chapter 1.3, Regulatory Framework) and is incorporated into this PEA by reference.

2. ALTERNATIVES CONSIDERED

2.1. NONAPPROVAL OF THE PROPOSAL

Shell would not be allowed to install the PRH facility, install subsea equipment located near the facility, and the batch setting of 19 DVA subsea wells to develop the Great White field as proposed in its Initial DOCD. This alternative would result in no impact from the proposed action but could preclude the development of much needed hydrocarbon resources from a known discovery; thereby resulting in a loss of royalty income for the United States and energy for America. 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 WITH EXISTING 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. Since additional mitigations were identified to avoid or mitigate potential impacts with the proposed action, this alternative was not selected.

2.3. APPROVAL 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. Approval of the proposal with existing and additional mitigation is the selected alternative. The following additional mitigations have been identified.

2.3.1. MITIGATIONS

2.3.1.1. Mitigation 8.03 (Advisory)—H_2S Absent

> The area in which the proposed drilling operations are to be conducted is hereby classified as "H_2S absent," in accordance with 30 CFR 250.417(c). The location and depths of the planned wells are not expected to encounter an H_2S hazard. An H_2S Contingency Plan is not required to be submitted and approved by the MMS prior to Shell conducting the proposed activities. (8.03)

2.3.1.2. Mitigation 19.03 (Advisory)—ROV Survey Not Required

> In accordance with NTL 2001-G04, the MMS has determined that Shell will not need to conduct the two ROV surveys you proposed in your plan. (19.03)

3. DESCRIPTION OF THE AFFECTED RESOURCES

INTRODUCTION

Chapter 3 describes the physical, biological, socioeconomic, and human resources in and adjacent to Grid 5 that could be potentially affected by development and production activities for the proposed Perdido project. The descriptions present environmental resources as they are now, thus providing baseline information for the further analyses in Chapter 3 where potential impacts from the Perdido project in Alaminos Canyon Block 857 are examined. Discussions in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007) are summarized or incorporated into this PEA by reference where appropriate.

3.1. PHYSICAL RESOURCES

Descriptions of the following components of the physical environment are contained in Appendix A of the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007): (1) geologic and geographic setting; (2) physical oceanography; (3) meteorological conditions; and (4) existing OCS-related infrastructure. These discussions are incorporated into this PEA by reference.

Physical environments in the Central Gulf are characterized in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007; Chapter 3.1) and are incorporated into this PEA by reference. Summaries of these resources follow and include water quality and air quality.

3.1.1. Water Quality

3.1.1.1. Coastal Waters

3.1.1.1.1. Description

Coastal water quality along Texas and Louisiana is relevant to development and production activities in Grid 5 and the Perdido project. The most likely service bases for development of Grid 5 are located on the coast at Galveston, Texas, and Port Fouchon, Louisiana. Marine transportation to and from Grid 5 would traverse coastal waters to reach these bases, and accidental oil spills could make landfall along this coastline.

The bays, estuaries, and nearshore coastal waters of the north-central Gulf are important 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 water quality degradation than adult stages.

Gulf Coast water quality was given a fair rating in the National Coastal Condition Report II (USEPA, 2004a). Five factors—dissolved oxygen, dissolved inorganic nitrogen, dissolved inorganic phosphorus, chlorophyll *a,* and water clarity—were used to rate water quality. Dissolved oxygen is essential for aquatic life, and low levels can result in mortality to benthic organisms and other organisms that cannot escape. The nutrients, nitrogen and phosphorous, are necessary in small amounts but can stimulate excessive phytoplankton growth. Chlorophyll *a* is a measurement of phytoplankton productivity and is one of several symptoms of eutrophic conditions. Water with greater clarity can support more submerged aquatic vegetation, which stabilizes the shoreline from erosion, reduces the impact of nonpoint-source pollution, and provides habitat for many species.

Estuaries with a poor water quality rating comprised 9 percent of the Gulf Coast estuaries, while those ranked fair to poor comprised 55 percent. In Texas and Louisiana, estuaries that received a poor water quality rating in the report had low water clarity and high dissolved inorganic phosphorus in comparison with levels expected for the region. Dissolved oxygen levels in Gulf Coast estuaries are good and less than 1 percent of bottom waters exhibit hypoxia (dissolved oxygen (O_2) below 2 milligrams (mg) per liter (L)).

Sediments can serve as a sink for contaminants that were originally transported via water in either dissolved or particulate form or via atmospheric deposition. Sediments may contain pesticides, metals, and organic contaminants. The sediments of Gulf Coast estuaries were ranked as fair. Metals were the type of sediment contamination found to most frequently exceed toxicity guidance.

In the overall assessment of the Gulf coastal condition, which includes indicators in addition to water quality, the coastal habitat index, the rating of wetlands habitat loss, was rated as poor. Wetlands can trap particulate material and nutrients transported by rainfall runoff and contribute to improved water quality.

The priority water quality issues identified by the GOM Alliance are bacterial-related beach and shellfish bed closures, estuarine hypoxia, harmful algal blooms, and seafood, particularly mercury, contamination. Several of these issues are linked to economic consequences for the the Gulf States as well. Nutrient loading was also identified as a regional action item (Gulf of Mexico Alliance, 2005). The hypoxic zone is discussed in the following Chapter 3.1.1.2 below. The Alliance was organized in 2005 as a collaborative means to solve regional problems to implement the U.S. Ocean Action Plan.

Harmful algal blooms form intermittently in some areas of Gulf waters. Red tide occurs naturally and has reached bloom concentrations in the waters off Texas. A toxin is produced which in sufficient concentrations can result in fish kills and marine mammal deaths. When the bloom is transported towards the coast, beach and oyster bed closures may occur.

Population growth in coastal areas can result in a decline in water quality. Urban runoff is the leading source of contaminants that impair coastal water quality. Since 1960, the population of the coastal counties of the Gulf Coast States has increased by more than 100 percent. The coastal counties of Texas have experienced a 52 percent population increase from 1980 to 2003 (Crossett et al., 2004). Population growth results in additional clearing of the land, excavation, construction, expansion of paved surface areas, and drainage controls (U.S. Commission on Ocean Policy, 2004a and b). These activities alter the quantity, quality, and timing of freshwater runoff. Storm-water runoff, which flows across impervious surfaces such as parking lots, is more likely to be warmer and to transport contaminants associated with urbanization. These include suspended solids, heavy metals and pesticides, oil and grease, and nutrients.

Other pollutant source categories 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 and Texas. 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 (about 3.7 million bbl/yr) (NRC, 2003; Table I-9) into the waters of the Gulf.

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 the release of contaminants.

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 ppt during fall and winter but decline to 20 ppt during spring and summer due to increased runoff (USDOI, MMS, 2000a; page III-9). Oxygen and nutrient concentrations also vary seasonally.

3.1.1.1.2. Impacts Analysis

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 industrial, agricultural, or municipal and point or nonpoint sources.

A discussion of impacts to coastal and offshore water quality from OCS activity is provided in Chapters 4.1.3.4, 4.2.1.1.2, and 4.2.2.1.2 of the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007) and is hereby incorporated into this PEA by reference.

The impact-producing factors associated with development and production of the Perdido project in Alaminos Canyon 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) accidental spills of crude oil, diesel fuel, chemicals associated with production, or other materials from vessels in coastal waters; and (4) spills from pipelines transporting product. Water-based drilling mud discharges, water-based and synthetic-based cuttings discharges, and produced-water discharges are impact-producing factors that originate and are discharged at the PRH over 100 mi (160 km) away from the coast. The discharges are regulated by USEPA and will not impact coastal waters.

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

Service vessels that use navigation channels, turning basins, shallow harbors, and docking facilities could cause increases in water turbidity from mud that is resuspended by propeller wash. Dredging and spoil dumping carried out to maintain, deepen, or straighten navigation channels could also increase the turbidity of coastal waters. Actions specifically attributed to vessels supporting the Perdido project would have an insignificant impact.

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

The pipelines that transport OCS production into State waters are protected by burial when water depth is less than 200 ft (61m). Pipeline damage may still occur, but very infrequently, as the result of accidents or extreme weather, for example mudslides.

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 Perdido project is located approximately 142 mi (229 km) from the nearest Texas coastline and 200 mi (322 km) south of Freeport. The distance of this project and the Grid 5 infrastructure from coastal waters introduces lengthy spill travel times and tremendous dilution factors for any accidental spills of crude oil, diesel fuel, or other materials. Spills that affect coastal waters would tend to originate from pipelines leaks or severance or from vessels in transit to or from the coastal area. Spills that may occur in Alaminos Canyon Block 857 present an extremely small likelihood of affecting coastal water resources. Spills of crude oil and diesel fuel can occur in offshore waters from pipeline ruptures, vessel and transfer accidents, and in well blowouts. If a large spill (≥1,000 bbl) were to occur at the surface or originate from a well blowout, the oil would form a 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. Tarballs may form as the lighter components of spill oil evaporate and leave behind the heavier fraction of the oil, which forms sticky balls at sea. The presence of tarballs on beaches is a nuisance and visually unattractive. Oil can also be trapped in the marsh grass of coastal wetlands where it would affect the local water quality while degrading. Spills associated with the Perdido project would be few (if any), volumetrically small, and take place near or in Alaminos Canyon.

Some wastes not permitted for offshore disposal are brought ashore for disposal or recycling and can present spill hazards if not handled properly. Disposal of synthetic-based fluids (SBF) from development drilling in Grid 5 are governed by the USEPA Region 6 general NPDES permit, which does not allow the fluid fraction to be discharged overboard on the OCS. Exploration and production waste (E&P waste) include oil-based drilling fluids and cuttings, liquid wastes ("fracing" fluids, i.e., fluids forced into formations to fracture, dissolve cement, or prop open pore throats, emulsifiers, workover fluids, mud additives, etc.), and possibly well test solids and produced sand are also transported across coastal waters to shore. These wastes are taken to transfer stations and on to State-regulated disposal locations in Texas and Louisiana. 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 proposed Perdido project. Because the proposed action would use existing onshore support bases, only the discharges from these support bases or service vessels would result in effects to coastal waters. The contribution by the proposed action to the level of these effects is expected to be very minor, transient, and not contribute significantly to the decline in coastal water quality. Spilled oil originating in coastal waters and attributable to the Perdido project would not be ≥1,000 bbl and is expected to be substantially recovered while still at sea.

3.1.1.1.3. Cumulative Analysis

Introduction

Cumulative impacts on water quality include sources of pollutants that affect both coastal and offshore settings. Human sources in coastal waters include effluents, wastes, or surface runoff from varied urban, rural, and industrial sources. These sources include the following: (1) petrochemical industry (inclusive of OCS development and processing); (2) agriculture and animal processing; (3) agricultural and urban runoff; (4) municipal and recreational sewerage treatment; (5) marinas; (6) commercial fishing; (7) maritime shipping and cruise ships; (8) hydromodification activities; (9) wood processing, pulp, and paper mills; (10) recreational boating and fishing; (11) manufacturing activities; (12) accidental spills of oil, diesel fuel, or other material; and (13) atmospheric deposition of airborne contaminants onto the sea. Contaminants entering coastal waters can also be transported to offshore marine waters.

Human sources in offshore waters include effluents and discharges from fixed (MODU's and production platforms) and mobile sources (vessels of all types). Anchored MODU's and fixed platforms are fixed but temporary. They operate for periods ranging from months to decades. Each fixed or mobile source has routine and permitted effluents and discharges. Fixed platforms and MODU's discharge (1) water-based mud (WBM) and cuttings; (2) cuttings wetted with synthetic-based mud (SBM); (3) small quantities of wellbore cement and treatment, completion, and workover (TCW) chemicals; (4) domestic and sanitary discharges; (5) produced water; (6) bilge, ballast, cooling, and desalinization unit water; and (7) deck wash.

Vessels such as OCS service boats and crewboats, freighters, tankers, barges, fishing boats, and cruise ships discharge (1) bilge, ballast, and cooling water; (2) domestic and sanitary discharges; and (3) deck wash. Both fixed and mobile sources can accidentally spill oil, diesel fuel, or other material, and trash and debris can be lost overboard despite handling requirements.

Worldwide, natural seeps from geologic formations release 4,200,000 bbl (1.8 x 10^8 gal) of oil into the oceans each year (NRC, 2003; page 2). Natural hydrocarbon seeps are the most significant source of oil entering Gulf waters. Recent studies have suggested that seepage rates in the GOM are much higher than earlier estimates (NRC, 2003; page 191). Mitchell (2000) estimated that 500,000 bbl/yr of oil seeped into northern GOM waters (U.S. territorial waters); a figure NRC doubled to estimate seepage rates for the entire GOM. In the same range, if apportioned to the GOM, would be a recent estimate by MMS (USDOI, MMS, 2003b), which concluded that 1,700 bbl/day are released into all U.S. territorial waters each day by natural seeps (620,000 bbl/yr). The NRC (2003; page 191) estimated that an average of 980,000 bbl of oil enters the entire GOM each year from natural seeps (with a range of 560,000 to 1,400,000 bbl). This average amount is four times the volume of the 1989 *Exxon Valdez* spill (USDOC, NOAA, 1992) every year.

Table 3-1 reports the annual contribution of oil in marine waters of North America (U.S. and Canada) from various human activities and natural sources. The NRC (2003; Table 3-2) provided a best estimate that 1,820,000 bbl of petroleum enters North American marine waters (U.S. and Canada) each year. The majority of this amount is from natural seeps; approximately 1,120,000 bbl or 62 percent. Table 3-2 shows that the largest fraction of oil entering the water from all sources relates to the consumption of petroleum (33%) and that only 5 percent is related to the production or transportation of oil (including refining). Subtracting out the amount contributed by natural seeps, nearly 85 percent of the 627,700 bbl of oil entering North American marine waters each year from human activities comes from the following sources, in relative order: (1) land-based runoff and polluted rivers; (2) recreational boats and jet skis, particularly those with 2-cycle engines; (3) atmospheric deposition; and (4) jettisoned aircraft fuel (NRC, 2003; Table 3-2). Approximately 9 percent of the total attributable to human activity comes from transportation, pipeline, or refining activity (NRC, 2003; page 3), and 3 percent comes from oil and gas exploration and production (NRC, 2003; page 2).

No irreversible or irretrievable impacts to the marine environment on a broad oceanic scale are caused by either natural seeps or accidental spills (NRC, 2003). Natural seeps have released oil into the GOM and the oceans of the world in all types of coastal and marine environments for millennia. Natural marine systems can accommodate rather substantial quantities of oil in the sea, apparently without much noticeable impact.

The Gulf Coast has been, and will continue to be, heavily used for industrial, commercial, and recreational enterprises. The Mississippi River will continue to be the major source of contamination of the Gulf. Over time, continuing coastal water quality contamination will degrade offshore water quality. If the capacity of coastal waters to assimilate contaminants is exceeded, there will be a subsequent, gradual movement of the area of degraded waters farther offshore over time. This degradation could cause short-term loss of the designated uses of large areas of shallow offshore waters due to the contamination itself or the effects of contamination such as lingering hypoxia or episodes of harmful algal blooms. The signs of environmental stress are already evident, among them high nutrient loads, low-dissolved oxygen, toxic contamination, high bacteria counts that close shellfish grounds, and wetland loss. Degradation of coastal water quality is expected to continue because no cessation or reduction in any of the sources that contribute to degradation is likely to occur in the near future. Efforts to improve water quality progress slowly because of a complex regional regulatory structure with State and Federal responsibilities, land-use issues, and the costs associated with implementing additional controls.

Table 3-1

Average Annual Releases of Oil in North American Marine Waters (1990-1999) in Barrels

Source	Best Estimate	Minimum	Maximum	Percent of Best Estimate
Natural Seeps	1,120,000	560,000	1,680,000	62.0
Platforms	1,120	1,050	1,260	0.06
Atmospheric Deposition	840	490	3,150	+
Produced Water	18,900	1,470	2,590	1.0
Total Extraction Activity	21,000	16,100	30,100	1.5
Pipeline Spills	13,300	11,900	14,700	0.7
Tank Vessel Spills	37,100	28,000	44,800	2.0
Coastal Facility Spills	13,300	11,900	15,400	0.7
Atmospheric Deposition	70	*	140	+
Total Transportation Activity	63,700	51,800	77,000	3.5
Land-Based (river, runoff)	378,000	18,200	13,300,000	20.7
Recreational Vessels	39,200	15,400	63,000	2.1
Commercial Vessel Spills	8,400	7,700	9,800	0.4
Operational Discharges	154	420	4,200	+
Atmospheric Deposition	147,000	63,700	567,000	8.0
Aircraft Dumping	10,500	7,000	30,800	0.5
Total Consumption Activity	588,000	133,000	14,000,000	33.0
Total All Activity Sources	1,820,000	770,000	16,100,000	100.0**

Notes: * denotes <70 bbl.
** does not add to 100 due to independent rounding.
+ <0.001%.

Source: NRC (2003; Table 3-2—converted to bbl from metric tons (1 metric ton = 7 bbl)).

3.1.1.2. Offshore Waters

3.1.1.2.1. Description

The water offshore of the Texas and Louisiana coasts can be divided into two regions: the continental shelf and the slope west of the Mississippi River (<305 m or 1,000 ft) and deep water (>305 m). The continental shelf off the modern Mississippi River Delta is narrow because of the outbuilding of sediment from the river onto the shelf. To the west the shelf broadens and is about 100 mi (161 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 encompassing 55 percent of the continental U.S. (Murray, 1998). Lower salinities are characteristic nearshore where freshwater from the rivers mix 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 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 seasonal stratified water column. The less dense and low-salinity water from the Mississippi River "floats" on top of denser, more saline water and creates a stratified water column. High nutrient loads in the river water enhance algae production and increase 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 bottom fauna. Hypoxic conditions last until local wind-driven circulation mixes the water column. The zone increased from an average of 8,300 km^2 (3,205 mi^2) in 1985-1992 to over 16,000 km^2 (6,178 mi^2) in 1993-2001 (Rabalais et al., 2002).

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. Phosphorus is believed to play a larger role than originally suspected and, in the 2005 reassessment, the Hypoxia Task Force suggested the occurrence of phosphorous may contribute to the hypoxic conditions in the GOM (USEPA, 2005).

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 zone of suspended clay-sized particles that may play a role in transporting fine-grained sediment and contaminants from nearshore 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, 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 300 m (984 ft). 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). Seeps are visible around the PRH in satellite images. Between three and six slicks are present at any time (Shell, 2006). 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 (MacDonald, 1998) to a range of between 280,000 and 700,000 bbl/yr (Mitchell et al., 1999). The NRC's own best estimate is an annual input of 980,000 bbl/yr for the entire Gulf (NRC, 2003; page 191), which is four times the volume of the *Exxon Valdez* spill per year (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. These fluids have been identified to have three origins: (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 is either injected back into the reservoir or discharged overboard according to NPDES permit limits (see chapter 1.4, Offshore Discharges and Waste Disposal). 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).

Grid 5 is entirely in deep water, for which limited information is available on water quality. Generally, the water quality in deep water could be considered significantly better than that of the coastal waters (USDOI, MMS, 2002A). Water at depths >1,400 m (4,593 ft) is relatively homogeneous with respect to temperature, salinity, and oxygen (Nowlin, 1972; Pequegnat, 1983; Gallaway et al., 1988). Offshore Texas, Louisiana, and Alabama show detectable levels of petroleum hydrocarbons, likely from natural seeps (USDOI, MMS, 1997 and 2000b). 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, do not appear to contain elevated levels of metal contaminants (USDOI, MMS, 1997 and 2000b). Reported total hydrocarbons, including biogenic (e.g., from plankton and other biological sources) hydrocarbons, 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.

The MMS studied the effect of exploration and development at four drilling sites located in water depths greater than 1000 m (3,280 ft) (CSA, 2006). The sampling design called for before and after exploratory or development drilling and captured the drilling-related changes that occur in sediments and sediment pore water. The Garden Banks Block 516 site most closely resembles the proposed Perdido project. Samples were collected from near and farfield locations in the interval between exploratory drilling and development drilling and again after the five development wells were drilled. At Garden Banks Block 516 prior to developmental drilling, the average sediment barium concentration was 2.5 percent in nearfield samples. After drilling the mean sediment barium concentration rose to 5.9 percent in nearfield samples. Farfield barium concentrations before and after drilling were 0.13 to 0.15 percent. The concentrations of other metals in sediments also increased. Cuttings wetted with SBF were discharged and the effects were detected in the decrease in sediment dissolved oxygen after development drilling and the visible microbial mat growth on these cuttings.

3.1.1.2.2. Impact Analysis

The impact-producing factors associated with proposed development and production of the Perdido project in Alaminos Canyon Blocks 812, 813, 814, and 857 that could affect offshore water quality include (1) degradation of GOM offshore waters from coastal activity, runoff, and riverine inputs; (2) activities that contact or disturb the sea bottom and increase turbidity; (3) discharges during the drilling and completion of wells; (4) discharges during production, such as produced water, from offshore OCS oil and gas production; (5) disturbances during decommissions; and (6) accidental spills of crude oil, diesel fuel, chemicals or other materials from vessels in offshore waters.

Operations

Water depths in Grid 5 range from 2,350 to 2,750 m (7,710 to 9,022 ft). These deep marine waters and environments would be most directly affected by the proposed Perdido project Phase 1 installation activities. The spar would be moored to the seafloor by nine mooring legs. Subsea production equiptment including manifolds, well tree, flowline sleds, and umbilical termination assemblies would be placed and flowlines and export pipelines would be installed. Topsides equipment would be installed. The host would be built so that future developments in the region can tie in. The impacts to water quality from future tie-in's will be assessed in future documents.

Localized sediment disturbance and increased turbidity near the sea bottom would occur from installation of the suction piles or suction deployment anchors. Emplacement of the nine anchors is assumed to disturb an area of about 45 ac (18 ha). The installation of subsea production equipment would disturb less than 1 ac (0.5 ha). The export pipeline would occupy about 270 ac (108 ha) over its 210 mi (337 km) length. The total area of sea bottom that could be disturbed by the installation as well as the turbidity resulting from the disturbance is about 620 ac (250 ha). These activities would occur intermittently over a 15-month period. These disturbances would not adversely affect offshore water quality because the area of potential disturbance is small and the effects would be most intense during the first year of the project. Elevated turbidity would be a short-term, localized, and reversible condition once the disturbance ceases.

A range of effluents and wastes would be discharged overboard from the proposed Perdido project. Overboard discharges and wastes intended from the project are shown in the wastes and discharge tables (Tables 3-2 and Table 3-3, respectively). The types and discharge rates will be in accordance with USEPA NPDES General Permit GMG 290000 for USEPA Region 6, or an individual NPDES permit if one is secured by Shell and its partners. The USEPA permit GMG 290000 will expire in November 2007 and is expected to be reissued at that time. Wastes destined for onshore disposal or recycling pose no potential impacts to affected resources unless spilled.

A total of 19 wells—15 producers, 3 water injection wells, and 1 spare well—would be drilled. Synthetic-based drilling fluid (SBF) would be used but would be recovered and recycled. The DOCD estimates the discharge of 20,000 bbl of water-based drilling mud containing barite per well, 1,800 bbl water-based fluid (WBF) cuttings per well and 45,000 bbl SBF-wetted cuttings. The amounts of waste to be generated in the future would be dependent upon the rate at which new wells are phased in.

Sanitary and domestic waste would be produced on the MODU as well as the vessels used to install the hull and moorings, the topsides, and the export pipelines. The total volumes of treated sanitary and domestic wastes are estimated to be 34,000 bbl and 49,000 bbl, respectively. These discharges are treated to meet USEPA discharge requirements. Discharge would occur daily. Water would be impacted by the introduction of suspended solids and biochemical oxygen demand (BOD) matter.

Because the PRH would process oil and gas produced from other facilities, it can be assumed that, in the future, larger volumes of produced water from multiple fields would be treated and discharged from the PRH. Three injection wells are planned and would be available to also accept produced water or other waste that does not meet discharge requirements.

Table 3-2

Estimates of Total Overboard Discharges and Wastes
for the Proposed Perdido Project

Waste Type	Volume
Water-Based Mud 1	20,000 bbl
Synthetic-Based Mud Cuttings	45,000 bbl
Water-Based Mud Cuttings	33,600 bbl
Synthetic-Based Mud Adhered to Cuttings	13,500 bbl
Excess Cement	2,250 bbl
Produced Water	3,650,000 bbl
Well Treatment, Completion, Blowout Preventer And Workover Fluids	3000 bbl
MODU Domestic Water	18,000 bbl
MODU Sanitary Water	12,000 bbl
Deck Drainage	31,500 bbl
Ballast Water	438,000 bbl
Firewater Bypass	3,360,000 bbl
Crewboat and Support Vessel Domestic Water	4,500 bbl
Crew Boat and Support Vessel Sanitary Water	3,000 bbl
Installation Vessels' Domestic Water (Solitaire, Thialf, Balder)	16,500 bbl
Installation Vessels' Sanitary Water (Solitaire, Thialf, Balder)	11,000 bbl

[1] approximately 1,000 bbl/well.

Table 3-3

Estimates of Total Wastes Brought to Shore
for the Proposed Perdido Project

Waste Type	Volume
Spent Synthetic-based Drilling fluid	152,000 bbl total
Produced Sand	200 bbl/year
Used Oil	250 bbl/year
Chemical Products	100 bbl/year
Produced Sand	No discharge
Solid Wastes (both recyclable and nonrecyclable taken onshore)	178 bbl/month

Decommissioning effects would be similar in scope and magnitude with offshore construction and installation operations, unless the subsea production infrastructure is left in place, in which case the impacts on the sea bottom would be reduced or eliminated. All discharges would be expected to adhere to NPDES discharge criteria designed to mitigate adverse environmental effects.

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, 2000b and 2003c). A spill of SBF could accumulate on the seafloor and result in smothering of benthic organisms and anoxic surface sediments as microbial degradation occurs.

No blowouts are projected as a result of drilling, well completions, workovers, or hydrocarbon production associated with the Perdido project based on historical trends in the GOM (Appendix A). Spills that occur from development and production activity for the Perdido project would be few (if any).

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 due to 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 Perdido 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 host facility and from the host facility 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 Perdido 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.

3.1.1.2.3. Cumulative Analysis

The sources identified in Chapter 3.1.1 (Water Quality) contribute to cumulative water quality degradation in offshore waters. Spills of oil, diesel fuel, and other materials may occur from vessels transporting crude oil and petroleum products; from vessels involved in commercial fishing, freight or passenger transport; and from OCS operations. Well blowouts can disturb the bottom, increase turbidity, and put oil into the sea. Should one of these blowouts occur, localized, short-term changes in water quality would be expected. Cumulative impacts would be negligible.

Bottom area disturbances resulting from non-OCS sources are not expected in Grid 5 water depths. Bottom disturbances from anchoring the Nobel MODU and production structures like the PRH would produce short-lived effects on water quality on small footprints of about 5 ac (2 ha) per anchor. Cumulative impacts are negligible.

Daily operational discharges to offshore waters occur from vessels moving through Gulf waters and from MODU's and production facilities (Chapters 3.1.1.1.2 and 3.1.1.2.2). The discharge of drilling fluid, cuttings, and produced water are the main effluents from oil and gas exploration, development, and production operations. Although not an issue for the Perdido project in Grid 5, other production projects in Grid 5 that follow may include the drilling of development wells. The discharges from OCS production facilities have been examined in several studies (Avanti Corporation, 1993; CSA, 1997a and b; Kennicutt, 1995; Neff, 1997). These studies concluded that contaminants in produced water, drilling fluid, and cutting discharges should be undetectable in the water column beyond 1,000 m (3,281 ft) from the discharge point. The contaminant deposition and accumulation rate on the sea bottom from discharges is primarily dependent on the water depth and current strength. Sediment contaminants from OCS discharges may occur from several hundred to several thousand meters from the discharge point depending on volumes discharged. Biological responses to contaminant levels retained in bottom sediments are not expected to be detectable beyond a couple hundred meters, and toxic effects to the benthos would be localized, limited to within a hundred meters of the discharge, and of a relatively small magnitude. Toxic effects beyond 100 m (328 ft) should be controlled through the USEPA's NPDES permit requirements.

Well blowouts can resuspend fine-grained sediment in the water to increase turbidity. The rapid accumulation of sediment (or cuttings if well drilling is part of the development project) on the sea bottom that are thicker than 30 cm (1 ft) would be lethal for all sessile and most motile invertebrates (Frey, 1975; Basan et al., 1978; Ekdale et al., 1984). An accumulation rate of this type would not be expected in most deepwater development projects, and most soft-bottom, motile invertebrates would have a chance to react and move. Diluted and discharged slowly over large areas, these wastes contribute in a very small way to the degradation of offshore water quality. As a result, cumulative impacts are negligible.

3.1.2. Air Quality

3.1.2.1. Description

Grid 5 is located west of 87.5° W. longitude and hence falls under 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 Perdido project in Alaminos Canyon Block 857 is located approximately 200 mi (322 km) south of Galveston County, Texas, an area that is in attainment of the NAAQS for CO, NO_x, SO_x, and PM and that, for prevention of significant deterioration (PSD) purposes, is classified as a Class II area.

The influence to onshore air quality is dependent upon meteorological conditions and air pollution emitted from operational activities. The pertinent meteorological conditions regarding air quality are the wind speed and direction, the atmospheric stability, and the mixing height (which govern the dispersion and transport of emissions). The typical synoptic wind flow for the Grid 5 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 mid-latitude frontal systems. Because of the routine occurrence of these various conditions, the winds blow from all directions in the area of concern (Florida A&M University, 1988).

3.1.2.2. Impact Analysis

Air quality would be affected in the immediate vicinity of the development operations, service vessels, and aircraft. The cumulative impact from emissions for this DOCD will not exceed MMS's exemption levels. The drilling, facility installation, and production activities are not expected to significantly affect onshore air quality. The distance from Alaminos Canyon Block 857 to any PSD Class I air quality area such as the Breton National Wildlife Refuge (BNWR) is >200 km (124 mi). Galveston County, the location of the primary service, is not in attainment for ozone (USDOI, MMS, 2002A; Figure 3-1).

Air quality could be affected in the event of spilled oil. 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 nonattainment for ozone. However, due to the distance from shore, the project is not expected to have any impacts on onshore air quality including nonattainment areas. If a fire occurs, particulate and combustible emissions will be released in addition to the VOC's.

Conclusion

No significant long-term impacts on air quality would be expected from the proposed Perdido project. The air quality in the immediate vicinity of the proposed activities would be affected by the projected emissions. The distance between Grid 5 and the shoreline introduces tremendous dilution factors for point-source emissions in Alaminos Canyon Block 857. No special mitigation, monitoring, or reporting requirements apply to this project.

3.1.2.3. Cumulative Analysis

Cumulative impacts on air quality within the offshore area would come primarily from sources generated outside the Grid 5 area and include emissions from industrial plants, power generation, and urban transportation. The location of Grid 5 is far removed from coastal populations or industrial activity. The OCS activity that takes place in the Grid 5 would be widely spaced production platforms, all >100 mi from shore, and would not affect the overall quality of air over the Texas coast. Most of the Gulf's coastal areas are currently designated as "attainment" for all the NAAQS regulated pollutants (USEPA, 2003).

3.2.1. Sensitive Coastal Resources

Sensitive coastal environmental resources in the Central Gulf are characterized in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007; Chapter 3.2.1) and are incorporated into this PEA by reference. Summaries of these resources follow and include (1) barrier beaches and dunes and (2) wetlands.

The impact-producing factors associated with the proposed development and production of the Perdido project in Alaminos Canyon Blocks 812, 813, 814, and 857 that could affect barrier beaches and dunes, wetlands, and subtidal seagrass communities include (1) oil spills from blowouts or vessel collisions, (2) chemical and drilling fluid spills, and (3) oil-spill response and cleanup. Of these, oil spills represent a high consequence and low-probability accidental event. Chapters 4.2.1.1.3 and 4.2.2.1.3 (Impacts on Sensitive Coastal Environments) in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007; pages 4-83 through 4-88 and 4-151 through 4-157) contain a discussion of impacts from OCS activity on barrier beaches and dunes and wetlands and are incorporated into this PEA by reference.

No blowouts would be expected as a result of well completions, workovers, or hydrocarbon production associated with the proposed Perdido project, based on historical trends in the GOM (Table A-1). Spills that occur from development and production activity would be few (if any), volumetrically small, and be located near project activities in Alaminos Canyon Blocks 812, 813, 814, and 857.

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 Perdido 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 occurring in the deepwater environment of Grid 5 would not be large enough to enable them to persist long enough in the marine environment before weathering processes significantly degrade the spill before it makes landfall. 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 the spilled oil and 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 and wetlands) would not be expected to occur.

Oil-spill response activity is governed by area contingency plans (ACP) authorized by the Oil Pollution Act and coordinated by USCG. These plans specify response procedures, priorities, and appropriate countermeasures for local coastal resources. The cleanup of slicks that come to rest in wetland areas or protected waters (0-1.5 m [0-5 ft] 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 1 m (3 ft) 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 due to fluid withdrawal, dredging to maintain channels, flood control projects, and channelization can occur (USDOI, MMS, 2007; Chapter 4.5.3). Insofar as the oil and gas industry on the OCS is one of many industrialized uses of coastal waters, the incremental contribution of the proposed action to the cumulative impacts on sensitive coastal resources is expected to be very small.

3.2.1.1. Barrier Beaches and Dunes

3.2.1.1.1. Description

Barrier islands make up more than two-thirds of the northern GOM shore. Each of the barriers is either high profile or low profile depending on the elevations and morphology of the island (Morton et al., 2004**)**. The height and continuity of these elevations determine the ability of the barriers to withstand storm surge flooding and overwash. Coastal barriers of the Western GOM that may be in the area of potential effect are generally divided into two physiographic areas—Chenier Plain of eastern Texas and western Louisiana and the Texas barrier islands. Due to both the distance from the proposed offshore activity (approximately 350 mi or 563 km) and the prevailing easterly winds, the currently proposed offshore facility is expected to have little to no affect on the Louisiana barrier islands. Due to the low probability of impact, only a brief discussion of the Louisiana barrier islands will be noted here. Beaches and barrier islands in the Gulf have these features:

- a shoreface—underwater seaward slope from the low tide waterline;
- a foreshore—exposed, usually nonvegetated slope from the ocean to the beach berm crest; and
- a back shore—exposed, sparsely vegetated area between the beach berm-crest and dune area, occasionally absent due to storm activity.

The Louisiana barrier island beaches are in constant flux as a result of the sediment source, composition, and the wave and wind climate in the vicinity of the islands. The easternmost islands are trangressive (landward migrating island), have low profiles, and are characterized by (1) rapid erosion, (2) lower profiles and narrow widths; (3) sparse vegetation and discontinuous dunes; and (4) numerous, closely spaced, active wash-over channels. Due to this landward migration, the loss of fringe marshes and other nearshore wetlands continues to occur. Due to the loss of these wetland fringes, this portion of the Louisiana coast is left more vulnerable to hurricanes and further wetland loss, as well as terrestrial habitat loss. Those remaining Louisiana barrier islands located farther to the west are regressive in nature (island migration is more seaward) and the shorelines of these island formations are characterized by (1) wider and higher profiles, (2) well-vegetated dunes, and (3) few if any wash-over channels (USDOI, MMS, 2007). Both transgressive and regressive shorelines are important ecologically. Barrier islands, particularly vegetated ones with freshwater and or saltwater pools, may serve as habitat for a wide variety of animal life, especially birds. The islands and spits protect the bays, lagoons, estuaries, salt marshes, seagrass beds, and other wetland environments, some of which may contain threatened or endangered species. In general, most of the Louisiana barrier island chain is moving landward and, therefore, increasing the vulnerability of the Louisiana coastline to storm surge along with the associated wetlands loss.

The Gulf coastline of Texas is about 367 mi (590 km) long. The barrier islands of Texas are mostly accreted sediments that were reworked from river deposits, previously accreted Gulf shores, bay and lagoon sediments, and exposed seafloors (White et al., 1986). As defined above, the barrier islands of Texas have both transgressive and regressive processes involved in their formation.

Elevations of Galveston Island and Bolivar Peninsula beach ridges generally range from 1.5 to 3 m (5 to 10 ft) above sea level (Fisher et al., 1972). The beaches of Galveston Island and Bolivar Peninsula are locally eroding or accreting. Construction of seawalls and jetties on Galveston Island has contributed to this erosion.

Padre Island is moderately regressive; the shoreline is retreating and more land is being exposed. It is typically 1.5-3 m (5-10 ft) above sea level and occasionally overwashed by hurricane surges. Vegetation on Padre Island is generally sparse, becoming even less dense on its southern portion. The vegetation largely consists of grasses and scrubby, woody growth (Brown et al., 1977).

Wetlands and aquatic habitats on central Texas Gulf Coast barrier and delta complexes (Matagorda Island, Matagorda Peninsula, and Colorado River Delta) are dominated by estuarine emergent wetlands (salt and brackish marshes), which in 2001 encompassed 11,257 ha (27,817 ac) in the study area and represented 67 percent of the vegetated wetland and aquatic classes (marshes, mangroves, and seagrass beds). Among other mapped classes, seagrass beds are most abundant at 4,607 ha (11,384 ac), followed by tidal flats (2,289 ha or 5,656 ac), Gulf beaches (1,124 ha or 2,778 ac), palustrine marshes (857 ha 2,118 ac), and mangroves (112 ha or 278 ac). Historically, losses and gains in habitats have occurred throughout the study area, but the overall trend in vegetated wetlands is one of net gain, as revealed by slight increases in estuarine marshes of about 500 ha (1,236 ac) from the 1950's through 2001. However, the total area of tidal flats decreased by about 1,840 ha (4,547 ac) since the 1950's (White et al., 2003).

The southeast Texas coast bordering the Gulf of Mexico is a low-energy, low-tidal range region that is constantly changing as a result of active coastal processes that are directly linked to meteorological events. Wind-driven waves and tidal currents are the most important geological agents controlling sediment transport and evolution of the Gulf and bay shores. Wind directions and intensities vary seasonally with southeasterly and southwesterly winds prevailing most of the year.

Hurricane Katrina in August 2005 caused severe erosion and landloss for the coastal barrier islands of the deltaic plain. The eye of Hurricane Katrina passed directly over the 50-mi Chandeleur Island chain. Aerial surveys conducted by the U.S. Geological Survey on September 1, 2005 show that these islands were heavily damaged by the storm (USDOI, GS, 2005). Initial estimates suggest that Hurricane Katrina reduced the Chandeleur Islands by one-half of their pre-storm land area. Although barrier islands and shorelines have some capacity to regenerate over time, the process is very slow and often incomplete. With each passing storm, the size and resiliency of these areas can be diminished, especially when major storms occur within a short time period. Hurricane Katrina was the fifth hurricane to impact the Chandeleur Island chain in the past 8 years. The other storms were Hurricanes Georges (1998), Lili (2002), Ivan (2004), and Dennis (2005).

Grand Isle was also heavily damaged by Hurricane Katrina. Although Hurricane Katrina made landfall more than 50 mi (80 km) to its east, Grand Isle received extremely high winds and a 12- to 20-ft (4- to 6-m) storm surge that caused tremendous structural damage to most of the island's camps, homes, and business (Louisiana Sea Grant, 2005).

Boyd and Penland (1988) estimated that storms raise mean water levels 1.73-2.03 m (5.68-6.66 ft) above mean sea level 10-30 times per year. Under those conditions, the following would be overwashed: 67 percent of Timbalier Island; 100 percent of Isles Dernieres and the Barataria Bay Barriers (excluding Grand Isle); and 100, 89, and 64 percent of the southern, central, and northern portions of the Chandeleur Islands, respectively (USDOI, MMS, 2007).

Hurricane Rita in September 2005 severely impacted the shoreface and beach communities of Cameron Parish in southwest Louisiana. Some small towns in this area have no standing structures remaining. A storm surge approaching 6 m (20 ft) caused beach erosion and overwash that flattened coastal dunes, depositing sand and debris well into the backing marshes.

Barrier beaches and dune environments are further characterized in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007; Chapter 3.2.1.1).

3.2.1.1.2. Impact Analysis

The Isles Dernieres and Timbalier barrier islands lie a few miles off the Louisiana coast and inshore of Grid 5. 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 on the quantity and location of the spill. Based on the Oil Spill Risk analysis (OSRA) model for assessing oil spills (USDOI, MMS, 2007) the probability of an offshore oil spill reaching a Louisiana beach (within 10 days) from the WPA is 1 percent. In coastal Louisiana, the heights of dune lines range from 1.6 to 4 feet (0.5 to 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 oil 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 contacted 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 sands 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 geographic area known as the Texas Coastal Bend Beach Area (TCBA) is located 142 mi (228 km) from the proposed PRH and is the nearest shoreline in the vicinity of the proposed action. The TCBA is bordered by Mexico to the south and includes Padre Island and the Laguna Madre to the north. Based on the OSRA models, the probability of an offshore spill ≥1000 bbl) reaching TCBA would be 1 percent. The topography in the area of the TCBA has both low-and high-profile beach and shoreface formations. The southernmost reach of the TCBA adjacent to Mexico is the lower profile beachhead represented by South Padre Island. South Padre is characterized by short discontinuous dunes, unstable dry sand dunes, as well as coppice dunes and flats. The vegetation in these areas is sparse and becomes more sparse, scrubby, and woody near the southern portion of the island. While the probability is low for an oil spill reaching this geographic area, this portion of the TCBA would be at highest risk of having the spilled oil encroaching upon the vegetated areas of the back beach through overwash of the lower dune systems. However, it must be noted that, within the 10 days estimated for the oil to make landfall, it would have undergone significant biodegradation, bioxidation, weathering, and dilution due to various weathering factors and the viability of contaminants of concern should be minimal. The studies of vegetative recovery on oiled Texas beaches (Webb, 1988) have verified that substantial recovery of beach vegetation is possible after oil exposure.

The cleanup of oil spills that contact beaches is described in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007). 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 by 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.

Conclusion

There is a very low probability of a spill from the proposed Perdido development contacting barrier beaches; therefore, no significant, long-term impacts to the physical shape and structure of barrier beaches and dunes would be expected to occur from accidental spills of oil, diesel fuel, drilling fluids, or chemicals. Should a spill make landfall and a cleanup take place, impacts to barrier beaches and dunes would be minimal. Weathering conditions including, temperature, wind, and both physical and chemical sea conditions, mixing forces, and floating debris may all assist in eliminating or diluting the effect of the spill landfall. The high profile of the islands and the slope of the foreshore most likely to be affected would further reduce exposure of the vegetated wetlands protected by the dune system. Recovery periods longer than 2 years would be very unlikely.

3.2.1.1.3. Cumulative Analysis

No pipeline landfalls are predicted as a result of the proposed action; the only other remaining potential impacts to the barrier beaches would result from natural erosive processes, beach stabilization structures (jetties, etc.) possible oil spills, and a minimal increase in wave-induced erosion associated with a light increase in vessel traffic.

Based on the OSRA models (noted in the impacts analysis), there is low probability of an offshore spill reaching either the Louisiana or Texas Barrier beaches. The proposed action will be connected to an existing pipeline; therefore, no additional pipeline emplacement or dredging associated with pipeline emplacement will be needed. While unlikely, if an offshore spill reaches shore, impacts from both OCS and non-OCS sources to the sand-starved Louisiana coast should not result in long-term alteration of landform if the beaches are cleaned using techniques that do not significantly remove sand from the beach or dunes. Due to the higher profile barrier beaches along the western Texas coast, beach oiling would not be expected to be as extensive and rapid recovery is expected using the approved beach cleaning techniques. The proposed action is not expected to adversely alter barrier beach configurations significantly beyond existing, ongoing impacts in very localized areas downdrift of artificially jettied and maintained channels. A proposed action may extend the life and presence of facilities in eroding areas, which would accelerate erosion in those areas. Strategic placement of dredged material from channel maintenance, channel deepening, and related actions can mitigate adverse impacts upon those localized areas. Thus, the incremental contribution of the proposed action to the cumulative impacts on coastal barrier beaches and dunes is expected to be very small.

Aside from these factors coastal barrier beaches have experienced severe adverse cumulative impacts from natural processes (i.e., hurricanes, erosion and subsidence) and human activities. Natural processes are generally considered the major contributor to these impacts, whereas human activities cause both severe local impacts as well as the acceleration of natural processes that deteriorate coastal barriers. Human activities that have caused the greatest adverse impacts to the barrier beach and dune resources for the "area of influence" are pipeline installation, navigation channel stabilization and maintenance, and beach stabilization structures.

Barrier beaches along coastal Louisiana have experienced severe erosion and landward retreat (marine transgression) because of natural processes enhanced by human activities. Adverse effects on barrier beaches and dunes have resulted from changes to the natural dynamics of water and sediment flow along the coast trying to control catastrophic floods and change the natural environment to better accommodate navigation on waterways used to support OCS and non-OCS seaborne traffic. The western beaches of Texas also undergo degradation through recreational use due to the accessibility of the beaches by road. Federal, Louisiana, and parish governments have made efforts over the last 10 years to slow the landward retreat of Louisiana's Gulf shorelines. In addition, avoidance procedures for pipeline emplacement near barrier islands and beaches have been included in "conditioned permits" required by the Corps of Engineers. These procedures assure that pipeline activities near these sensitive beaches are placed under the islands and beaches using indirect drilling techniques, or the pipeline routing is planned to avoid these sensitive areas. As noted above, the current action proposes no new pipeline landfalls and therefore poses no impact to the barrier beach and dune systems from pipeline placement.

In summary, the natural processes such as storm driven erosion, subsidence, and loss of sediment supply through changes in hydrologic regime will continue to impact the barrier island resource. Barrier beaches and dunes exist on the deltaic plain and are subject to the equilibrium between sediment input, subsidence, and sea level. Without additional sediment the deltaic plain is not replenished and the land no longer aggrades. Inevitably, it begins to subside as sediments on the delta plain compact and dewater. Beach nourishment projects using OCS sand resources (e.g., Ship Shoal) would be expected to increase. Remediation projects for some of the most threatened coastal barrier systems, such as Isles Dernieres, can be expected. Beach nourishment projects will have the effect of slowing the loss or conversion of barrier beaches and dunes, but they will not arrest the natural subsidence of the deltaic plain. Other non-OCS activity that contributes to barrier beach and dune erosion, or conversion to another environment, includes the emplacement of levees and stabilization structures for channels and beaches, recreational vehicle use on dunes and beaches, recreational and commercial development, and removal of coastal vegetation. Deterioration of Gulf barrier beaches is expected to continue in the future.

3.2.1.2. Wetlands

3.2.1.2.1. Description

According to DOI (Dahl, 1990; Henfer et al., 1994), during the mid-1980's, 4.4 percent of Texas (3,083,860 ha; 7,620,218 ac) (Henfer et al., 1994), 28 percent of Louisiana (3,557,520 ha; 8,790,632 ac), 14 percent of Mississippi (17,678,730 ha; 43,684,142 ac), and 8 percent of Alabama (1,073,655 ha; 2,653,002 ac) 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 <1 m (3 ft) 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.

The effects of human and natural activities in the coastal area have severely degraded the deltaic processes and shifted the coastal area from a condition of net land building to one of net landloss (USCOE, 2004). In the aftermath of Hurricanes Katrina and Rita, scientists with State and Federal Government agencies, universities, and nongovernmental organizations have begun analyzing the losses to coastal wetlands and barrier islands of the Gulf Coast. Although Louisiana's coastal marshes and barrier islands provide a frontline of defense against storm surge, 90 percent of those wetlands are at or below sea-level elevation. Furthermore, Louisiana is historically prone to major storm events. According to the LSU Hurricane Center, the central Louisiana coast has experienced landfall of more major hurricanes (Category 3 and above) than anywhere in the continental U.S. over the past century.

In 2005, Hurricanes Katrina and Rita caused almost 30,562 ha (~119 mi^2) of land change (primarily wetlands to open water) in southeastern Louisiana. Hurricane Rita also transformed about 25,382 ha (98 mi^2) of land to open water in southwestern Louisiana (Barras, 2006). The permanency of this loss may not be known for several growing seasons, as some of the shallow areas may recover rapidly while others may remain open ponds. The Louisiana Coastal Area Ecosystem Restoration Study projected 173,529 ha (670 mi^2) of landloss for this area for the 50-year period ending in 2050. Thus, the 56,203 ha (217 mi^2) of potential landloss from the hurricanes represent 42 percent of the total 50-yr estimate.

In general, brackish and saline marshes appeared to have fared better than fresh and intermediate marshes. The greatest impacts were observed in the fresh and intermediate marshes of the Louisiana coast where 71 percent of the water area increases occurred. The brackish and saline zones accounted for 20 percent of the water gains.

Wetland ecology and inventory studies are characterized in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007; Chapter 3.2.1.2, Wetlands).

3.2.1.2.2. Impact Analysis

Forested wetlands (bottomland and swamp), bay and canal-fringing wetlands, and marshes occur along the southern Louisiana coastline. No pipeline to the shore is proposed in the project. Spill volumes of crude oil, diesel fuel, or drilling fluids that might occur from the proposed development and production 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 development and production 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 much greater potential for adversely impacting wetlands than an offshore deepwater spill simply due to proximity. 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.

Conclusion

There is a very low probability of a spill from the proposed Perdido development contacting wetland environments. Should a spill make landfall and a cleanup proceed with approved procedures, impacts to wetlands would be minimal. Recovery periods longer than 2 years would be very unlikely. Therefore, no significant, long-term impacts to the structure or vitality of wetlands would be expected to occur from accidental spills of oil, diesel fuel, drilling fluids, or chemicals.

3.2.1.2.3. Cumulative Analysis

Cumulative impacts on wetlands include the sources identified in Chapter 4.4.3 (Sensitive Coastal Environments). Because 90 percent of coastal Louisiana is <1 m above sea level, subsidence and transgression of the sea can cause significant wetland loss or conversion into different environments. Estimates for wetland loss or conversion vary but most reported rates are close to 25 mi^2 per year. A recent estimate predicted that about 640,000 ac (1,000 m^2) of existing wetlands will be submerged in less than 50 years (LCWCRTF, 1993).

Wetland loss on the deltaic plain of coastal Louisiana is primarily due to subsidence, erosion, and reduced sediment input from the Mississippi River. Like barrier beaches and dunes, wetlands exist on the deltaic plain are subject to the equilibrium between the addition of sediment to the delta and shoreline and subsidence that has been disturbed by changes to the river from widespread navigation and flood control projects. The OCS activity of pipeline emplacement, navigation channel deepening or maintenance, and construction of expanded onshore support facilities around Port Fourchon can lead to future wetland loss or conversion. The conversion of wetlands to agricultural, residential, and commercial uses has also been a major cause of wetland loss and will likely continue to be, but at a slower rate as people are prompted to move inland after major storms. Wetland loss is projected to continue around the Gulf, the question being whether the rate stabilizes or increases.

3.2.2. Sensitive Offshore Resources

Sensitive offshore environments in the Central Gulf are characterized in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007; Chapters 3.2.2, 3.2.3, 3.2.4, 3.2.6, 3.2.7, and 3.2.8) and are incorporated into this PEA by reference. Summaries of these resources follow and include (1) deepwater benthic communities, (2) chemosynthetic communities, (3) marine mammals, (4) sea turtles, (5) coastal and marine birds, (6) Gulf sturgeon, and (7) essential fish habitat and fish resources.

The impact-producing factors associated with the proposed Perdido project in Alaminos Canyon Blocks 812, 813, 814, and 857 that could affect deepwater benthic communities, chemosynthetic communities, marine mammals, sea turtles, coastal and marine birds, gulf sturgeon, and essential fish habitat and fish resources include (1) physical contact with anchors, mooring lines, and other engineered structures; (2) noise in the air and sea; (3) collisions with vessels; (4) lights in the remote offshore environment; (4) spilled oil and response activities; (5) effluent discharges; and (6) solid trash and debris. A discussion of the impacts from OCS activity on deepwater benthic communities, chemosynthetic communities, marine mammals, sea turtles, coastal and marine birds, gulf sturgeon, and essential fish habitat and fish resources can be found in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007; Chapters 4.2.1.1.4 through 4.2.1.1.8, 4.2.2.1.4 through 4.2.2.1.6, 4.2.2.1.8 through 4.2.2.1.10 and 4.4.10) and is incorporated into this PEA by reference.

Of these potential impact-producing factors, oil spills represent a high consequence and low-probability accidental event. No blowouts are projected as a result of development drilling, well completions, workovers, or hydrocarbon production associated with the Perdido project based on historical trends in the GOM (Appendix A, Table A-1). Spills that occur from development and production activity for the Perdido project would be few (if any), volumetrically small, and be located near project activities in Alaminos Canyon Block 857.

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 Perdido 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 occurring in the deepwater environment of Grid 5 would not be large enough to enable them to persist long enough in the marine environment before weathering processes significantly degrade the spill before it makes 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 and approximately 30 percent is assumed to be chemically dispersed, further reducing the overall probability and severity of spills that may move inshore. Because the landfall of spilled oil, diesel fuel, drilling fluids, or chemicals is highly unlikely, the potential impacts from spill landfall, i.e., response and cleanup activities on barrier beaches and dunes and wetlands, are not expected to be incurred.

Cumulative impacts on sensitive offshore resources include those that affect animals living in and on the sea bottom and in the water column, as well as those animals that require nearshore or coastal resources for part of their lifecycle. The cumulative impacts on these resources are discussed below.

3.2.2.1. Deepwater Benthic Communities

3.2.2.1.1. Description

"Deep water" is a term of convenience referring to vast areas of the Gulf with water depths ≥400 m (1,312 ft) that are typically covered by pelagic clay and silt. The Grid 5 area encompasses a range of habitats in water depths between 2,000 and 3,400 m (6,562 and 11,155 ft) deep. As in all areas of the Gulf, a wide variety of organisms ranging from single-celled bacteria to invertebrates and fish inhabit this depth range. 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 animals, a remarkable assemblage of invertebrates 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. This unique group is discussed in Chapter 3.2.2.6.

The continental slope in the GOM extends from the edge of the continental shelf about 200 m (656 ft) to a water depth of approximately 3,000 m (9,840 ft) (USDOI, MMS, 2007; pages A-3 through A-8). Grid 5 lies in the middle part of the continental slope, which corresponds to the upper part of the abyssal depth zone as characterized by Pequegnat (1983) and Gallaway et al. (1988).

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 to 12,468 ft)—Large asteroid, *Dynaster insignis*, is the most common megafaunal species.

3.2.2.1.1.1. 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) 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 (Gallaway et al., 2003). 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 towards the depths in the range of Grid 5. Adults from the families Ophidiidae, Alepocephalidae, and Ipnopidae numerically dominate the lower slope and continental rise from 2,000 to 3,000 m (6,650 to 9,840 ft) (Rowe and Kennicutt, 2002).

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 Perdido project, at a depth of approximately 2,382 m (7,815 ft), lies within this broad transition zone.

3.2.2.1.1.2. Macrofauna

The benthic macrofaunal component of the NGMCS Study (Gallaway et al., 2003) included sampling in areas at similar depths east of the Perdido project. One station, W5, was located to the east of Grid 5 at a similar depth of 2,300 m (7,544 ft). The NGMCS Study as a whole 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, and others. 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., 1988, 2003). Recently, a deep Gulf of Mexico benthos (DGoMB) program has expanded on the depth and geographic coverage of the previous MMS-sponsored continental slope studies (Rowe and Kennicutt, 2002). This study included stations at depths from 300 m (984 ft) to over 3,000 m (9,840 ft). The nearest station in this study, RW6, was located in Alaminos Canyon and is about 50 km (31 mi) east of the project area in a water depth of 3,000 m (9,840 ft). Data from this more recent study shows macrofaunal densities at this water depth at a density ranging from 1,000 to 3,000 individuals/m^2, slightly higher than those reported in Gallaway et al. (1988, 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).

3.2.2.1.1.3. Meiofauna

Meiofauna primarily composed of small nematode worms, as with megafauna and macrofauna, also decline 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).

3.2.2.1.1.4. Microbiota

Less is known about the microbiota in the GOM than the other size groups, especially in deep water (USDOI, MMS, 2000a; page IV-15; CSA, 2000). While direct counts 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.

3.2.2.1.2. Impact Analysis

3.2.2.1.2.1. Deepwater Benthic Communities

The potential impacts to deepwater benthic communities expected to inhabit Grid 5, excluding chemosynthetic communities (discussed in 3.2.2.6), are discussed in this section.

The impact-producing factors associated with development and production of the Perdido project in Alaminos Canyon Block 857 that could affect deepwater benthic communities include (1) drilling discharges including primarily cuttings with adhering drilling muds, (2) seafloor disturbances from anchoring and emplacement of facilities, and (3) blowouts during well drilling or production. The deepwater ecosystem in Grid 5 can be characterized as vast expanses of soft-bottom faunas, with a potential for isolated and small patches of expulsion zones associated with seepage from subsurface. Hydrocarbon seepage can create habitat suitable for chemosynthetic communities as well as authigenic carbonate hard bottoms that can become exposed above the seabed. The topography of Alaminos Canyon Block 857 area is highly variable with areas that are steep and rugged, and others areas that are relatively flat. Within the grid as a whole, some isolated patches of hard bottom likely exist with associated organisms favoring hardgrounds such as ahermatypic corals.

The most important impact-producing factors on deepwater benthic communities are physical disturbances of the seafloor caused by (1) deposition of drilling cuttings and associated drilling fluids; (2) anchoring of the drilling rig or production spar platform; (3) installation or maintenance of subsea infrastructure such as pumps, flowlines, and umbilicals on the sea bottom; and (4) resuspension of sediment during a blowout from drilling or workovers of production wells. The maximum bottom area disturbed in any way is estimated to be no larger than 250 ac (102 ha). Anchors and mooring lines from the completion/installation rig or the spar can cause disturbances with lethal affects in small footprints on the seafloor of a few acres. Among these disturbances would be (1) crushing of benthic faunas by anchors or mooring lines; (2) burial or disruption of fauna from scraping, plowing, or redistribution of bottom sediment by mooring lines that pivot on their anchors; and (3) increased turbidity from sediment that is resuspended as a result of anchor emplacement or mooring line motion that fouls or interferes with filter-feeding organs.

The drilling rig will have a total of 16 anchors and the production spar will use a total of 9 mooring legs. The areal extent and severity of the impact caused by anchors and anchoring are related to the size and configuration of the anchor and mooring system, the length of chain resting on the bottom, and the swing arc that a chain could have as a result of currents or winds. An estimated sea-bottom disturbance footprint for each anchor and the swing arc of its mooring line is approximately 5 ac (2 ha) for a total of 80 ac (32 ha) for 16 anchors. An additional area of sea bottom will be disturbed by the installation of subsea production facilities, such as manifolds, blowout preventers, umbilicals, and flowlines. In addition, five SBS's that would be tied back to the host would be installed on the seafloor. In total, the potential sea-bottom area that can be disturbed as a result of the Perdido project is a very small portion of this vast deepwater environment and all impacts will occur on soft-bottom habitat only. The anchoring configuration of a spar is closer to the central axis of the facility (i.e., mooring lines are drawn up closer to vertical and underneath the platform) than other semisubmersible anchoring configurations.

A blowout at the seafloor could create a crater on the sea bottom and resuspend and disperse large quantities of bottom sediments within a 300-m radius of the blowout site, burying both infaunal (live in the sediment) and epifaunal (live on 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. Rapid burial by accumulations of sediment >30 cm (1 ft) 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; Ekdale 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.

Routine surface discharges of drilling cuttings have been documented to reach the seafloor in water depths greater than 400 m (1,310 ft); however, significant accumulation thickness will be limited to a relatively close distance from the surface discharge point. A recent study looked at both exploratory and production facility drilling discharges in water depths of 1,000 m (3,280 ft) ad reported detectable accumulations at distances as far as 1 km (0.6 mi) (CSA, 2006). Geophysically mapped thicknesses of cuttings accumulations at one site showed a rapid decrease of thickness with increasing distance from the well site (CSA, 2006). Accumulation thickness was less than 7.6 cm (3 in) within 240 m (787 ft). The total amount of area significantly impacted by discharge accumulation could be expected to be somewhat larger at the PRH due to the longer descent time of muds and cuttings; however, the increased dispersion distance will also result in thinner accumulations.

Conclusion

The proposed Perdido project is expected to have minimal impacts on the ecological function, biological productivity, or distribution of soft-bottom communities. Bottom disturbances from (1) discharge of drilling cuttings and associated drilling muds, (2) anchoring of the drilling rig and the spar platform, and (3) installation or maintenance of subsea infrastructure such as flowlines, separator and boosting systems, and umbilicals on the sea bottom, are unlikely to be of a sufficient size or duration to adversely affect these benthic community types to any significant or permanent degree. Crushing or burial of individual organisms could take place within small areas of a few acres. Minor and temporary impacts, such as interference with filter-feeding structures, could occur over larger areas inside an envelope estimated to be no more than about 250 ac (102 ha) based on the total number and installation of anchors for the proposed project. Routine discharges from the PRH are not expected to adversely impact these community types because of the water depths in Alaminos Canyon Block 857. Bottom disturbance from a blowout during completion or workover of the production wells is not likely based on the historical record of blowout events in the Gulf.

Recruitment of new organisms would take place from nearby areas, and organisms from undisturbed areas are free to migrate into disrupted areas after the disturbance ceases or structures are removed.

3.2.2.1.3. Cumulative Analysis

3.2.2.1.3.1. Deepwater Benthic Communities

Cumulative impacts on deepwater benthic communities include crushing and physical disturbance of the sea bottom from drilling discharges and emplacement of other drilling rigs, production platforms, and subsea production infrastructure. The water depth in the Grid 5 area ranges from 2,000 to 3,400 m (6,562 to 11,155 ft). These depths are too deep for anchoring by service vessels, which will use a mooring buoy system. There are no non-OCS activities that could cause sea-bottom disturbances, for example, commercial bottom trawling. The cumulative impacts on nonchemosynthetic benthic communities are expected to cause little damage to the ecological function or biological productivity of the expected typical communities existing on sand/silt/clay bottoms of the deep Grid 5 area of the GOM. Large motile animals would tend to move, and recolonization from populations from neighboring substrates would be expected in any areas impacted by burial.

3.2.2.2. Marine Mammals

3.2.2.2.1. Description

Twenty-eight cetaceans (whales and dolphins) and one sirenian (manatee) species have confirmed occurrences in the northern GOM (Table 3-4) (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 (Table 3-4). 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 manatee has been reported in Louisiana coastal waters, but the coastal waters of Peninsular Florida and the Florida Panhandle are the manatee's normal habitat.

Information on each marine mammal species listed in Table 3-4 can be found in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007; Chapter 3.2.3) and is incorporated into this PEA by reference. The MMS has been conducting scientific research of marine mammals in the GOM since 1991, including GulfCet I and II and the Sperm Whale Acoustic Monitoring Program (SWAMP). The most recent study, Sperm Whale Seismic Study (SWSS), completed four years of field work in 2005. This multi-faceted program involved numerous partners and researchers. Yearly reports have been published annually and a synthesis report of the SWSS study will be published in 2007. These studies have shown that the GOM has a diverse and abundant marine mammal community including a genetically-distinct resident population of the endangered sperm whale.

The distribution and abundance of cetaceans within the northern GOM is strongly influenced by various mesoscale oceanographic circulation patterns. These patterns are primarily driven by river discharge (primarily the Mississippi and Atchafalaya Rivers), wind stress, and the Loop Current and its derived circulation phenomena. Circulation on the continental shelf is largely wind-driven, with localized effects from freshwater (i.e., river) discharge. Beyond the shelf, mesoscale circulation is largely driven by the Loop Current in the eastern Gulf. Approximately once or twice a year, the Loop Current sheds anticyclonic eddies (also called warm-core rings). Anticyclones are long-lived, dynamic features that generally migrate westward and transport large quantities of high-salinity, nutrient-poor water across the near-surface waters of the northern Gulf. These anticyclones, in turn, spawn cyclonic eddies (also called cold-core rings) during interaction with one another and upon contact with topographic features of the continental slope and shelf edge. These cyclones contain and maintain high concentrations of nutrients and stimulate localized production (Davis et al., 2000). In the north-central GOM, the relatively narrow continental shelf south of the Mississippi River Delta may be an additional factor affecting cetacean distribution (Davis et al., 2000). Outflow from the mouth of the Mississippi River transports large volumes of low salinity, nutrient-rich water southward across the continental shelf and over the slope. River outflow also may be entrained within the confluence of a cyclone-anticyclone eddy pair and transported beyond the continental slope. In either case, this input of nutrient-rich water leads to a localized deepwater environment with enhanced productivity and may explain the persistent presence of aggregations of sperm whales within 50 km (31 mi) of the Mississippi River Delta in the vicinity of Mississippi Canyon.

Table 3-4

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 attenuata	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 or threatened.

3.2.2.2.2. Impact Analysis

The impact-producing factors associated with development and production of the Perdido project in Alaminos Canyon that could affect marine mammals include (1) noise from vessel traffic, air traffic, and development and production activities, (2) degradation of water quality from oil spills or other material spills, (3) collision potential with service vessels, (4) spill-response activities, and (5) trash and debris from structures and service vessels. These impact-producing factors are the same for nonthreatened and nonendangered marine mammal species as well as those listed under the Endangered Species Act (ESA). Chapters 4.2.1.1.5 and 4.2.2.1.5 (Impacts on Marine Mammals) in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007) contain a discussion of impacts from OCS activity and are incorporated into this PEA by reference.

Operations

The noise and the shadow from helicopter overflights, take-offs, and landings can cause a startle response and can interrupt whales and dolphins while resting, feeding, breeding, or migrating (Richardson et al., 1995). Frequent overflights could have long-term consequences if they repeatedly or consistently disrupt important life functions such as feeding and breeding. The FAA Advisory Circular 91-36C encourages pilots to maintain higher than minimum altitudes over noise-sensitive areas: a minimum altitude of 213 m (700 ft) while in transit offshore and 152 m (500 ft) while working between platforms. Guidelines and regulations put in place by NOAA Fisheries under the authority of the Marine Mammal Protection Act include provisions specifying that helicopter pilots maintain an altitude of 305 m (1,000 ft) within 91 m (300 ft) of marine mammals.

The proposed action is expected to have one helicopter roundtrip per day during installation and development and two roundtrips per week during drilling and operations. These occurrences would be temporary and pass within seconds. As more industry development projects occur in the area, helicopter activity is expected to increase. However, marine mammals are not expected to be adversely 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 and drill rig operations and vessel traffic). The effect of underwater noise on cetaceans is a controversial subject and numerous studies are investigating impacts. Noise from service-vessel traffic may elicit a startle and/or avoidance reaction from whales and dolphins or mask their sound reception. There is the possibility of short-term disruption of movement patterns and behavior, but such disruptions are unlikely to affect survival or productivity. Long-term displacement of animals from an area is a possibility, though not confirmed in any GOM studies. 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 may approach vessels that are in transit to bow-ride. The behavioral disruptions apparently caused by noise and the presence of service-vessel traffic are unlikely to affect long-term survival or productivity of whale populations in the northern GOM.

Well completion, workover activities, and operations would produce sounds transmitted to the water at intensities and frequencies that could be heard by whales and dolphins. Noise from structure installation 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. 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 and occurs almost exclusively in the eastern Gulf, baleen whales are extralimital and are rare in the GOM (Würsig et al., 2000).

The potential effects that water-transmitted noise have on 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. Individual marine mammals exposed to recurring disturbance could be stressed or otherwise affected in a negative but inconspicuous way. The behavioral or physiological responses to noise associated with the Perdido development, however, are unlikely to affect long-term survival or productivity of whale or dolphin populations in the northern GOM.

Many types of plastic materials end up as solid waste during drilling and production operations. Some of this material is accidentally lost overboard where whales and dolphins can consume or become ensnared in it. The result of plastic ingestion 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 and the bins are returned to shore by service vessels for disposal. The MMS issued Notice to Lessees and Operators (NTL) 2003-G11 "Marine Trash and Debris Awareness and Elimination" to help mitigate the potential threat trash and debris pose to marine mammals, fish, sea turtles, and other marine animals.

The primary operational waste discharges generated during offshore oil and gas exploration and development are drilling fluids, drill cuttings, produced water, deck drainage, sanitary wastes, and domestic wastes. During production activities, additional waste streams include produced sand and well treatment, workover, and completion fluids. Minor additional discharges occur from numerous sources; these discharges may include desalination unit discharges, blowout preventer fluids, boiler blowdown discharges, excess cement slurry, and uncontaminated freshwater and saltwater. The USEPA, through general permits issued by the USEPA Region that has jurisdictional oversight, regulates all waste streams generated from offshore oil and gas activities.

Most operational discharges are diluted and dispersed when released in offshore areas and are considered to have sublethal effects (API, 1989; NRC, 1983; Kennicutt, 1995). Any potential impacts from drilling fluids would be indirect, either as a result of impacts to prey species or possibly through ingestion via the food chain (Neff et al., 1989). Contaminants in drilling muds or waste discharge may biomagnify and bioaccumulate in the food web, which may kill or debilitate important prey species of marine mammals or species lower in the marine food web. Trace metals, including mercury, in drilling discharges have been a particular concern. However, Neff et al., (1989) concluded that metals associated with drilling fluid were virtually nonbioavailable to marine organisms. Marine mammals generally are inefficient assimilators of petroleum compounds in prey (Neff, 1990).

Accidental Events

Spills that occur from Perdido development and production activity would be few (if any), volumetrically small, and located near project activities in Alaminos Canyon, if they did occur. Oil spills and spill-response activities have the potential to adversely affect whales and dolphins by causing soft tissue irritation, fouling of baleen plates, respiratory stress from inhalation of toxic fumes, food reduction or contamination, direct ingestion of oil and/or tar, 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, (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). Potential mechanisms for long-term injury include (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). Chronic effects may 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 and dolphin 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 some marine mammals can suffer long-term impacts from oil spills, but the evidence for cetaceans being among this affected population 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 oil and individual whales or dolphins can be reasonably expected. Contact between marine mammals and spilled oil is unlikely, and the duration of this contact with mobile animals in the open ocean is expected to be very brief. Effects on marine mammal populations are expected to be insignificant.

Service vessels present a collision hazard to marine mammals. The Perdido project is expected to require four roundtrip crew and supply-vessel trips per week as well as numerous other support vessels onsite during installation and development. As additional projects are pursued by industry in the area, increased ship traffic levels could increase the probability of collisions between ships and marine mammals, resulting in injury or death to some animals. Dolphins may bow-ride vessels that are in transit from a shore base to an offshore location. The MMS issued NTL 2003-G10, "Vessel Strike Avoidance and Injured/Dead Protected Species Reporting," to help avoid collisions between vessel and marine mammals. The consequence of a vessel collision and a marine mammal is likely to be lethal, but the probability of a collision taking place is low with the current mitigations in place.

Conclusion

The proposed Perdido project is expected to have little impact on the vitality of any marine mammal species or productivity of any population endemic to the northern GOM. No deaths would be expected from direct exposure to spilled oil or to chronic long-term effects caused by contact with spilled oil. Although interaction between marine mammals and a weathered oil spill is possible, sublethal effects would be the likely result. 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. 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. Marine mammals could be injured or killed by eating indigestible debris or plastic items originating from the proposed development activities, but the likelihood of such an encounter is very small. Marine mammal populations are not expected to be adversely impacted by routine discharges due to current regulations and guidelines, and rapid dilution.

3.2.2.2.3. Cumulative Analysis

Cumulative impacts on marine mammals include (1) water quality degradation from oil, fuel, and material spills, high nutrient loads, high turbidity, high BOD, urban runoff, industrial discharges, pathogens, and upriver contaminants; (2) noise in the water from infrastructure, vessels, and facility removal; (3) vessel traffic and collision hazard; (4) seismic surveying; and (5) trash and debris. Non-OCS activity that contributes to cumulative impacts includes the same impact-producing factors from OCS activity, but which arise from other industrial, commercial, or recreational activity. Also, commercial fishing activity can kill or injure marine mammals by accident. The cumulative impacts from the major impact-producing factors on sea turtles would be dominantly sublethal, primarily behavioral changes, temporary disturbances, or displacement of localized groups, and rarely lethal. Marine mammal deaths attributable to non-OCS activity, such as commercial fishing, would be much greater than any caused by OCS activity.

Of these effects, the potential for collision between marine mammals and service vessels probably represents the greatest potential for adverse cumulative impacts on marine mammals over the 40-year exploration and production cycle. This judgment is made because collisions between large vessels and cetaceans, though rare events, typically results in crippling injuries or death. The collision hazard from service vessels is expected to decrease because of recent mitigations put into place by MMS, such as observers on vessels who are trained to spot marine mammals and turtles at sea. The potential for collisions with non-OCS vessels remains because requirements applicable to OCS activity do not apply to other industrial or commercial activity. Collisions between marine mammals and freight or cruise ships are not documented. While collision incidents between marine mammal and vessels that result in death attributable to OCS activity decrease or remain the same, the total number of marine mammal deaths resulting from collisions with all vessels associated with non-OCS activity will probably increase or remain the same.

Deaths or serious injuries due to explosive structure-removal operations are not expected or would be extremely rare. Depending on mitigation measures developed during ESA Section 7 consultations and if the removal of subsea production infrastructure is not required in deepwater developments, the chance of harm to marine mammals can be reduced. Noise in the water from platforms or service vessels may (1) disrupt normal activities like feeding, breeding, resting, or deep-dive recovery; (2) cause physiological stress and greater susceptibility to disease or predation; or (3) cause them to avoid these noise sources. There are effective prohibitions on discarding trash or debris from development activity at sea. Marine mammals could be injured or killed from ensnarement in or consumption of marine debris, particularly plastic items, lost from OCS structures and service vessels.

Cumulative impacts on GOM marine mammals include the degradation of water quality resulting from operational discharges, vessel traffic, noise generated at offshore structures, MODU's, helicopters, seismic surveys, explosive structure removals, oil spills, oil-spill-response activities, loss of debris from ocean-going vessels and OCS structures, commercial fishing (capture and removal), pathogens, and negative impacts to prey populations. Cumulative impacts on marine mammals would be expected to result in a number of chronic and sporadic sublethal effects (behavioral effects and nonfatal exposure to or intake of non-OCS and OCS-related contaminants or discarded debris) that may stress and/or weaken individuals of a local group or population and predispose them to infection from natural or anthropogenic sources. Few deaths would be expected from chance collisions between marine mammals and OCS service vessels, ingestion of debris such as plastic material, and pathogens.

Oil spills and associated slicks of any size are infrequent events, but if they do occur they have a very small potential to contact marine mammals. Sublethal effects could occur with exposure of marine mammals to a weathered oil slick. Disturbance (noise from vessel traffic and drilling operations, etc.) and/or exposure to platform discharges may cause sublethal effects, may stress animals and weaken their immune systems, and may make them more vulnerable to parasites and diseases.

The net result of any disturbance would be dependent upon the size and percentage of the population affected; ecological importance of the disturbed area; environmental and biological parameters that influence an animal's sensitivity to disturbance and stress; and the accommodation time in response to prolonged disturbance (Geraci and St. Aubin, 1980).

3.2.2.3. Sea Turtles

3.2.2.3.1. Description

Five species of sea turtle are found in the waters of the GOM: green, leatherback, hawksbill, Kemp's ridley, and loggerhead. All are protected under the ESA, and all except the loggerhead turtle (threatened) are listed as 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 27-50 m (80-160 ft) 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.

Information on each turtle species can be found in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007; Chapter 3.2.4) and is incorporated into this PEA by reference.

3.2.2.3.2. Impact Analysis

The impact-producing factors associated with development and production of the Perdido project in Alaminos Canyon that could affect loggerhead, Kemp's ridley, hawksbill, green, and leatherback turtles, (all listed as endangered or threatened species) include (1) noise from helicopter, platform, and vessel traffic; (2) possible collisions with service vessels; (3) brightly-lit structures; (4) project-related trash and debris; (5) oil spills and spill-response activities; and (6) water-quality degradation from platform effluents. Chapters 4.2.1.1.6 and 4.2.2.1.6 in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007) contain a discussion of impacts from OCS activity and are incorporated into this PEA by reference.

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 is expected to have one helicopter roundtrip per day during installation and development and two roundtrips per week during drilling and operations. These occurrences would be temporary and pass within seconds. 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, however, are negligible relative to other sources of noise that are propagated in water (e.g., platform or drill rig 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 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 or productivity. Sea turtles exposed to recurring vessel disturbance could be stressed or otherwise affected in a negative but inconspicuous way. Whether or not persistent noise causes sea turtles to avoid the area is unknown.

Well completion, workover activities, and operations would produce sounds transmitted in the water at intensities and frequencies that could be heard by sea turtles. Noise from structure installation 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 Perdido project is expected to require four roundtrip crew and supply-vessel trips per week as well as numerous other support vessels onsite during installation and development. Increased vessel traffic from additional development projects pursued by industry in the area raises the probability of collisions between ships and sea turtles, which may result in injury or death to some animals.

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.

Many types of materials, including plastic wrapping materials, end up as solid waste during development and production operations. Some of this material could be accidentally lost overboard where sea turtles can consume it. The result of ingesting materials 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. Disposal of solid wastes offshore takes place in covered bins that are warehoused in a secure area on the platform, whereupon the bins are returned to shore for landfill disposal by a service vessel for landfill disposal. The MMS issued NTL 2003-G11 “Marine Trash and Debris Awareness and Elimination” to help mitigate the potential threat trash and debris pose to marine mammals, fish, sea turtles, and other marine animals.

The primary operational waste discharges generated during offshore oil and gas exploration and development are drilling fluids, drill cuttings, produced water, deck drainage, sanitary wastes, and domestic wastes. During production activities, additional waste streams include produced sand and well treatment, workover, and completion fluids. Minor additional discharges occur from numerous sources; these discharges may include desalination unit discharges, blowout preventer fluids, boiler blowdown discharges, excess cement slurry, and uncontaminated freshwater and saltwater. The USEPA, through general permits issued by the USEPA Region that has jurisdictional oversight, regulates all waste streams generated from offshore oil and gas activities.

Most operational discharges are diluted and dispersed when released in offshore areas and are considered to have sublethal effects (API, 1989; NRC, 1983; Kennicutt, 1995). Any potential impacts from drilling fluids would be indirect, either as a result of impacts to prey species or possibly through ingestion via the food chain (Neff et al., 1989). Contaminants in drilling muds or waste discharge may biomagnify and bioaccumulate in the food web, which may kill or debilitate important prey species of 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 Perdido project would be highly diluted in the open marine environment. These effluents would be within permitted limits and therefore have negligible effects on sea turtles that may come into contact with Perdido outfall sources.

Accidental Events

Spills that occur from Perdido development and production activity would be few (if any), volumetrically small, and located near project activities in Alaminos Canyon, if they did occur. 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 oil and consumption of oil (tarballs) and 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 oil or to chronic long-term effects. Several potential mechanisms for long-term impacts may be (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. 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 oil are unlikely to be realized. Contact between sea turtles and spilled oil is very unlikely, and the duration of this contact with mobile animals in the open ocean would be very brief. Adverse effects on sea turtle populations are expected to be insignificant.

No juvenile deaths or sublethal impacts on young or newly-hatched sea turtles, or nests on nesting beaches and habitats, would be expected because the probability of shoreline impact from an oil spill from the Perdido project is extremely small. Further, a slick would be unlikely to survive weathering and sea conditions that would bring it to 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 minimal because of the very low probability of contact between oil and these areas and protective spill remediation procedures. 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.

Conclusion

The proposed Perdido project is expected to have little impact on the vitality of any sea turtle species or productivity of any population endemic to the northern GOM. A sublethal impact to sea turtle individuals exposed to a weathered oil slick is the most likely result. There is no conclusive evidence whether or not anthropogenic noise in the water has caused displacements of sea turtle populations or is injurious to the 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 Perdido development activities, but the likelihood of such an encounter is very small.

3.2.2.3.3. Cumulative Analysis

Cumulative impacts on sea turtles and their habitats include (1) water quality degradation from oil, fuel, and other chemical spills, high nutrient loads, high turbidity, urban runoff, industrial discharges, pathogens, and upriver contaminants; (2) habitat loss or degradation; (3) infrastructure and vessel noise, lighting, and removal; (4) vessel traffic and collision hazard; (5) trash and debris; and (6) natural phenomena such as sea-level rise, subsidence, and storms and hurricanes. Non-OCS activity that contributes to cumulative impacts include commercial and recreational fishing that kill or injure turtles by accident, beach lighting, and entrainment in power plant intakes. The cumulative impacts from the major impact-producing factors on sea turtles would primarily be behavioral changes, temporary disturbances, or displacement of localized groups, and rarely lethal. Turtle deaths attributable to non-OCS activity are expected to be greater than any caused by OCS activity.

Of these effects, dislocation from preferred beach-nesting habitats or destruction of these habitats probably represents the greatest potential for adverse cumulative impacts on sea turtles over the 40-year exploration and production cycle. Habitat loss or degradation of preferred nesting beaches can link to stresses that act to reduce reproductive success, such as overcrowding on remaining and suitable nesting beaches. Natural influences on habitat displacement or destruction caused by sea-level rise, subsidence of the Mississippi River Delta, and landfall of hurricanes will greatly eclipse any influences from OCS activity. Natural effects such as subsidence, however, have been accentuated by cumulative changes to the river's flow patterns and sediment load as a result of flood control projects, dams, channelization, and other civil works designed to improve navigation.

Deaths due to explosive structure-removal operations should not take place or should be extremely rare with the explosive removal mitigations required by MMS. The Perdido project is far from shoreline nesting habitat, and any bright lighting on the site should have no effect on sea turtle hatchlings. Underwater noise from platforms or service boats may disrupt normal activities and may cause physiological stress, causing turtles to become more susceptible to disease or predation. Collision hazards from service vessels would be expected to decrease because of mitigations put into place by MMS.

There are prohibitions on discarding trash or debris from project activity at sea. Sea turtles could be injured or killed from ensnarement in or consumption of marine debris, particularly plastic items, lost from OCS structures and service vessels.

Oil spills, chemical dispersants, and spill-response activities on sensitive nesting coastlines are potential hazards that may adversely affect sea turtles or the reproductive success of populations. Contact with and consumption of oil and oil-contaminated prey may seriously affect sea turtles. Large spills are extremely rare events, and for this reason no contact or interaction is expected between turtles and freshly spilled oil. Incidental contact with degraded or weathered oil may be expected between turtles that inhabit or transit through the Perdido project area. The effects from contact with spilled oil in a weathered slick would be sublethal behavioral changes.

The incremental contribution of the proposed Perdido project to the cumulative impacts would be negligible. The effects of the most likely impacts, such as the physical presence and operation of the platform facility, or noise from the platform, helicopters, and service-vessel traffic, would only be expected to modify the behavior of turtles that come into contact with these project facilities.

3.2.2.4. Essential Fish Habitat and Fish Resources

3.2.2.4.1. Description

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. Due to the wide variation of habitat requirements for all life history stages for managed species, EFH was previously 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 322 km from shore). Through extensive analysis in GMFMC (2004), a new approach was adopted with Generic Amendment #3 to all Gulf of Mexico Fishery Management Plans. The Generic amendment (GMFMC, 2005) will reduce the extent of EFH relative to the 1998 Generic Amendment by removing EFH description and identification from waters between 100 fathoms (183 m or 600 ft) and the seaward limit of the EEZ (as deep as 3,200 m or 10,499 ft). However, the habitats most important to managed species (i.e., those shallower than 100 fathoms) will still be designated as EFH, and so the great majority of benefits to the biological environment will remain. The area of Grid 5 no longer has a blanket designation as EFH but does retain EFH designation for specific species, including many highly migratory species such as tunas, swordfish and sailfish.

The Magnuson Fishery Conservation and Management Act (USDOI, MMS, 2007; page 1-7) 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 WPA/CPA Final Multisale EIS (USDOI, MMS, 2007). National Marine Fisheries (NMFS) concluded EFH consultation with a letter dated December 21, 2006, on the Multisale EIS and all activities described with no additional conservation recommendations beyond those followed routinely MMS.

Pelagic fishes occur throughout the water column from the beach to the open ocean. Temperature, salinity, and turbidity of the water column are the only partitioning of this vast habitat. On a broad scale, pelagic fishes recognize different watermasses based upon physical and biological characteristics. Three ecologic groups of pelagic fish are recognized, primarily by water depth: (1) coastal pelagics species; (2) oceanic species; and (3) mesopelagic species. Two of these three pelagic ecological groups − oceanics and mesopelagics − would be encountered in Grid 5 and in the area of the Perdido project. Coastal pelagic species occur in waters from the shoreline to the shelf edge, generally delineated by the 200-m (656 ft) isobath, and would not be extant in Grid 5.

Oceanic pelagic species occur throughout the GOM, especially at or beyond the shelf edge; however, some species venture onto the shelf with watermass intrusions (e.g., Loop Current). 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 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. Many of the oceanic fishes associate with drifting *Sargassum*, which provides areas for foraging and where young fish can be protected and grow.

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.

Mesopelagic fishes occur deeper in the GOM waters than the oceanic species group, usually at depths between 200 and 1,000 m (656-3,280 ft) below the surface. Mesopelagic fishes 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 to feed in shallower, food rich layers of the water column (Hopkins and Baird, 1985). Mesopelagic fishes are important ecologically because they transfer substantial amounts of energy daily between depth zones. Mesopelagic species are not harvested commercially but have been collected in special, discrete-depth nets that provide some quantitative data on relative abundance (Bakus et al., 1977; Hopkins and Lancraft, 1984; Hopkins and Baird, 1985; Gartner et al., 1987).

Gulf Sturgeon

The Gulf sturgeon (*Acipenser oxyrinchus desotoi*) is one of just two threatened fish species listed 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 importance of smell to foraging sturgeons is not known. Another adaptation of sturgeon to major rivers and offshore waters is mobility (an adaptation to the large habitat scale). According to Wooley and Crateau (1985), Gulf sturgeon historically occurred in most major river systems from the Mississippi River to the Suwannee River, Florida, and marine waters of the Central and Eastern GOM south to Florida Bay. The decline of the Gulf sturgeon is believed to be due to overfishing and habitat destruction, primarily the damming of coastal rivers and the degradation of water quality (Barkuloo, 1988).

A subspecies of the Atlantic sturgeon, the Gulf sturgeon is anadromous (ascends rivers to breed), with immature and mature fish participating in freshwater migrations. Gill netting and biotelemetry have shown that subadults and adults spend 8-9 months each year in rivers and 3-4 of the coolest months in estuaries or Gulf waters. Sturgeon less than about two years old live in riverine and estuarine habitats throughout the year (Clugston, 1991). In spring, large subadults and adults that migrate from estuaries into major river passes feed primarily on lancelets, brachiopods, amphipods, polychaete worms, and snails. Small sturgeon in river passes feed on amphipods, shrimp, isopods, oligochaetes, and aquatic insect larvae (Clugston, 1991). During the riverine stage, adults cease feeding, undergo gonadal maturation, and migrate upstream to spawn. Spawning occurs over coarse-grained substrates in deep river channels and in deep holes in the river bed.

Critical habitat for the Gulf sturgeon includes 14 geographic areas in rivers emptying into the GOM that encompass 1,760 mi (2,783 km) of river and 2,333 mi^2 (6,042 km^2) of estuarine and marine habitat (*Federal Register*, 2003). Information on the Gulf sturgeon can be found in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007; Chapter 3.2.7) and is incorporated into this PEA by reference.

3.2.2.4.2. Impact Analys

The impact-producing factors associated with development and production of the Perdido project in Alaminos Canyon Block 857 that could affect EFH and fish resources include (1) coastal and marine environmental degradation, (2) rig presence, (3) temporary discharge of drilling cuttings (4) longer-term discharge of produced water and permitted effluents, and (5) blowouts or spilled oil. Chapters 4.2.1.1.8, 4.2.2.1.10 and 4.4.10 in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007) contain a discussion of impacts from OCS activity and are incorporated into this PEA by reference.

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 and floating trash can adversely affect fish and EFH, although these impacts would be minor. Produced water would influence water quality and could potentially produce sublethal effects in fish over a limited area. Any effects would be local and not significant. Marine EFH on the shelf includes both high- and low-relief live bottoms and natural reefs. There are some areas of exposed authigenic carbonate resulting from bacterial precipitation of carbonate that cam become exposed above the substrate, but these areas are outside the impacted areas from the proposed Perdido project. Intentionally established artificial reefs are not an issue in Grid 5 due to extreme water depth. The Perdido production structure that remains over time will establish a defacto artificial reef by providing hard substrate throughout the euphotic zone where none existed before. The resulting artificial reef will both attract some species of pelagic fish and will also allow the establishment of a variety of reef-associated fish that will live on or near the platform structure. Most, if not all, 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.

Drilling fluids and cuttings will be discharged offshore to contribute to localized temporary marine environmental degradation. Drilling operations are restricted in time and pelagic species in the area could easily avoid discharge plumes. Routine discharges from the spar 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.

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 Perdido development and production activity would be few (if any), volumetrically small, and located near project activities in Alaminos Canyon Block 857, if they did occur. Fish resources 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, 2003; 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. Impacts of oil spills on adult fish have generally been thought to be minimal. The NOAA Office of Response and Restoration's Internet site states, "Most often, fish either are unaffected by oil, or are affected only briefly" (USDOC, NOAA, 2006). 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).

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, however, and larvae spread far and wide in the marine nearshore and offshore. 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 levels 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. 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.

Conclusion

The proposed Perdido project is expected to have little impact on any coastal or marine fish, EFH, or commercial fisheries endemic to the northern GOM. The PRH will attract a variety of fish species, some permanently residing on and near to the structure. Impacts on adult fish or EFH are not expected. If a 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 take place in 1-2 years by fish from adjacent unaffected areas that replenish larvae in early phases of the life cycle.

3.2.2.4.2.1. Impacts on Gulf Sturgeon

The existing range of the Gulf sturgeon in 1996 extended from the Mississippi River to Charlotte Harbor in western Florida (Patrick, personal communication, 1996). Gulf sturgeon is not known from estuaries or rivers of coastal Louisiana west of the Mississippi River. If populations of this listed species were identified from these habitats, spilled oil represents the main potential impact-producing factor of the proposed action. Gulf sturgeon can take up oil by direct ingestion, ingestion of oiled prey, or the absorption of dissolved petroleum components across gill mucus and gill epithelium; however, liver enzymes of adult fish oxidize soluble hydrocarbons into compounds that are excreted in the urine (Spies et al., 1982), without lethal effects. If behavioral studies of other fish species provide a guideline (Farr et al., 1995; Nevissi and Nakatani, 1990), adult sturgeon are likely to actively avoid an oil spill.

Conclusion

If the habitat range of the Gulf sturgeon extends west of the Mississippi River Delta, younger sturgeon could suffer physiological stress, irritation, or impaired liver function from an oil spill resulting from the Perdido project, if one should occur.

3.2.2.4.3. Cumulative Analysis

Principal cumulative impacts on EFH and fish resources include (1) degradation of water quality from oil, fuel, and material spills, high nutrient loads, high turbidity, high BOD, urban runoff, industrial discharges, pathogens, trash and debris, and upriver contaminants; (2) loss of essential habitat important for parts of the life cycle, such as healthy estuarine systems, (including wetland loss); and (3) commercial overfishing. Of these, water quality degradation from multiple inputs and sources, not unique to OCS oil and gas activity, represents the greatest potential for cumulative impacts on fish resources and EFH over the 40-year exploration and production cycle of the typical OCS lease sale. Cumulative water quality degradation attributable to OCS oil and gas activity, such as large oil spills, can be dramatic and visually striking when it occurs, but historical data show that that the probability of occurrence is extremely low. Planktonic fish eggs and larvae are more susceptible than adults to environmental contaminants. Impacts from these influences may be manifested by diminished representation of fish eggs and larvae in sampling studies.

Hurricanes may impact fish resources by destroying both coastal wetlands and offshore live-bottom and reef communities and changing physical characteristics of inshore and offshore ecosystems As a cumulative impacting factor, hurricanes certainly had a substantial impact on Gulf Coast fisheries and EFH in 2005. Contrary to initial fears, however, the majority of significant fishery resource impacts were to the nearshore costal and wetlands areas of Texas, Louisiana, Mississippi, and Alabama. Hurricanes Katrina and Rita did cause substantial infrastructure (artificial reef EFH) destruction offshore, but the actual impacts to fish resources and EFH were not significant. Hurricanes have essentially no cumulative impacts in deepwater environments such as the Grid 5 area.

The incremental contribution of the proposed action’s impacts to the cumulative impact on fish resources and EFH is negligible and likely undetectable among the other cumulative impacts.

3.2.2.5. Coastal and Marine Birds

3.2.2.5.1. Description

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 assumes six major groups: (1) seabirds; (2) shorebirds; (3) marsh and wading birds; (4) waterfowl; (5) raptors; and (6) diving birds. Many species are mostly pelagic and are rarely sighted nearshore. 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.

Information on coastal and marine birds can be found in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007; Chapter 3.2.6) and is incorporated into this PEA by reference.

Seabirds

Seabirds are a diverse group of birds that spend much of their lives on or over saltwater (Table 3-5). Species diversity and 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 (Terres, 1991). Seabirds typically aggregate in social 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, or current activity. Seabirds obtain their food from the sea with a variety of behaviors including piracy, scavenging, dipping, plunging, and surface seizing.

Table 3-5

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.). Gulf of Mexico shorebirds comprise five taxonomic families—Jacanidae (jacanas), Haematopodidae (oystercatchers), Recurvirostridae (stilts and avocets), Charadriidae (plovers), and Scolopacidae (sandpipers, snipes, and allies) (Hayman et al., 1986). 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 marshes and 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 3-6). 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).

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 3-7). 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 serves as the southern terminus of the Mississippi (Louisiana, Mississippi, and Alabama) flyway. Waterfowl are social and have a diverse array of feeding adaptations related to their habitat (Johnsgard, 1975).

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 U. S. Fish and Wildlife Service (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 3-8). Of the two pelican species in North America, only the brown pelican is listed as endangered under the ESA.

Listed Species of Coastal and Marine Birds

The following coastal and marine bird species that inhabit or frequent the northern GOM coastal areas 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, plovers may have a preferred prey base and/or the substrate coloration provides protection from aerial predators due to camouflage by color matching in specific wintering habitat. 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 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 10, 2001, the critical habitat was designated for the wintering population of piping plover in 146 areas along approximately 2,700 mi (4,344 km) of the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Louisiana, and Texas (*Federal Register*, 2001).

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.

Table 3-6

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.

Table 3-7

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
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 Gulf-wide unless otherwise indicated; NA = not available

Table 3-8

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.

Whooping Crane

The whooping crane (*Grus americana*) is an omnivorous, wading bird. The whooping crane 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.

Least Tern

The least tern is not considered federally endangered or threatened in coastal areas within 50 mi (80 km) 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 FWS is currently considering the complete delisting of the bald eagle. The bald eagle would still be protected under the Bald and Golden Eagle Protection Act (USDOI, FWS, 2007). The FWS made available a draft environmental assessment of its proposed regulatory definition of "disturb" under the Bald and Golden Eagle Protection Act (*Federal Register*, 2006). 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 08 0.8 km) 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. As of the 2003-2004 survey season, the Louisiana Department of Wildlife and Fisheries reports 234 active nests were found in Louisiana producing 314 young.

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 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).

3.2.2.5.2. Impact Analysis

The impact-producing factors associated with development and production of the Perdido project in Alaminos Canyon Block 857 that could affect coastal and marine birds include (1) air emissions, (2) helicopter and service-vessel traffic and noise, (3) lights from the PRH, (4) oil spills and oil-spill-response activities, and (5) trash and debris from the spar and service vessels. These impact-producing factors apply to nonthreatened or nonendangered bird species as well as those that are listed. Chapters 4.2.1.1.7 and 4.2.2.1.8 in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007) contain a discussion of impacts from OCS activity and are incorporated into this PEA by reference.

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 in three ways: inhalation, absorption, and ingestion.

Air emissions from the project will have a negligible effect on coastal or marine birds that inhabit or transit the offshore OCS area in Grid 5. Emissions from activities associated with the proposed action would be expected to have minimal effects on offshore air quality because of the prevailing atmospheric conditions, emission heights, and pollutant concentrations. Because of distance to the shoreline, no effects would be expected on onshore air quality that could be deleterious to birds.

Helicopter and service-vessel traffic related to the proposed action could sporadically disturb birds while feeding, resting, nesting, or reproducing, 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 610 m (2,000 ft) 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 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 spar 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 spar's 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. 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," prohibit the disposal of equipment, containers, and other materials into offshore waters by lessees. Coastal and marine birds would, therefore, seldom 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. Due to the low potential for interaction between coastal and marine birds and project-related debris, effects would not occur or would have negligible impact.

Accidental Events

Spills that occur from the Perdido project would be few (if any), volumetrically small, and located near project activities in Alaminos Canyon Block 857 if they did occur. Contact with spilled oil 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 probably 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: (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 displays good intentions but have extremely limited success.

Conclusion

The proposed Perdido project is expected to have little 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 sublethal, 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.

3.2.2.5.3. Cumulative Analysis

Cumulative impacts on coastal and marine birds include (1) air emissions; (2) water quality degradation from oil, fuel, and material spills, high nutrient loads, high turbidity, high BOD, urban runoff, industrial discharges, pathogens, and upriver contaminants; (3) habitat loss and shoreline modification from construction and development; (4) collisions with aircraft; (5) noise from aircraft and vessels; (6) trash and debris; and (7) natural phenomena such as sea-level rise, subsidence, and storms and hurricanes. Non-OCS industrial, commercial, or recreational activities that contribute to these cumulative impacts involve the same impact-producing factors as OCS activities. These impacts could be especially critical to endangered or threatened bird species that must maintain a viable reproductive population size or depend on a few key habitat areas. The cumulative impacts from the major impact-producing factors on coastal and marine birds would be rarely lethal and dominantly sublethal, constituting behavioral changes, temporary disturbances, or displacement of localized inshore bird groups.

Industry activity that contributes to habitat modification and destruction includes construction and maintenance of pipelines and corridors, and dredging to accommodate deep-draft service vessels used to support deepwater projects. Non-OCS activity would include coastal development, shoreline modifications, flood control programs, and dredging, which would be done to accommodate international shipping and cruise ship traffic.

Exposure to contaminants or discarded debris will usually cause behavioral changes, temporary disturbances, or displacement of localized inshore bird groups. The rates of air and water degradation in coastal and marine environments and the amount of shoreline trash and debris is likely to increase slowly in line with regional economic and population growth trends. Behavioral changes can be expected as competition increases among bird groups for favored habitats. The trash and debris burden on shorelines that is attributable to OCS activity is expected to decline because of continuing education programs for offshore workers, enforcement of controls for trash produced offshore and on service vessels, and industry sponsorship and participation in “beach sweeps” to assay the types of trash found along shorelines and remove it. There are effective prohibitions on discarding trash or debris at sea from OCS activity. Trash could ensnare or cripple individual birds and small plastic fragments that are ingested by birds could injure or kill them.

Helicopter traffic will increase slightly but will not present an increased collision hazard because these occurrences are rare even now. Aircraft or vessel traffic could sporadically disturb feeding, resting, or nesting behavior of birds or cause abandonment of preferred habitat.

Accidental events, such as an oil spill, would cause lethal effects in birds that are heavily oiled. Coastal birds can be vulnerable to spills making landfall; for example, 3,686 bird deaths by contact with oil from the 1969 Santa Barbara Channel spill (Nation, 2003; page 16) were estimated. Contact with weathered oil or a dissipated slick, dispersant chemicals, and spill-response activities in wetlands and other biologically sensitive coastal habitats would be expected to cause lethal to sublethal effects to individuals from any or all bird groups through ingestion or inhalation of oil, ingestion of oiled prey, or food being unavailable because of a spill. Large spills are extremely rare events, and for this reason little or no contact or interaction is expected between birds and freshly spilled oil. Incidental contact with degraded or weathered oil can be expected between birds that inhabit or migrate through Grid 5 over the next 40 years.

The incremental contribution of the proposed Perdido project to the cumulative impact would be negligible because the effects of the most likely impacts, such as the physical presence and operation of the platform facility, or noise from helicopters and service-vessel traffic, would only be expected to modify the behavior of birds that come into contact with these project facilities.

The cumulative effects of habitat modification or loss due to onshore commercial, industrial, agricultural and residential development (non-OCS related) may cause an eventual decline or alteration in species density, composition or distribution of avian species typical of coastal regions over a 40-year period. Some of these changes may become permanent, as documented in historical census data, and stem from a net decrease in preferred habitat.

3.2.2.6. Chemosynthetic Communities

3.2.2.6.1. Description

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 cells 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 subsequently 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 approximately 400 to 2,743 m (1,312 to 9,000 ft) (Rosman et al., 1987; MacDonald, 1992; Allen, 2005). 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. Figure 10 shows the location of known chemosynthetic communities and their relationship to Grid 5 and Alaminos Canyon Block 857.

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 slow to moderate rate oil and gas seeps (Roberts and Carney, 1997). 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). Vestimentiferan tube worms and lucinid and vesicomyid bivalves rely on H_2S, whereas different mytilid mussels can use either dissolved methane or sulfides, some can utilize both. 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 2,743 m (951 and 9,000 ft) (Roberts et al., 1990; MacDonald, 1992; Allen, 2005). The total number of chemosynthetic communities in the Gulf is now known to exceed 50. A recent MMS study, *Investigations of Chemosynthetic Communities on the Lower Continental Slope of the Gulf of Mexico*, has performed exploration surveys specifically targeting water depths below 1,000 m (3,280 ft). This project confirmed the presence of twelve additional chemosynthetic communities not previously know in these water depths. Using general knowledge of the number of active seeps on the seabed and large-scale geophysical information, numerous additional chemosynthetic communities are expected throughout most of the GOM slope.

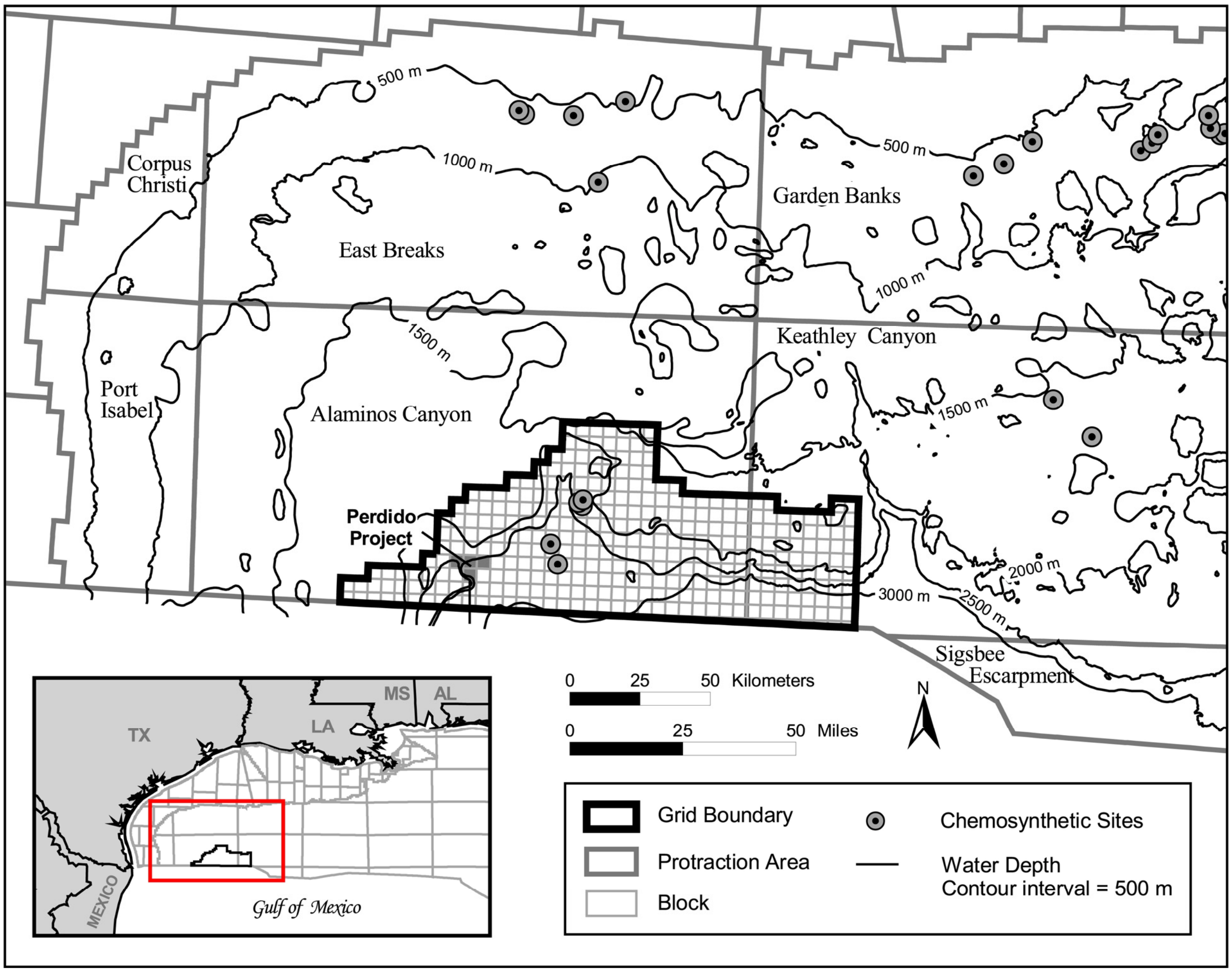

Figure 10. Known chemosynthetic communities and their relationship to Grid 5

A review for the potential occurrence of chemosynthetic communities associated with Alaminos Canyon Block 857 including the spar location and subsea infrastructure for the proposed Perdido project was performed for this EA. Grid 5 includes numerous lease blocks that contain some areas of high seabed seismic amplitude reflectivity that could represent natural gas hydrates or carbonate hardground substrates and the potential for the occurrence of chemosynthetic communities. Outside Alaminos Canyon Block 857, there are four other known chemosynthetic community locations in Grid 5. They are located in Alaminos Canyon Blocks 601, 645, 775, and 818. The closest to Alaminos Canyon Block 857 is a relatively small strip of communities in Alaminos Canyon Block 818 approximately 13 nmi to the east. The DOCD presenting environmental information for Alaminos Canyon Block 857, received by MMS described numerous newly discovered chemosynthetic communities comprised primarily of tube worms in the vicinity of the Perdido spar installation. In fact, the initial anchor pattern shows three anchor lines from the spar extending directly over the known locations of some of those communities and then extending to the touchdown points of the anchor lines and bottom locations of those three anchors approximately 300 m (1,000 ft) beyond the location of the communities. According to the operator's anchor handling plan, the anchor line (polyester rope) will be carried to a point directly over the location of the three suction pile (or suction deployment anchor) with a "maximum of 250 feet of grounded chain on the sea floor during installation." This procedure would leave a buffer distance of 750 ft (229 m) between the anchor chain touchdown point and the locations of the known chemosynthetic community locations.

There are no documented areas of exposed hard substrate (typically composed of seep-related authigenic carbonate) that could be used as habitat for deepwater corals or other hard bottom organisms such as sea fans that could be considered significant sensitive biological communities.

3.2.2.6.2. Impact Analysis

Although a number of newly discovered chemosynthetic communities have been reported in Alaminos Canyon Block 857, these areas will be avoided by the drilling activity and the semi-submersibles 16-anchor array as well as the installation of the PRH spar platform and its associated 9-anchor array. Chapters 4.2.1.1.4.2.1 and 4.2.2.1.4.2.1 in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007) contain a general discussion of impacts from OCS activity and are incorporated into this PEA by reference.

The NTL 2000-G20, "Deepwater Chemosynthetic Communities," makes mandatory the search 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 presence or absence of high-density chemosynthetic communities. If such communities are indeed present, no drilling operations or other bottom-disturbing activities may take place in the area; if the communities are not present, drilling or anchoring may proceed. A definitive 100 percent correlation between the geophysical characteristics recorded by geophysical surveys and the presence of chemosynthetic communities has not been proven; however, the associations have proven to be very reliable in virtually all situations encountered to date. In light of probable avoidance of all chemosynthetic communities (not just high-diversity types) as required by NTL 2000-G20, the frequency of inadvertent impact is expected to be very low, and the severity of such an impact is judged to result in minor disturbance to ecological function of the community, with no alteration of ecological relationships with the surrounding benthos.

Conclusion

The proposed Perdido project is not expected to impact known high-density chemosynthetic communities. Although several communities of this type are known in the vicinity of the proposed activities as shown by geophysical characteristics and video tape documentation, they will be avoided by anchor handling techniques described by the operator in their development plan. The areas exhibiting characteristic geophysical signatures that could support chemosynthetic communities were documented by video from an ROV. No high-density chemosynthetic community components occur in the vicinity of the production drilling in the southwest corner of Alaminos Canyon Block 857.

3.2.2.6.3. Cumulative Analysis

Cumulative impacts on chemosynthetic communities include the sources identified in Chapter 3.2.2.1.3.1 (Deepwater Benthic Communities). No additional impacts to chemosynthetic communities from either OCS or non-OCS-related activities would be expected. Normal fishing practices should not disturb these areas. Other bottom-disturbing activities such as trawling and anchoring are virtually nonexistent at water depths greater than 400 m (1,312 ft). The MMS reviews plans for exploration and development operations and pipeline applications that include geophysical evaluations of bottom characteristics or direct observations in areas planned for OCS activity. Sea-bottom areas likely to be disturbed by these projects are examined to determine if conditions exist that have the potential to host chemosynthetic communities. If these conditions exist, mitigations designed to avoid sea-bottom disturbances to chemosynthetic communities are applied. These reviews and mitigations are designed to protect these unique communities; therefore, cumulative impacts from activity in Grid 5 are not expected. No impacts from non-OCS-related activities would be expected in Grid 5.

3.3. SOCIOECONOMIC AND HUMAN RESOURCES

3.3.1. Socioeconomic Resources

Socioeconomic resources in the Western Gulf are characterized in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007; Chapter 3.3) and are incorporated into this PEA by reference. Summaries of these resources follow and include (1) the impact area for the proposed Perdido 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 132 counties and parishes along the U.S. portion of the GOM. This area includes 42 counties in Texas, 32 parishes in Louisiana, 7 counties in Mississippi, 8 counties in Alabama, and 43 counties in Florida, which are listed in Table 3-17 and illustrated in Figure 3-12 of the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007). Thirteen economic impact areas (EIA's) divide the impact area for analysis purposes and are considered in Chapters 3.3.1 and 3.3.2 in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007) as the economic impact area for the proposed Perdido project in Grid 5.

The criteria for including counties and parishes in this impact area are explained in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007; Chapter 3.3.5.1, Socioeconomic Analysis Area). This impact area is based on sets of counties (and parishes in Louisiana) that have been grouped on the basis of intercounty commuting patterns. The labor market area's (LMA) identified by this grouping are commuting zones, as identified by Tolbert and Sizer (1996). In their research, Tolbert and Sizer (1996) used journey-to-work data from the 1990 census to construct matrices of commuting flows from county to county. A statistical procedure known as hierarchical cluster analysis was employed to identify counties that were strongly linked by commuting flows. The researchers identified 741 of these commuting zones for the U.S. Twenty-three of these LMA areas span the Gulf Coast, from the southern tip of Texas to Miami and the Florida Keys, and comprise the 13 MMS-defined EIA's for the Gulf.

The socioeconomic resources evaluated in this PEA are limited to that portion of the GOM's coastal zone directly or indirectly affected by OCS development and production in Grid 5. The cumulative analysis examines impacts from the proposed Perdido project and subsequent development projects in Grid 5 over the next 40 years; however, the Perdido development is proposed to continue for 20 years.

3.3.1.2. Commercial Fisheries

3.3.1.2.1. Description

The most recent, complete information on landings and value of fisheries for the U.S. was compiled by NOAA Fisheries for 2004. During 2004, commercial landings of all fisheries in the GOM totaled nearly 1.4 billion pounds, valued at over $670 million (USDOC, NMFS, 2006). The GOM provides over 34 percent of the commercial fish landings in the continental U.S. (excluding Alaska) on an annual basis. Menhaden, with landings of about 1.02 billion pounds and valued at $44.9 million, was the most important GOM species in terms of quantity landed during 2004. Shrimp, with landings of nearly 257 million pounds and valued at about $367 million, was the most important GOM species in terms of value landed during 2004.

Commercial fishing in deeper waters, i.e., >200 m (>656 ft), 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 (open waters into which enough light penetrates for photosynthesis) fishes; (2) reef fishes; and (3) invertebrates. The Perdido development and Grid 5 are 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 and the general lack of commercially viable densities or biomass in very deep Gulf waters. 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 assuredly occur in Grid 5. Oceanic pelagic fishes were not landed in high quantities relative to other finfish groups.

3.3.1.2.2. Impact Analysis

The impact-producing factors associated with development and production of the Perdido project in Alaminos Canyon Block 857 that could affect commercial fishing include (1) underwater OCS obstructions, (2) coastal and marine environmental degradation, (3) space-use conflicts, (4) temporary discharge of drilling cuttings (5) longer-term discharge of produced water and permitted effluents, and (6) blowouts or oil spills. Chapters 4.2.1.1.9, 4.2.2.1.11, and 4.4.10 in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007) contain a discussion of impacts from OCS activity and are incorporated into this PEA by reference.

The most likely objectives for commercial fishing would be epipelagic species that are highly mobile and have the ability to avoid disturbed areas. This fishery is traditionally pursued using a highly mobile longliner fleet. Desirable pelagic fish species may be attracted to the Perdido spar production facility because of 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. This effect might enhance feeding of epipelagic predators by attracting and concentrating smaller fish species.

Some area previously available to longline fishing will be eliminated by the installation of the Perdido facility. There is a slight possibility of pelagic longlines becoming entangled in the offshore structures; however, longline fishers use radar and generally are aware of offshore structures when placing their sets. Therefore, little or no impact on pelagic longlining is expected.

Virtually all commercial trawling in the GOM is performed in water depths <200 m (656 ft). Longline fishing is performed in water depths >100 m and usually beyond 300 m (984 ft). Either activity is carried out in water depths that are substantially shallower than the bottom locations of potential obstructions from the Perdido project. Subsea production infrastructure would be located in water depths of approximately 2,378 m (7,800 ft). Because these subsea facilities (i.e., boosting systems, umbilicals, and flowlines) are in water depths >800 m (2,624 ft), they could be left in place without the requirement to sever and remove the equipment to a depth of 5 m (16 ft) below the mudline with MMS authorization. The USCG could designate and enforce a safety zone radius of 500 m (1,640 ft) from surface structure, if requested or required. As of early 2003, only seven deepwater production structures have established official safety zones, but they do not restrict vessels <30.5 m (100 ft) in length. Six other deepwater facilities were also in the process of requesting Coast Guard-designated safety zones.

Drilling fluids and cuttings discharged offshore would contribute to localized temporary marine environmental degradation. Drilling operations are restricted in time and pelagic species in the area could easily avoid discharge plumes. Routine discharges from the production spar facility 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 of nearshore and open marine environments is a persistent and recurring event resulting in frequent but nonlethal physiological irritation to those resources that lie within the range of impact. 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 of Grid 5.

Spills that could occur from the Perdido development and production activity would be few (if any), volumetrically small, and located near project activities in Alaminos Canyon 857, if they did occur. A blowout or large oil spill (≥1,000 bbl) from the PRH would be recovered offshore, and what is not recovered would arrive inshore in a highly weathered and degraded state. As discussed in Chapter 3.2.2.4.2 (Impacts on Fish Resources and Essential Fish Habitat), 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 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 effects caused by the level of activity of the Perdido project would be indistinguishable from variations due to natural causes.

Conclusion

There will be some unavoidable loss of fishing space because of the physical presence of the development that could otherwise have been used for pelagic fishing such as longlining. This impact is not considered to be significant because the overall footprint of the development is very small compared with the total space available in the Gulf, and the PRH will be the only surface structure in all of the Grid 5 area. A large oil spill might have commercial implications but, for the most part, the Gulf fishing fleets are highly mobile and cover a wide area. In addition, there are no commercially important demersal species at the water depth of this proposed action.

The proposed Perdido 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 Grid 5, nor is the Perdido project uniquely located to impact a commercial fishery that includes Grid 5 or adjacent grids. 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 spar structure and could potentially improve commercial catches using fishing techniques other than longlining. A large oil spill might adversely affect commercial resources, but impacts are recoverable within one year and Gulf fishing fleets can respond by temporarily moving the location of their operations.

3.3.1.2.3. Cumulative Analysis

Cumulative impacts on commercial fisheries are the same as on fish resources in general and on EFH. These impacts include (1) degradation of water quality from oil, fuel, and material spills, high nutrient loads, high turbidity, high BOD, urban runoff, industrial discharges, pathogens, trash and debris, and upriver contaminants; (2) loss of essential habitat important for parts of a fishery's life cycle, such as healthy estuarine systems (including wetland loss); and (3) overfishing.

Impact-producing factors of the cumulative scenario that are expected to substantially affect commercial fishing include commercial and recreational fishing techniques or practices, hurricanes, installation of other production platforms in the foreseeable future, additional underwater OCS obstructions, seismic surveys, petroleum spills, subsurface blowouts, and offshore discharges of drilling muds and produced waters. At the estimated level of cumulative impact, the resultant influence on commercial fishing, landings, and value of those landings is not expected to be substantial due to the remote location of Grid 5 and extreme water depths.

The incremental contribution of the proposed action's impacts to the cumulative impact on commercial fishing is negligible and likely undetectable among the other cumulative impacts.

3.3.1.3. Recreational Resources

3.3.1.3.1. Description

The northern GOM coastal zone is one of the major recreational regions of the U.S., particularly in connection with marine fishing and beach-related activities. The shorefronts along the Gulf Coasts of Florida, Alabama, Mississippi, Louisiana, and Texas offer a diversity of natural and developed landscapes and seascapes. The coastal beaches, barrier islands, estuarine bays and sounds, river deltas, and tidal marshes are extensively and intensively used for recreational activity by residents of the Gulf South and tourists from throughout the Nation, as well as from foreign countries. Publicly owned and administered areas (such as national seashores, parks, beaches, and wildlife lands), as well as specially designated preservation areas (such as historic and natural sites and landmarks, wilderness areas, wildlife sanctuaries, and scenic rivers), attract residents and visitors throughout the year. Commercial and private recreational facilities and establishments (such as resorts, marinas, amusement parks, and ornamental gardens) also serve as primary interest areas and support services for people who seek enjoyment from the recreational resources associated with the GOM.

Texas has 624 mi (1,004 km) of coastline on the GOM, approximately 480 mi (772 km) of which are beach (NRDC, 2004). The USEPA reports 166 beaches in 14 counties (USEPA, 2004b). Virtually the entire Texas coast is bordered by a barrier island system that separates the GOM from the bays. Although fishing activity is heavy in the bay systems, most swimming occurs on the Gulf beaches. According to National Survey on Recreation and the Environment (NSRE) 2000 data on beach visitation, Texas ranks fifth with 3.9 million participants. Most coastal travel occurs in Harris, Nueces, Cameron, and Galveston Counties.

Louisiana has about 397 mi (638 km) of general coastline and 7,721 mi of tidal shoreline, behind only Alaska and Florida in length of marine shore. Louisiana's coastline is primarily wetlands, and much of the State's 7,656 mi^2 of estuarine water is largely inaccessible to swimmers. The USEPA reports 16 coastal beaches in seven counties/parishes along the Gulf, half of which are in Cameron Parish (USEPA, 2004b). Louisiana beaches are primarily used by local and State residents, and use is highest during the spring and summer seasons (Louisiana Dept. of Health and Hospitals, Office of Public Health, 2005). The NSRE 2000 data on beach visitation estimates over 600,000 participants visited Louisiana beaches.

There is substantial recreational activity associated with the presence of oil and gas structures in the GOM from Alabama through Texas, and these activities have a considerable economic impact. A recent MMS study estimated that a total of 980,264 fishing trips were taken within 300 ft (91 m) of an oil or gas structure or an artificial reef created from such structures during 1999 out of a total 4.48 million marine recreational fishing trips in the Gulf from Alabama through Texas (Hiett and Milon, 2002). In addition, the study found that there were 83,780 dive trips near oil and gas structures out of a total 89,464 dive trips. Overall, the study estimated a total of $172.9 million in trip-related costs for fishing and diving near oil and gas structures, with $13.2 million in trip expenditures for diving and $159.7 million associated with trip expenses for recreational fishing.

The previous discussions describe the tourism and recreation baseline for the GOM prior to the impacts of Hurricanes Katrina and Rita. Both of these storms caused extensive adverse impact to tourism and recreation throughout the Gulf (USDOI, MMS, 2007; Chapters 3.3.2 and 3.3.3). These storms destroyed recreational beaches, public piers, hotels, casinos, marinas, recreational pleasure craft and charter boats, and numerous forms of other recreational infrastructure. The full extent of impacts to the tourism and recreation by the hurricanes has yet to be fully quantified, but it will likely take years for tourism and recreation to return to pre-hurricane levels.

3.3.1.3.2. Impact Analysis

The impact-producing factors associated with development and production of the Perdido project in Grid 5 that could affect recreational resources include trash and debris, blowouts, and spilled oil. Chapters 4.2.1.1.10 through 4.2.1.1.13 in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007) contain a discussion on impacts from OCS activity on recreational fishing and recreational resources and are incorporated into this PEA by reference.

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. The location of the Perdido project precludes any visual impacts on people engaged in activity along the shoreline or in coastal waters.

Very few recreational fishing trips go into deep water >100 mi (160 km) from shore and beyond the 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. 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 and debris include (1) accidental loss from staffed structures in State and Federal waters where hydrocarbons are produced, (2) commercial shrimping and fishing, (3) runoff from storm drains, (4) antiquated storm and sewage systems in older cities, and (5) commercial and recreational fishermen who discard plastics.

Spills that occur from Perdido development and production activity would be few (if any), volumetrically small, and located near project activities in Alaminos Canyon Block 857, if they did occur (Table A-5). Should a blowout or large oil spill ≥1,000 bbl occur as a result of Perdido project activity, the likelihood of contact with shoreline resources is very small. Should one 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.

The OSRA model is a computer simulation of oil-spill transport that uses realistic data for winds and currents. Table A-5 presents an esitmate of spill risk from the PRH facility to resouces. The risk of a coastal spill impact from the facility could be considered to be so low as to be near zero.

Conclusion

The proposed Perdido project is expected to have little impact on recreational resources. The risk of a large oil spill occurring because of the proposed development operations is very small. The displacements, inconvenience, or closure of recreational resources caused by an oil spill is below the level of social and economic concern. While some accidental loss of solid wastes may occur from the Perdido project or service vessels, existing mitigations and regulations that control the handling of offshore trash and debris would be expected to restrict these inputs so that they have a negligible impact on recreational resources.

3.3.1.3.3. Cumulative Analysis

Debris and litter derived from both offshore and onshore sources are likely to diminish the tourist potential of beaches and to degrade the ambience of shoreline recreational activities, thereby affecting the enjoyment of recreational beaches throughout the area. The incremental beach trash resulting from the proposed action is expected to be minimal.

Platforms and drilling rigs operating nearshore may affect the ambience of recreational beaches, especially beach wilderness areas. The sound, sight, and wakes of OCS-related and non-OCS-related vessels, as well as OCS helicopter and other light aircraft traffic, are occasional distractions that are noticed by some beach users.

Oil that contacts the coast may preclude short-term recreational use of one or more Gulf Coast beaches at the park or community levels. Displacement of recreational use from impacted areas will occur, and a short-term decline in tourism may result. Beach use at the regional level is unlikely to change from normal patterns; however, closure of specific beaches or parks directly impacted by a large oil spill is likely during cleanup operations. The incremental contribution of the Perdido project to the cumulative impact on recreational resources is minor due to the limited effect of increased helicopter, vessel traffic, and marine debris on the number of beach users. The cumulative impact of OCS and State oil and gas activities would be minor.

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 2005-G07 and NTL 2006-G07).

3.3.1.4.1. Prehistoric

3.3.1.4.1.1. Description

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. (CEI, 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-ft 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 depth 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.

3.3.1.4.1.2. Impact Analysis

The impact-producing factors associated with development and production of the Perdido project area in Alaminos Canyon Blocks 812, 813, 814, and 857 that could affect prehistoric archaeological resources include (1) direct contact or disturbance by the installation rig and spar anchors or mooring chains, (2) ferromagnetic structures or debris on the seabed, (3) onshore development in support of the project, and (4) oil spills. Chapters 4.2.1.1.12 and 4.2.2.1.14 in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007) contain a discussion of impacts from OCS activity and are incorporated into this PEA 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. No lease blocks in the Alaminos Canyon area or the entire Grid 5 area are located within MMS's designated high-probability areas for the occurrence of prehistoric archaeological resources.

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 Grid 5 (7,550-8,850 ft; 2,300-2,700 m), there is simply no potential for prehistoric archaeological resources in the area. The development activities for the Perdido project cannot possibly impact prehistoric archaeological resources.

Conclusion

There is no possibility that the proposed Perdido project will impact prehistoric archaeological resources because of the extreme water depths.

3.3.1.4.1.3. Cumulative Analysis

Grid 5 is located in water depths ranging between 7,550 and 8,850 ft (2,300 and 2,700 m), precluding the potential for prehistoric sites or artifacts.

Onshore prehistoric properties include sites, structures, and objects such as shell middens, earth middens, campsites, kill sites, tool manufacturing areqas, ceremonial complexes, and earthworks. At present, unidentified onshore preshitoric sites would have to be assessed after discovery to determine the uniqueness or significance of the information that they contain. Sites already listed in the National Register of Historic Places and those considered eligible for the Register have already been evaluated as having the potential for making a unique or significant contribution to science. Of the unidentified coastal preshitoric sites that could be impacted by onshore development, some may contain unique information.

Construction of new onshore facilities or pipelines in support of OCS activity or coastal development unrelated to OCS activity could result in the direct physical impact to previously unidentified prehistoric sites. This direct physical contact with a prehistoric site could cause physical damage to, or complete destruction of, information on the prehistory of the region and the Nation. Each facility constructed must receive approval from the pertinent Federal, State, county/parish, and/or community involved. Onshore archaeological resources would be protected through the review and approval processes of the various Federal, State, and local agencies involved in permitting onshore activities.

3.3.1.4.2. Historic

3.3.1.4.2.1. Description

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., 2003). 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. (2003), the shipwreck database lists no known shipwrecks that lie, or are presumed to lie, in Grid 5. The specific locations of archaeological sites cannot be known without first conducting a remote-sensing survey of the seabed and near-surface sediments. Regular reporting of shipwrecks did not occur until late in the 19th century, and losses of several classes of vessel, such as small fishing boats, were largely unreported in official records. 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 MMS approved the latest revision of NTL 2005-G07 "Archaeological Resource Surveys and Reports" on July 1, 2005. This revised NTL (1) continues to require a 50-m (164-ft) line-spacing density for historic shipwreck remote-sensing surveys in water depths less than 200m (656 ft) and a 300-m (984-ft) line-spacing density for historic shipwreck remote-sensing surveys in water depths greater than 200 m (656 ft), (2) increases the number of historic shipwreck blocks along the deepwater approach to the Mississippi River, (3) issues a reminder to operators of their requirement to notify MMS within 48 hours of the discovery of any potential archaeological site, and (4) updates some of the reporting requirements for archaeological assessments.

3.3.1.4.2.2. Impact Analysis

The impact-producing factors associated with development and production within the Perdido project area in Alaminos Canyon Blocks 812, 813, 814, and 857 that could affect archaeological resources include (1) direct contact or disturbance by the installation rig and spar anchors or mooring chains, (2) ferromagnetic structures or debris on the seabed, (3) onshore development in support of the project, and (4) oil spills. Chapters 4.2.1.1.12 and 4.2.2.1.14 in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007) contain a discussion of impacts from OCS activity and are incorporated into this PEA 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. Only one lease block in the Alaminos Canyon area (Alaminos Canyon Block 813), and the entire Grid 5 area, is located within MMS's designated high-probability areas for the occurrence of historic archaeological resources.

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 an historic archaeological resource from anchoring of the PRH or the installation of seabed production infrastructure for the Perdido 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. However, the use of a marine magnetometer for archaeological survey is not required in the Grid 5 area due to the extreme water depth. Therefore, the task of locating historic resources via an archaeological survey would not be made more difficult as a result of operational practices that leave ferromagnetic debris from OCS activity on the seabed.

Conclusion

Direct contact between anchors and mooring lines for OCS surface structures 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. The Perdido project is expected to have no direct or indirect impact on the inventory of known or unknown historical shipwrecks located in Grid 5. However, impacts are possible on a historic shipwreck because of incomplete knowledge about the location of shipwrecks in the Gulf, but they are not likely.

3.3.1.4.2.3. Cumulative Analysis

According to Garrison et al. (1989) and Pearson et al. (2003), the shipwreck database lists no known historic shipwrecks and one high-probability shipwreck block (Alaminos Canyon Block 813), which lies within Grid 5. The one high-probability shipwreck block is based on the presence of an unidentified sidescan-sonar target, which was located in this block during a recent high-resolution autonomous underwater vehicle survey.

No offshore historic properties have been identified in Grid 5. Onshore historic properties include locations such as historic buildings, forts, lighthouses, homesteads, cemeteries, and battlefields. Sites already listed on the National Register of Historic Places and those considered eligible for the National Register have already been evaluated as being able to make a unique or significant contribution to science. At present, unidentified historic sites may contain unique historic information and would have to be assessed after discovery to determine their importance.

Construction of new onshore facilities or pipelines in support of OCS activity or coastal development unrelated to OCS activity could result in the direct physical impact to previously unidentified historic sites. This direct physical contact with a historic site could cause physical damage to, or complete destruction of, information on the history of the region and the Nation. Each facility constructed must receive approval from the pertinent Federal, State, county/parish, and/or community involved. Onshore archaeological resources would be protected through the review and approval processes of the various Federal, State, and local agencies involved in permitting onshore activities.

3.3.2. Human Resources and Land Use

Human resources and land use in the Western Gulf are characterized in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007; Chapter 3.3.5) and are incorporated into this PEA by reference. Summaries of these resources follow and include (1) population and education, (2) infrastructure and land use, (3) navigation and port use, (4) employment, (5) current economic baseline data, and (6) environmental justice.

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. Chapters 4.2.1.1.13 and 4.2.2.1.15 in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007) contain a discussion of impacts on land use, coastal infrastructure, demographics, economic factors, and environmental justice from OCS activity and are incorporated into this PEA by reference.

The human resources and economic activity evaluated in this PEA are limited to that portion of the GOM's coastal zone directly or indirectly affected by OCS development and production in Grid 5. This economic area is concentrated primarily in Texas and Louisiana; however, multiplier effects extend into neighboring states as well. The impacts that result from industry activity on the Federal OCS are taking place in the midst of dynamic commercial and industrial enterprises that move goods and services on Gulf waters and that cause some of the same impact-producing factors as OCS activity.

3.3.2.1. Population and Education

3.3.2.1.1. Description

Tables 3-18 through 3-30 in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007) show baseline population projections for the potential impact areas. Baseline projections are for the impact area in the absence of the proposed activity. These projections include Woods & Poole's assumptions regarding Hurricane Katrina's impact on the Southeast. Table 3-34 in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007) presents population projections for eight counties and parishes that were the most negatively affected by Hurricanes Katrina and Rita in terms of population and employment losses: St. Bernard, Orleans, Plaquemines, Jefferson, and Cameron Parishes, Louisiana; and Hancock, Jackson, and Harrison Counties, Mississippi. 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). The GOM coastal region's population increased by 19 percent between 1990 and 2000 and by 9 percent between 2000 and 2006. The region's current total population is 23.3 million. In the U.S., population age structures typically reflect the presence of the baby-boom generation. This scenario is manifested in the Gulf Coast region by the relative decline in lower age cohorts over time. More distinctive is the changing race and ethnic composition of the region, which has a long-standing tradition of cultural heterogeneity (Gramling, 1994). While the African-American population increased 23.6 percent between 1990 and 2000, the growth rate has declined to 8.2 percent between 2000 and 2006. The Hispanic population increased 53.8 percent between 1990 and 2000 and has continued to increase rapidly since 2000 (24.4%). This group is now the second largest race/ethnic group in the region, making up 25.8 percent of the Gulf Coast population. Although Asians and Pacific

Islanders constitute a relatively small proportion of the Gulf Coast population, this group has experienced the highest growth rate between 1990 and 2000 (82.5%) and between 2000 and 2006 (28.2%). The white population has steadily declined and currently constitutes 53.6 percent of the region's population.

3.3.2.1.2. Impact Analysis

No project in Grid 5 is expected to exceed the employment and population impacts associated with the Thunder Horse project in Grid 16. Peak-year direct, indirect, and induced employment impacts associated with development activities proposed for Thunder Horse, the largest development plan proposed to date on the OCS, is projected to be comparable to that projected for the Perdido proposal. Should a project comparable in size and complexity to Thunder Horse occur in Grid 5, population impacts in any given subarea for any given year would still not be expected to exceed 1 percent of the baseline population for any subarea. 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 bases at Port Fourchon and Galveston, most of the additional employees associated with the Perdido project are not expected to require local housing.

Conclusion

The proposed Perdido project is expected to have a minimal impact on the region's population.

3.3.2.1.3. Cumulative Analysis

Activity from OCS development and production is expected to minimally affect the larger impact areas' demographic patterns or population or education levels but to moderately affect the population levels of local onshore areas where OCS activity is now concentrated. The impact region's population will continue to grow at a slow rate because of general economic development, including OCS activity. Baseline patterns and factors as described in Chapter 3.3.2 (Human Resources and Economic Activity) would not be expected to change for the impact area as a whole. Some coastal subareas, Port Fourchon and Galveston, for example, would be expected to experience some impacts due to population growth resulting from increasing demand for OCS labor and deepwater production activity. This peak period of population impacts is expected to occur between 2011 and 2014. These impacts could strain local infrastructure, such as schools, roads, hospitals, housing, and city services.

3.3.2.2. Infrastructure and Land Use

3.3.2.2.1. Description

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 the past two decades. 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 and into the Eastern Planning Area (EPA) where only exploration activities have taken place to date. The high level of offshore oil and gas activity in the GOM is accompanied by an extensive development of onshore service and support facilities. The major types of onshore infrastructure are described in Chapter 3.3.5.8 of the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007) and include gas processing plants, navigation channels, oil refineries, pipelines and pipeline landfalls, pipecoating and storage yards, platform fabrication yards, service bases, terminals, and other industry-related installations such as landfills and disposal sites for drilling and production wastes. The vast majority of this infrastructure also supports oil and gas activities in State waters and onshore.

Land use in the impact area varies from state to state. Louisiana's coastal impact area is mostly vast areas of wetlands and small communities and industrial areas that extend inland. The coasts of Texas and Florida are a mixture of urban, industrial, recreational beach, wetland, forest, and agricultural areas. 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.

3.3.2.2.2. Impact Analysis

The existing oil and gas infrastructure is expected to be sufficient to handle development associated with the Perdido project. The onshore support base for air transportation will be the existing PHI Heliport in Galveston, Texas. The onshore base for installation water traffic will be the existing Fourchon Terminal, while marine support for the drilling operation will be from existing facilities in Galveston, Texas. While support services will take place at these existing support bases, no expansion of these physical facilities is expected to result from the Perdido project. It is also unlikely that there will be any significant expansions at other existing infrastructure facilities as a result of the proposed activity. 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.

Activities associated with the Perdido project are not expected to significantly impact forms of social infrastructure (e.g., schools, hospitals, social services, etc.) in Galveston or Port Fourchon. This is due to the minimal population increase expected due to the project (Chapter 3.3.2.1.2, Population Impact Analysis).

Spills that occur from Perdido development and production activity would be few (if any), volumetrically small, and located near project activities if they did occur (see Table A-5). Should a blowout or large oil spill occur as a result of Perdido project activity, the likelihood of contact with shoreline resources is very small. Smaller spills would be subject to weathering and dispersion and would likely dissipate before landfall.

Conclusion

The proposed Perdido project is expected to have minimal impact on the region's existing infrastructure or land-use patterns. The existing oil and gas infrastructure is expected to be sufficient to handle development associated with the Perdido project. Accidental events such as oil spills and blowouts would have no effects on land use.

3.3.2.2.3. Cumulative Analysis

Much of the cumulative analysis for land use and coastal infrastructure presented in Chapter 4.5.15.1 of the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007) is applicable to the cumulative analysis of Grid 5 and is incorporated into this PEA by reference. Land use in the analysis area will evolve over time. The majority of this change is estimated as general regional growth rather than activities associated with the OCS Program and State oil and gas activities. Except for the projected new gas processing plants (up to 14 assuming average retirement and no expansions and/or the addition of new capacity to replace what is physically depreciating at all existing facilities) and the 4-6 pipeline shore facilities, the OCS Program will require no new oil and gas coastal infrastructure. There may be some expansion at current facilities, but the land in the analysis area is sufficient to handle development. There is also sufficient land to construct the projected new gas processing plants and pipeline shore facilities in the analysis area. While it is possible that up to 14 new, greenfield gas processing facilities could be developed, it is much more likely that a large share of the natural gas processing capacity that is needed in the industry will be located at existing facilities, using future investments for expansions and/or to replace depreciated capital equipment. New facilities and expansions would also support State oil and gas production. Thus, the results of OCS and State oil and gas activities are expected to minimally alter the current land use of the area.

Shore-based OCS and State servicing should also increase very slightly in the ports of Galveston, Texas; Port Fourchon, Louisiana; and Mobile, Alabama. There is sufficient land designated in commercial and industrial parks and adjacent to the Galveston and Mobile area ports to minimize disruption to current residential and business use patterns. Port Fourchon, though, has limited land available; operators have had to create land on adjacent wetland areas. Any changes in the infrastructure at Port Fourchon that lead to increases in Louisiana Highway 1 (LA Hwy 1) usage will contribute to the increasing deterioration of the highway. In the absence of the planned expansions, LA Hwy 1 would not be able to handle future OCS and State activities. Additional OCS activity will further strain Lafourche Parish's social infrastructure as well, such as local schools and the water system.

Other ports in the analysis area that have sufficient available land plan to make infrastructure changes. Since the State of Florida and many of its residents reject any mineral extraction activities off their coastline, oil and gas businesses are not expected to be located there.

The incremental contribution of the Perdido project to the cumulative impacts on land use and coastal infrastructure are expected to be minor. Of the new coastal infrastructure projected as a result of the OCS Program, none are expected to be constructed as a result of the proposed project. The proposed project would contribute to a very small percentage of the projected OCS-related activity at Port Fourchon.

3.3.2.3. Navigation and Port Use

3.3.2.3.1 Description

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.

3.3.2.3.2 Impact Analysis

The onshore support base for air transportation will be the existing PHI Heliport in Galveston, Texas. The onshore base for installation water traffic for the project will be the existing Fourchon Terminal in LA, while marine support for the drilling operation will be from existing facilities in Galveston, Texas. Both Fourchon and Galveston have longstanding and intensively used support facilities, and 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. No new navigation channels will be required by, and current navigation channels will not change as a result of the Perdido project.

Three supply/support vessels and two crewboats are expected to make two trips per week during the development and operation stages of the project. Seven helicopter trips per week are expected during the setting and installation stages of the project. Twelve helicopter trips per week are expected for drilling support and two trips per week are expected for operations support.

Spills that occur from Perdido development and production activity would be few (if any), volumetrically small, and located near project activities if they did occur (Table A-5). Smaller spills would be subject to weathering and dispersion and would likely dissipate before landfall. Accidental events such as oil spills and blowouts would likely have minimal impact on navigation and port use.

Conclusion

The proposed Perdido project is expected to have a minimal impact on navigation and port use.

3.3.2.3.3 Cumulative Analysis

Activity from OCS development and production is expected to minimally affect the impact areas' navigation and port usage patterns. The OCS Program will require no new navigation channels. A few OCS-related port channels may be deepened or widened during the impact period to accommodate deeper draft vessels necessary for deepwater development. The continued use of Port Fourchon by industry operators will place demands for channel maintenance and semi-regular dredging programs to ensure the port's, channels, navigation corridors, turning basins, and berthing areas can handle deeper draft vessels that typically service deepwater facilities. The USCOE surveys the navigation channels for which they are responsible every two years to determine the need for dredging. Dredging is then carried out as needed, but typical cycles between maintenance can be 1-6 years. Over the next few years USCOE expects to deepen many port access channels to accommodate deep-draft vessels (to about 7 m (23 ft)) (USDOI, MMS, 2007; page 4-64).

The incremental contribution of the Perdido project to the cumulative impacts on navigation and port use are expected to be minor. The number of service-vessel trips and helicopter trips related to the project represents a very small percentage of those estimated to be related to OCS Program activities in the WPA (USDOI, MMS, 2007; Table 4-5). The proposed project would contribute to a small percentage of the projected OCS-related activity at Port Fourchon.

3.3.2.4. Employment

3.3.2.4.1. Description

Table 3-41 in the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007) contains the analysis area's baseline employment projections by MMS-defined EIA. These projections are based on the Woods & Poole's *Complete Economic and Demographic Data Source* (Woods & Poole Economics, Inc., 2006) and assume the continuation of existing social, economic, and technological trends at the time of the forecast. Therefore, the projections include employment associated with the continuation of current patterns in OCS leasing activity as well as the continuation of trends in other industries important to the region. These projections also include Woods & Poole's assumptions regarding Hurricanes Katrina and Rita's impact on the Southeast.

Average annual employment growth projected from 2005 through 2030 ranges from a low of 1.22 percent for EIA LA-4 to a high of 2.50 percent for EIA FL-1 in the western panhandle of Florida. Over the same time period, employment for the United States is expected to grow at about 1.57 percent per year, while the GOM economic impact analysis area is expected to grow at about 1.73 percent per year. As described above, this represents growth in general employment for the EIA's.

The industrial composition for the EIA's in the WPA and that in the CPA are similar. In 2005, the top three ranking sectors in terms of employment in all EIA's in the analysis area, except FL-4, were the services, retail trade, and State and local government sectors—with the service industry ranking number one in all EIA's and retail trade ranking second in all EIA's, except FL-2, where State and local government is second. In FL-4, the top three rankings sectors were services; retail trade; and finance, insurances and real estate, in that order, with State and local government a close fourth. In EIA's TX-1, LA-1, LA-3, and FL-2, construction ranks fourth; in EIA's AL-1, MS-1, and TX-2, manufacturing ranks fourth; in EIA's LA-4, TX-3, and FL-3, finance, insurance, and real estate ranks fourth; and in EIA LA-2, mining ranks fourth.

3.3.2.4.2. Impact Analysis

The importance of the oil and gas industry to the coastal communities of the GOM is significant, particularly in Louisiana, eastern Texas, and coastal Alabama. This economic analysis focuses on the potential direct, indirect, and induced impacts of the OCS oil and gas industry on the population and employment of the counties and parishes in the impact region.

Peak-year direct, indirect, and induced employment associated with development activities proposed for Thunder Horse in Grid 16, the largest development plan proposed to date on the OCS, was projected at about 1,500 jobs (USDOI, MMS, 2002b). Total peak-year employment projections for activities resulting from the Marco Polo project in Grid 13 were comparable to Thunder Horse, 1,565 jobs per year throughout all subareas: 795 direct, 350 indirect, and 420 induced (USDOI, MMS, 2003d). The total peak-year employment from the Perdido project is not expected to exceed these projects and is expected to occur between 2011 and 2014.

The Perdido project is expected to have minimal impacts on employment throughout all 13 of the EIA's identified above in Chapter 3.3.1.1 (Socioeconomic Impact Area). The majority of employment resulting from the Perdido project is expected to occur in EIA's TX-1, TX-2, TX-3, LA-1, LA-2, and LA-3 because of the location of the project and because the oil and gas industry is best established in these areas. Even assuming that all 1,500 jobs would occur in any single EIA in Texas or Louisiana, a highly unrealistic assumption but one used to evaluate maximum possible impacts, employment does not exceed 1 percent of the total baseline employment projections for any given EIA during 2011 through 2014. This demand is expected to be met primarily with the existing available labor force.

Spills that occur from Perdido project activity would be few (if any), volumetrically small, and located near project activities if they did occur (Table A-5). Should a blowout or large oil spill occur, the likelihood of contact with shoreline resources is very small. Smaller spills would be subject to weathering and dispersion and would likely dissipate before landfall. The potential positive and negative employment impacts of an oil spill are characterized in Chapter 4.4.14.3 of the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007) and are incorporated into this PEA by reference. The net employment impacts of a spill are expected to be minimal.

Conclusion

The proposed Perdido project is expected to have minimal impacts on employment in the Texas, Louisiana, Mississippi, Alabama, and Florida EIA's. The project is expected to generate less than a 1 percent increase in employment in any of these subareas.

3.3.2.4.3. Cumulative Analysis

Much of the cumulative analysis for economic factors presented in Chapter 4.5.15.3 of the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007) is applicable to this cumulative employment analysis and is incorporated into this PEA by reference. This cumulative employment analysis focuses on the potential direct, indirect, and induced employment impacts from activities in Grid 5, together with those of other likely future projects (including those under the OCS Program), and trends in the region. Most approaches to analyzing cumulative effects begin by assembling a list of "other likely projects and actions" that will be included with the proposed action for analysis. However, no such list of future projects and actions could be assembled that would be sufficiently current and comprehensive to support a cumulative analysis for all 132 of the coastal counties and parishes in the analysis area over the time period of analysis. Instead of an arbitrary assemblage of future possible projects and actions, this analysis employs the baseline employment projections from Woods & Poole Economics, Inc. (2006) used above in Chapter 3.3.2.4.2 to define the contributions of other likely projects, actions, and trends to the cumulative case. These projections represent a more comprehensive and accurate appraisal of cumulative conditions than could be generated using the traditional list of possible projects actions.

The incremental contribution of the Perdido project to the cumulative employment impacts are expected to be minor. No project in Grid 5 is expected to exceed the employment impacts associated with the Thunder Horse project in Grid 16. Should a project comparable in size and complexity to Thunder Horse occur in Grid 5, employment impacts in any given subarea for any given year would still not be expected to exceed 1 percent of the baseline employment for any subarea (see Chapter 3.3.2.4.2. above).

Employment demand will continue to be met primarily with the existing population and available labor force in most EIA's. The MMS does expect some employment will be met through in-migration; however, this level is projected to be small and localized. Port Fourchon is experiencing full employment, housing shortages, and stresses on local infrastructure—roads (LA Hwy 1), water supply, schools, hospitals, etc. Port Fourchon is a focal point for OCS development, especially deepwater OCS operations. The Port (and the surrounding community and infrastructure) is experiencing increased activity as a result of the 2005 hurricane season. Any additional employment, particularly new residential employment, and the resultant strain on infrastructure, are expected to have a significant impact on the area. In addition, ports throughout the Gulf are experiencing labor shortages for higher skilled positions as electricians, fitters, crane operators, and boat captains, an issue that existed prior to the 2005 hurricane season. This may lead to additional in-migration to these areas to fill these positions.

3.3.2.5. Current Economic Baseline Data

Oil and natural gas prices are used to evaluate the oil and gas industry's ability to economically develop resources. Current oil and natural gas prices are above the economically viable threshold for drilling in the GOM. As of January 17, 2007, the West Texas Intermediate price was $52.25/bbl and the Henry Hub natural gas price was $6.565/MMBtu in the U.S. spot market (Oilnergy, 2007). On January 11, 2007, the NYMEX February contract for benchmark U.S. light sweet crude was $51.88/bbl (Oil and Gas Journal Online, 2007).

Drilling rig use is employed by the industry as another barometer of economic activity. Rig utilization rates were 87.5 percent in January 2007 and 83.2 percent in December 2006, an increase over the 78.9 percent in January 2006 (Rigzone, 2007). The average jack-up day rate in the GOM for December 2006 was $109,364 compared with $104,511 for December 2005 (Gulf of Mexico Newsletter, 2006a; 21:8). The average day rate trend for semisubmersibles in the GOM took a sharp upward turn in

December 2006 after falling slightly in November. The November average day rate was $356,833, while December's was $487,000. The increase can be attributed to continued deepwater demand and two new fixtures in December exceeding $500,000 per day (Gulf of Mexico Newsletter, 2006a; 21:8). As rig day rates hover at record highs, rig demand has been increasing worldwide. In 2005, 8 rigs were delivered; for 2006, 12 rigs were scheduled to be delivered (Gulf of Mexico Newsletter, 2006b; 20:35). The increasing number of rigs under construction and scheduled for delivery is insufficient to meet operators' growing demand for contract drilling services worldwide, so the tight U.S. Gulf rig supply situation will continue. More upward pressure on GOM day rates seems likely, as a number of rigs will leave the area for long-term commitments in other markets.

Heightened activity in the offshore rig market has also meant a boom for offshore service vessels (OSV). Though OSV activity is expected to decline soon in the GOM due to weather and scheduling, the GOM fleet remained working, keeping utilization at essentially 100 percent (Gulf of Mexico Newsletter, 2006c; 21:7). The November 2006 average day rates were as follows: anchor-handling tug/supply (AHTS) $70,000 for over 8,000-hp vessels; supply boat ranges from $12,200 for boats up to 200 ft and $18,625 for boats 200 ft and over; and crewboats range from $6,350 for boats under 125 ft to $6,975 for boats 125 ft and over (Greenberg, 2007). In comparison, the November 2005 average day rates were as follows: AHTS vessel ranged from $60,000 for over 8,000-hp vessels; supply boat ranged from $9,550 for boats up to 200 ft and $16,775 for boats 200 ft and over; and crewboats ranged from $3,925 for boats under 125 ft to $7,130 for boats 125 ft and over (Greenberg, 2007).

Another indicator of the direction of the industry is the exploration and production (E&P) expenditures of the oil and gas companies. According to the annual *Original E&P Spending Survey* by equity research analysts at Lehman Brothers, U.S. exploration and production spending will increase to $57 billion in 2006 compared with estimated 2005 expenditures of $50 billion (Gulf of Mexico Newsletter, 2005; 20:9). This represents a 14.9-percent increase in spending on the part of the 247 companies participating in the survey. However, Lehman analysts note that costs are driving budgets and that much of this spending increase is being driven by higher costs. In a reversal of the trend in recent years, most majors are budgeting higher domestic spending in 2006. Lehman analysts believe that they have recently become more attracted to unconventional gas plays and that increased competition abroad from national oil companies and limited access to some areas of the world is pushing the majors back to the United States (Gulf of Mexico Newsletter, 2005; 20:9).

Lease sales are another indicator of the offshore oil and gas industry. Sales over the last several years have resulted in a relative increase in the number of blocks leased. Lease Sale 200, which was held in August 2006, garnered close to $341 million in high bids from 62 companies. The total of all 541 bids on 381 tracts was nearly $463 million, a 38 percent increase over last year's Western Gulf sale. Interest in deepwater oil and gas production continues to grow, with 67 percent of all tracts receiving bids in water depths greater than 400 m (1,312 ft). The increased number of tracts receiving bids in shallow water indicates ongoing industry interest in deep gas in shallow waters as well.

3.3.2.6. Environmental Justice

3.3.2.6.1. Description

On February 11, 1994, President William J. Clinton issued Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, which directs Federal agencies to assess whether their actions have disproportionate environmental effects on people of ethnic or racial minorities or people with low incomes. Those environmental effects encompass human health, social, and economic consequences. The Federal agency in charge of the proposed action must provide opportunities for community input during the NEPA process (See Chapter 4 for a discussion of consultation and coordination.). There are no environmental justice issues in the actual offshore Gulf of Mexico OCS planning areas; however, environmental justice concerns may be related to nearshore and onshore activities in support of the proposed Perdido project. Environmental justice issues are in two categories—those related to routine operations and those related to accidental events. Issues related to routine operations center on increases in onshore activity (such as employment, migration, commuter traffic, and truck traffic) and on additions to or expansions of the infrastructure supporting this activity (such as fabrication yards, supply ports, and onshore disposal sites for offshore waste). Issues related to accidents focus on oil spills.

3.3.2.6.2. Impact Analysis

Federal agencies are directed by Executive Order 12898 to assess whether their actions would have a disproportionate and negative effect on the environment and health of people of ethnic or racial minorities or those with low income. The existing onshore facilities that can support the projected deepwater developments within Grid 5 are well established along the Gulf Coast, and no disproportionate impacts on ethnic or racial minorities or poor people would result from their continued operation.

Conclusion

The proposed Perdido project is expected to have no impacts on existing equities of environmental justice.

3.3.2.6.3. Cumulative Analysis

Future years may bring expansion or upgrading of existing onshore facilities that support OCS activities in Grid 5, but entirely new development is unlikely. The existing coastal support facilities are well established, and no disproportionate effects on ethnic or racial minorities or poor people would be expected to result from their continued operation. In the GOM coastal area, the contribution of the Perdido project to the cumulative effects of all activities and trends affecting environmental justice issues is expected to be negligible to minor. Chapter 4.5.15.4 of the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007) has a discussion of cumulative environmental justice effects in Lafourche Parish, Louisiana.

4. CONSULTATION AND COORDINATION

Necessary consultation and coordination for this proposed action was conducted during the preparation of the WPA/CPA Final Multisale EIS (USDOI, MMS, 2007). The States of Texas and Louisiana have approved Coastal Zone Management (CZM) Programs. Therefore, certificates of coastal zone consistency from the States were required for the proposed activities. The MMS mailed the DOCD and other required and necessary information to the Texas Coastal Council and Louisiana Department of Natural Resources for CZM concurrence on November 14, 2006. The State of Texas on December 11, 2006, and the State of Louisiana on December 13, 2006, provided letters with a Certificate of Coastal Zone Consistency with the State's CZM Program. The MMS published a description of Shell's proposed action in the *Galveston News* on January 13, 2007; the *Houston Business Journal* on January 19, 2007; and *The Times-Picayune* on January 19, 2007. The description provided the public with a Notice of Intent (NOI) to prepare an EA and outlined the activities Shell proposed for the Perdido project. The NOI requested that interested parties submit comments to MMS on issues that should be addressed in the PEA. The 30-day comment period ended on February 18, 2007. No comments were received during this period.

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7. APPENDIX

Appendix A—Accidental Oil-Spill Review

Appendix A

Accidental Oil-Spill Review

ANALYSIS OF THE POTENTIAL FOR AN ACCIDENTAL OIL SPILL AND THE POTENTIAL FOR IMPACTS FROM THE PERDIDO DEVELOPMENTS — GRID 5 (ALAMINOS CANYON BLOCKS 812, 823, 814, AND 857)

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 decisionmaking. The NEPA analyses address many issues relating to potential impacts, including issues that may have a very low probability of occurrence, but which the public considers important or for which the environmental consequences could be significant.

The past several decades of spill data show that accidental oil spills (≥1000 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), yet the issue of oil spills is important to the public. This document summarizes key information about the probability of accidental spills from offshore oil and gas activities in the GOM.

Spill Prevention

The Minerals Management Service (MMS) has comprehensive pollution prevention requirements that include numerous 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 occurrence and associated impacts. Details regarding MMS engineering and safety requirements can be found at 30 CFR 250.800 Subpart H.

OCS Spills in the Past

This summary of past OCS spills presents data for the period 1985-1999. The 1985-1999 time period was chosen to reflect more modern engineering and regulatory requirements and because OCS spill rates are available for this period. 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-1 through A-3). The most recent Final EIS's provide additional information on past OCS spills.

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 spill occurrence 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 the following sources: facilities, pipelines, and drilling.

Spill rates for facilities and pipelines have been developed for several time periods, and an analysis of trends for spills is presented in *Update of Comparative Occurrence Rates for Offshore Oil Spills* (Anderson and Labelle, 2000). Spill rates for the most recent period analyzed, 1985-1999, are presented here. Data for this recent period should reflect 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 blowouts are based on the number of blowouts with a release of oil per number of wells drilled. Spill rates for the period 1985-1999 are shown in Table A-4. 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 non-zero 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 the 1985-1999 period 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 non-zero spill rate. Spill rates are combined with site-specific data on production or pipeline volumes 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 a 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

Shell proposes to construct the Perdido Regional Host (PRH) facility in Alaminos Canyon (AC) Block 857. Moored in approximately 7,800 ft (2,380 m) of water, the PRH would be the deepest spar production facility in the world. Oil and gas produced at the Great White (Alaminos Canyon Blocks 812, 813, 814, 857, 900, and 901), Tobago (Alaminos Canyon Block 859), and Silvertip (Alaminos Canyon Block 815) Fields will be transported to the host facility via pipelines from these subsea facilities. The oil production from PRH would be sent through export pipelines to an existing pipeline in Alaminos Canyon Block 25 and gas production from PRH would be sent through export pipelines to an existing pipeline in East Breaks Block 599. Table A-5 presents an estimate of spill risk from the facility to resources. The risk estimate for the facility was calculated using the spill rate of 0.13 per billion barrels of oil produced, the estimated production for the proposed action, and oil-spill trajectory calculations.

The coastline and associated environmental resources are presented in Table A-5. The final column in Table A-5 presents the result of combining the SOV's and the TV's. 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 Final EIS's provide additional information on spills and potential impacts. The following section provides additional information regarding the spill-response preparedness requirements of MMS.

Spill Response

The MMS has extensive requirements for preparedness to respond to a spill in the event of an accidental spill. 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 subject operator has an oil-spill response plan on file with MMS and has current contracts with the offshore oil-spill response organizations, Clean Gulf Associates and the Marine Spill Response Corporation.

Potential spill sources during the life of this development project (20 years) would include an accidental blowout (worst case estimated to be approximately 37,000 bbl/day), a spill of liquid oil stored on the platform (approximately 4,100 bbl total storage capacity including flowlines on the platform), a spill of liquid oil stored on the rig (approximately 30,562 bbl total storage capacity), a spill of liquid oil stored on the associated vessels (capacity of the largest vessel is 78,000 bbl), or a spill from the associated oil flowlines or the export pipelines (total worst case for all pipelines estimated to be approximately 8,302 bbl). The operator has demonstrated spill-response preparedness for accidental releases in their oil-spill response plan. Details regarding a proposed response to this facility are included in the proposed plan.

The MMS will continue to verify the operator's capability to respond to oil spills via MMS Oil Spill Program. The operator is required to keep their oil-spill response plan up to date in accordance with MMS regulations. The operator must also conduct an annual drill to demonstrate the adequacy of their spill preparedness.

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Table A-1

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-2

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 (bbl)	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-3

Historical Record of OCS Spills ≥1,000 Barrels 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-4

Spill Rates Used to Estimate the Future Potential for Spills

Spill Source	Volume of Oil Handled in Billions of Barrels	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 non-zero risk.

[b] There have been no spills ≥1,000 bbl from blowouts during the period 1985-1999. One spill was "assigned" to provide a non-zero spill rate.

[c] There were no facility or blowout spills ≥1,000 bbl for the period 1985-1999; however, a non-zero 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-5

Spill Risk Estimate for Facilities(1)

Environmental Resource	Spill Occurrence Variable (2) (%) for the Perdido Hub	Transport Variable for Spill Launch Area 11 (3) within 3/10/30 days (%)	Transport Variable for Spill Launch Area 27 (3) within 3/10/30 days (%)	Spill Risk (4) within 3/10/30 days for Spill Lauch Area 11 (%)	Spill Risk (4) within 3/10/30 days for Spill Lauch Area 27 (%)
Counties/ Parishes					
Cameron, TX	9	<0.5/1/5	<0.5/<0.5/2	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Willacy, TX	9	<0.5/<0.5/2	<0.5/<0.5/1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Kenedy, TX	9	<0.5/1/8	<0.5/<0.5/4	<0.5/<0.5/1	<0.5/<0.5/<0.5
Kleberg, TX	9	<0.5/1/6	<0.5/<0.5/3	<0.5/<0.5/1	<0.5/<0.5/<0.5
Nueces, TX	9	<0.5/<0.5/4	<0.5/<0.5/2	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Aransas, TX	9	<0.5/1/5	<0.5/<0.5/3	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Calhoun, TX	9	<0.5/1/6	<0.5/<0.5/3	<0.5/<0.5/1	<0.5/<0.5/<0.5
Matagorda, TX	9	<0.5/1/10	<0.5/<0.5/7	<0.5/<0.5/1	<0.5/<0.5/1
Brazoria, TX	9	<0.5/<0.5/2	<0.5/<0.5/2	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Galveston, TX	9	<0.5/<0.5/3	<0.5/<0.5/3	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Chambers, TX	9	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Jefferson, TX	9	<0.5/<0.5/1	<0.5/<0.5/1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Cameron, TX	9	<0.5/<0.5/1	<0.5/<0.5/3	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5
Vermilion, La.	9	<0.5/<0.5/<0.5	<0.5/<0.5/1	<0.5/<0.5/<0.5	<0.5/<0.5/<0.5

(1) This combined risk analysis covers only the hub and subsea wells since the right-of-way pipeline application associated with the project has not yet been submitted and is likely to cover additional spill launch areas. A determination of these spill launch areas is not practical at this time since the exact route of the projected ROW pipeline has not been officially proposed by the operator—only tentative plans for the pipeline have been disclosed.
(2) The percent chance of a spill event occurring from the proposed Perdido activities. These calculations do not cover the future use of this platform as a hub facility.
(3) The percent chance that winds and currents will move a point projected onto the surface of the Gulf of Mexico beginning within the area of the proposed project and ending at specified shoreline segments or environmental resources within 30 days. 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. Model results used are for spill launch areas W011 and W027.
(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 (1) and (2).

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.