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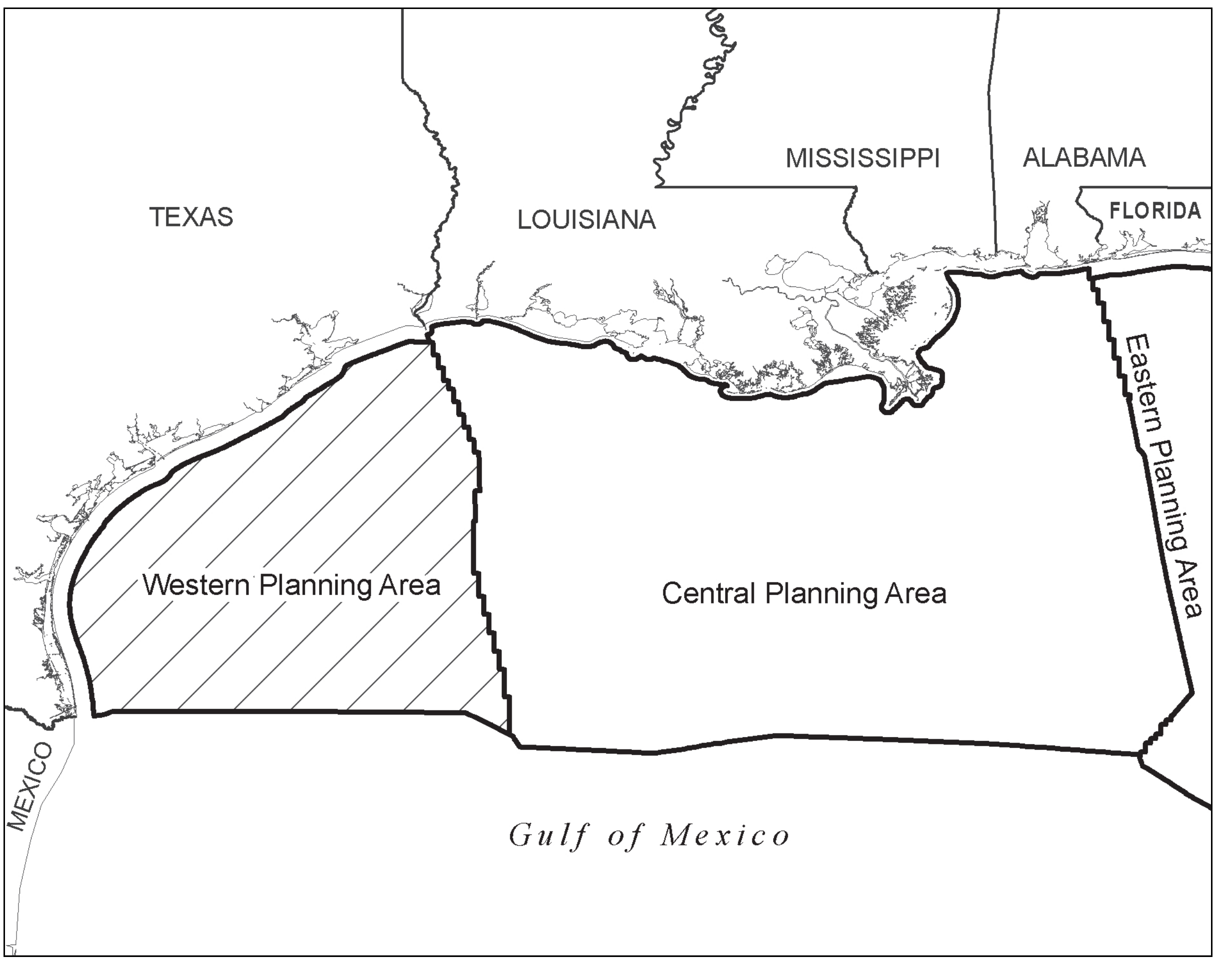
BOEMRE 2011-034

Gulf of Mexico OCS
Oil and Gas Lease Sale: 2011

Western Planning Area Lease Sale 218

Final Supplemental Environmental Impact Statement

Volume II: Chapters 5-8 and Appendices



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Chapter 5

Consultation and Coordination

5. CONSULTATION AND COORDINATION

5.1. DEVELOPMENT OF THE PROPOSED ACTION

The purpose of this Supplemental EIS is to address the remaining proposed Gulf of Mexico WPA OCS oil and gas lease sale (Lease Sale 218) scheduled under the *Outer Continental Shelf Oil and Gas Leasing Program: 2012-2017* (5-Year Program). This Supplemental EIS was prepared because of the potential changes to the baseline conditions of the environmental, socioeconomic, and cultural resources that may have occurred as a result of (1) the DWH event between April 20 and July 15, 2010 (the period when oil flowed from the Macondo well in Mississippi Canyon Block 252 [**Figure 1-2**]); (2) the acute impacts that have been reported or surveyed since that time; and (3) any new information that may be available since the publication of the Multisale EIS or the 2009-2012 Supplemental EIS. The environmental resources include sensitive coastal environments, offshore benthic resources, marine mammals, sea turtles, coastal and marine birds, endangered and threatened species, and fisheries. This Supplemental EIS analyzes the potential impacts of the proposed action on the marine, coastal, and human environments. It is important to note that this Supplemental EIS was prepared using the scientifically credible information that was publicly available at the time this document was prepared.

5.2. NOTICE OF PREPARATION OF THE SUPPLEMENTAL EIS

On November 10, 2010, a Notice of Intent to Prepare a Supplemental EIS (NOI) was published in the *Federal Register*. A second NOI was published on November 16, 2010, to correct clerical errors. Additional public notices were distributed via local newspapers, the U.S. Postal Service, and the Internet. A 45-day comment period, which closed on January 3, 2011, was announced for the NOI. Federal, State, and local governments, along with other interested parties, were invited to send written comments to the Gulf of Mexico OCS Region on the scope of the Supplemental EIS. The comments in these letters are summarized in **Chapter 5.3.2.**

5.3. DEVELOPMENT OF THE DRAFT SUPPLEMENTAL EIS

Scoping for the Draft Supplemental EIS was conducted in accordance with CEQ regulations implementing NEPA. Scoping provides those with an interest in the OCS Program an opportunity to provide comments on the proposed action. In addition, scoping provides BOEMRE an opportunity to update the Gulf of Mexico OCS Region's environmental and socioeconomic information base. The scoping process commenced on November 16, 2010, with the publication of the corrected NOI in the *Federal Register*. The NOI and scoping process was conducted for both this Supplemental EIS for the WPA and for a separate Supplemental EIS for the CPA, which is currently under development. Scoping meetings were held in Louisiana, Texas, and Alabama. No meeting had more than 15 attendees. The dates, times, locations, and public attendance of the scoping meetings for the proposed Draft Supplemental EIS were as follows:

Tuesday, November 16, 2010
1:00 p.m. CST until adjournment
Hilton New Orleans Airport
New Orleans, Louisiana
9 registered attendees
4 speakers

Wednesday, November 17, 2010
1:00 p.m. CST until adjournment
Houston Airport Marriott
Houston, Texas
16 registered attendees
5 speakers

Thursday, November 18, 2010
1:00 p.m. CST until adjournment
The Battle House Renaissance
Mobile Hotel and Spa
Mobile, Alabama
13 registered attendees
4 speakers

5.3.1. Summary of Scoping Comments

Comments (both verbal and written) were received in response to the NOI and from the three scoping meetings from Federal, State, and local government agencies; interest groups; industry; businesses; the Seminole Tribe of Florida; and the general public on the scope of the Supplemental EIS, significant issues that should be addressed, alternatives that should be considered, and mitigation measures. All scoping comments received were considered in the preparation of this Supplemental EIS. All speakers at the scoping meetings were generally supportive of the proposed lease sales and recognized the economic benefits of the OCS Program. Comments received from attendees included the following:

- use currently available new information to evaluate impacts;
- supported holding lease sales as soon as possible;
- move expeditiously to complete the Supplemental EIS;
- cancelling lease sales would harm the economy, damage energy production, depress job creation, and reduce revenues to the State and Federal treasuries;
- resume permitting of existing leases;
- Lease Sales 216, 218, and 222 should be held with no reduction in acreage;
- recommended that the Supplemental EIS incorporate all new regulations and requirements put in place post-Macondo; and
- put no restrictions on drilling in deepwater areas.

5.3.2. Summary of Written Comments Received in Response to the Notice of Intent

In response to the NOI, BOEMRE received 11 individual letters by e-mail, 595 identical form e-letters from an advocacy website, and a package of three CD's with over 20,000 identical website-derived form letters from an advocacy group. Information submitted from written comments is summarized in **Table 5-1**, including the form letters submitted by the Consumer Energy Alliance. All scoping comments received were considered in the preparation of this Supplemental EIS. Scoping comments appropriate for a lease sale NEPA document include scenario information; physical, biological, and socioeconomic resources to consider; impacting factors and impacts on resources; alternatives to be analyzed; and mitigation measures. Several comments received did not apply to scoping for this document including, but not limited to, scheduling and delays of remaining lease sales, expediting the completion of the Supplemental EIS, impacts from delay of the lease sales that had been scheduled as part of the 5-Year Program, categorical exclusions, and using this Supplemental EIS as a document to tier future lease sales for the 2012-2017 lease sale program. All other comments described in **Table 5-1** were considered in this document.

5.3.3. Cooperating Agency

According to Part 516 of the DOI Departmental Manual, BOEMRE must invite eligible governmental entities to participate as cooperating agencies when developing an EIS, in accordance with the requirements of NEPA and the CEQ regulations. The BOEMRE must also consider any requests by eligible government entities to participate as a cooperating agency with respect to a particular EIS, and then to either accept or deny such requests.

The NOI's published on November 10 and November 16, 2010, included invitations to other Federal agencies and State, tribal, and local governments to consider becoming cooperating agencies in the preparation of this Supplemental EIS. The USEPA (Region 6) and NOAA requested to participate as cooperating agencies. The BOEMRE has accepted NOAA and USEPA (Region 6) as cooperating agencies.

5.4. Distribution of the Draft Supplemental EIS for Review and Comment

The BOEMRE sent copies of the Draft Supplemental EIS to the public and private agencies and groups listed below. Local libraries along the Gulf Coast were provided copies of this document; a list of these libraries is available on the BOEMRE Internet website at http://www.gomr.boemre.gov/homepg/regulate/environ/libraries.html. To initiate a public review and comment period on the Draft Supplemental EIS, BOEMRE published a Notice of Availability in the *Federal Register* on April 20, 2011 (USEPA Notice of Availability publication date, April 22, 2011); all comments received were considered in the preparation of this Final Supplemental EIS.

Federal Agencies

Congress
- Congressional Budget Office
- House Resources Subcommittee on Energy and Mineral Resources
- Senate Committee on Energy and Natural Resources

Department of Commerce
- National Marine Fisheries Service
- National Oceanic and Atmospheric Administration

Department of Defense
- Department of the Air Force
- Department of the Army
  - Corps of Engineers
- Department of the Navy
  - Naval Mine and ASW Command

Department of Energy
- Strategic Petroleum Reserve PMD

Department of the Interior
- Bureau of Ocean Energy Management, Regulation and Enforcement
- Fish and Wildlife Service
- Geological Survey
- National Park Service
- Office of Environmental Policy and Compliance
- Office of the Solicitor

Department of State
- Bureau of Oceans and International Environmental and Scientific Affairs

Department of Transportation
- Coast Guard
- Office of Pipeline Safety

Environmental Protection Agency
- Region 4
- Region 6

Marine Mammal Commission

State and Local Agencies

Louisiana
- Governor's Office
- City of Grand Isle
- City of Morgan City
- City of New Orleans
- Department of Culture, Recreation, and Tourism
- Department of Environmental Quality
- Department of Natural Resources
- Department of Transportation and Development
- Department of Wildlife and Fisheries
- Houma-Terrebonne Chamber of Commerce
- Jefferson Parish Director
- Jefferson Parish President
- Lafourche Parish CZM
- Lafourche Parish Water District #1
- Louisiana Geological Survey
- South Lafourche Levee District
- St. Bernard Planning Commission
- State House of Representatives, Natural Resources Committee
- State Legislature, Natural Resources Committee

Texas
- Governor's Office
- Attorney General of Texas
- City of Lake Jackson
- General Land Office
- Southeast Texas Regional Planning Commission
- State Legislature Natural Resources Committee
- State Senate Natural Resources Committee
- Texas Historical Commission
- Texas Legislation Council
- Texas Parks and Wildlife Department
- Texas Water Development Board
- Texas Sea Grant

Industry

Air Armament Center
Alabama Petroleum Council
American Petroleum Institute
Area Energy LLC
Baker Atlas
Bellwether Group
B-J Services Co
BP Amoco
Chevron U.S.A. Inc.
Coastal Conservation Association
Coastal Environments, Inc.
Continental Shelf Associates, Inc.
Dominion Exploration & Production, Inc.
Ecological Associates, Inc.
Ecology and Environment
Energy Partners, Ltd.
EOG Resources, Inc.
Escambia County Marine Resources
Exxon Mobil Production Company
Florida Petroleum Council
Florida Propane Gas Association
Freeport-McMoRan, Inc.
Fugro Geo Services, Inc.
Gulf Environmental Associates
Gulf of Mexico Newsletter
Horizon Marine, Inc.
Industrial Vehicles International, Inc.
International Association of Geophysical Contractors
J. Connor Consultants
John Chance Land Surveys, Inc.
Marine Safety Office
Midstream Fuel Service
Mote Marine Laboratory
Murphy Exploration & Production
Newfield Exploration Company
NWF Daily News
Petrobras America, Inc.
PPG Industries, Inc.
Propane Market Strategy Newsletter
Science Applications International Corporation
Seneca Resources Corporation
Shell Exploration & Production Company
Stone Energy Corporation
Strategic Management Services-USA
T. Baker Smith, Inc.
Texas Geophysical Company, Inc.
The Houston Exploration Company
Triton Engineering Services Co.
W & T Offshore, Inc.
Washington Post
WEAR-TV

Special Interest Groups

1000 Friends of Florida
Alabama Oil & Gas Board
American Cetacean Society
Audubon Louisiana Nature Center
Bay County Audubon Society
Citizens Assoc. of Bonita Beach
Clean Gulf Associates
Coastal Conservation Association
Earthjustice
Florida Chamber of Commerce
Florida Institute of Oceanography
Florida Marine Research
Florida Natural Area Inventory
Florida Public Interest Research Group
Florida Sea Grant College
Gulf Coast Environmental Defense
Gulf County
Gulf County Atlantic Fisheries
Gulf Island National Seashore
Hernando County Planning Department
Hunt Oil
Izaak Walton League of America, Inc
JOC Venture
Louisiana State University
Marine Mammal Commission
Mission Enhancement Office
Mississippi State University
Mobile Bay National Estuary Program
Natural Resources Defense Council
Nature Conservancy
Nicholas State University
Perdido Key Association
Population Connection
Portersville Revival Group
Sierra Club
South Mobile Communities Association
Southeastern Fisheries Association
The Conservancy
The Conservation Fund
The Daspit Company
The Nature Conservancy
Walton County Growth Management

Ports/Docks

Louisiana

Greater Baton Rouge Port Commission
Greater Lafourche Port Commission
Grand Isle Port Commission
Plaquemines Port, Harbor and Terminal District
Port of Baton Rouge
Port of Iberia District
Port of New Orleans
Twin Parish Port Commission
St. Bernard Port, Harbor and Terminal District

Texas

Brownsville Navigation District—Port of Brownsville
Port Freeport
Port Mansfield/Willacy County Navigation District
Port of Beaumont
Port of Corpus Christi Authority
Port of Galveston
Port of Houston Authority
Port of Isabel—San Benito Navigation District
Port of Port Arthur Navigation District

5.5. PUBLIC HEARINGS

In accordance with 30 CFR 256.26, BOEMRE scheduled public hearings soliciting comments on the Draft Supplemental EIS. The hearings provided the Secretary of the Interior with information from interested parties to help in the evaluation of potential effects of the proposed lease sale. An announcement of the dates, times, and locations of the public hearings was included in the Notice of Availability for the Draft Supplemental EIS. A copy of the public hearing notices was included with the Draft Supplemental EIS that was mailed to the parties indicated above, posted on the BOEMRE Internet website (http://www.gomr.boemre.gov), and published in local newspapers.

The hearings were held on the following dates and at the times and locations indicated below:

Tuesday, May 17, 2011
1:00 p.m. and 6:00 p.m. CDT
Houston Airport Marriott
George Bush Intercontinental
18700 John F. Kennedy Boulevard
Houston, Texas 77032
20 registered attendees
4 speakers

Thursday, May 19, 2011
1:00 p.m. and 6:00 p.m. CDT
Bureau of Ocean Energy Management, Regulation and Enforcement
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123
8 registered attendees
0 speakers

Houston, Texas, May 17, 2011

Four speakers representing industry provided testimony at the public hearings held in Houston, Texas, on May 17, 2011. Industry representatives included Walt Rosenbusch of the International Association of Geophysical Contractors, Marc Lawrence of Global Geoscience Solutions, Erik Milito of the American Petroleum Institute, and Clint Moore, a geologist. All speakers offered support for proceeding with proposed WPA Lease Sale 218. Mr. Rosenbusch and Mr. Lawrence commented that, although the "towed streamer" approach to seismic operations was the predominant method, the Supplemental EIS should also incorporate other types of seismic operations in their analysis. Mr. Milito emphasized the need to proceed with regularly scheduled lease sales in terms of needed job creation, increased government revenue, and needed energy production. Mr. Moore offered support for Mr. Milito's comments.

Responses to these comments have been incorporated into the responses to the letters of comment in **Chapter 5.11**.

New Orleans, Louisiana, May 19, 2011

There were no speakers at the public hearings held in New Orleans, Louisiana, on May 19, 2011.

5.6. COASTAL ZONE MANAGEMENT ACT

If a Federal agency's activities or development projects within or outside of the coastal zone will have reasonably foreseeable coastal effects in the coastal zone, then the activity is subject to a Federal Consistency Determination (CD). A consistency review will be performed and a CD will be prepared for the affected States prior to the proposed lease sale. To prepare the CD's, BOEMRE reviews each State's Coastal Management Plan (CMP) and analyzes the potential impacts as outlined in this Supplemental EIS, new information, and applicable studies as they pertain to the enforceable policies of each CMP. The CZMA requires that Federal actions that are reasonably likely to affect any land or water use or natural resource of the coastal zone be "consistent to the maximum extent practicable" with relevant enforceable policies of the State's federally approved coastal management program (15 CFR 930 Subpart C).

Based on the analyses, the BOEMRE Director makes an assessment of consistency, which is then sent to each State with the Proposed Notice of Sale. If a State concurs, BOEMRE can hold the lease sale. If the State objects, it must do the following under the CZMA: (1) indicate how the BOEMRE presale proposal is inconsistent with their CMP and suggest alternative measures to bring the BOEMRE proposal into consistency with their CMP; or (2) describe the need for additional information that would allow a determination of consistency. Unlike the consistency process for specific OCS plans and permits, there is no procedure for administrative appeal to the Secretary of Commerce for a Federal CD for presale activities. Either BOEMRE or the State may request mediation. Mediation is voluntary, and the DOC would serve as the mediator. Whether there is mediation or not, the final CD is made by DOI and it is the final administrative action for the presale consistency process. Each Gulf State's CMP is described in Appendix B of the Multisale EIS (USDOI, MMS, 2007b).

5.7. ENDANGERED SPECIES ACT

The Endangered Species Act of 1973 (ESA) (16 U.S.C. 1631 *et seq.*), as amended (43 U.S.C. 1331 *et seq.*), establishes a national policy designed to protect and conserve threatened and endangered species and the ecosystems upon which they depend. In accordance with Section 7 of the ESA, BOEMRE consulted with NMFS and FWS on possible and potential impacts from the proposed sale on endangered/threatened species and designated critical habitat under their jurisdiction. A biological assessment was prepared for each consultation. The action area analyzed in the biological assessments included the lease sale area addressed in this Supplemental EIS.

The formal ESA consultation with NMFS was concluded with receipt of the Biological Opinion on July 3, 2007. The Biological Opinion concludes that the proposed lease sale and associated activities in the Gulf of Mexico under the 5-Year Program are not likely to jeopardize the continued existence of threatened and endangered species under NMFS jurisdiction or destroy or adversely modify designated critical habitat. The informal ESA consultation with FWS was concluded with a letter dated September 14, 2007. The FWS concurred with BOEMRE's determination that this proposed action under the 5-Year Program was not likely to adversely affect the threatened/endangered species or designated critical habitat under FWS jurisdiction.

Under these existing consultations with FWS and NMFS, BOEMRE continues to request annual concurrence from both NMFS and FWS to ensure current activities and any actual take remain consistent with the Terms and Conditions of the Biological Opinion. For 2010, NMFS emailed their concurrence to BOEMRE on December 3, 2009, and FWS emailed their concurrence to BOEMRE on December 8, 2009.

Following the DWH event, on July 30, 2010, BOEMRE requested reinitiation of ESA consultation with both NMFS and FWS. The NMFS responded with a letter to BOEMRE on September 24, 2010. The FWS responded with a letter to BOEMRE on September 27, 2010. The reinitiated consultations are not complete at this time, although BOEMRE is in discussions with both agencies. The BOEMRE is working with both agencies to develop an interim coordination program while consultation is ongoing.

The existing consultations remain in effect until the reinitiated consultations are completed. The existing consultation recognizes that BOEMRE-required mitigations and other reasonable and prudent measures should reduce the likelihood of impacts from BOEMRE-authorized activities.

With consultation ongoing, BOEMRE will continue to comply with all Reasonable and Prudent Measures and the Terms and Conditions under these existing consultations, along with implementing the current BOEMRE-imposed mitigation, monitoring, and reporting requirements. Based on the most recent and best available information at the time, BOEMRE will also continue to closely evaluate and assess risks to listed species and designated critical habitat in upcoming environmental compliance documentation under NEPA and other statutes.

5.8. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

Pursuant to Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act, Federal agencies are required to consult with NMFS on any action that may result in adverse effects to EFH. The NMFS published the final rule implementing the EFH provisions of the Magnuson-Stevens Fisheries Conservation and Management Act (50 CFR 600) on January 17, 2002. Certain OCS activities authorized by BOEMRE may result in adverse effects to EFH, and therefore, require EFH consultation.

In March 2000, BOEMRE's Gulf of Mexico OCS Region consulted with NMFS's Southeast Regional Office in preparing a NMFS regional finding for the Gulf of Mexico OCS Region that allows BOEMRE to incorporate the EFH assessments into NEPA documents. The BOEMRE consulted on a programmatic level by letters of July 1999 and August 1999 to address EFH issues for certain BOEMRE OCS activities (i.e., plans of exploration and production, pipeline rights-of-way, and platform removals).

An EFH consultation for the CPA and WPA lease sales included in the 5-Year Program, using the *Gulf of Mexico OCS Oil and Gas Lease Sales: 2003-2007; Central Planning Area Sales 185, 190, 194, 198, and 201; Western Planning Area Sales 187, 192, 196, and 200, Draft Environmental Impact Statement* (USDOI, MMS, 2002) as the NEPA document, was initiated in March 2002 by this Agency with NMFS's Southeast Regional Office. The NMFS responded in April 2002, endorsing the implementation of resource protection measures previously developed cooperatively by this Agency and NMFS in 1999 to minimize and avoid EFH impacts related to exploration and development activities in the CPA and WPA. In addition to routine measures, additional conservation recommendations were made. In May 2002, this Agency responded to NMFS, acknowledging receipt and agreement to follow the additional conservation recommendations. The EFH conservation measures recommended by NMFS serve the purpose of protecting EFH. Continuing agreements, including avoidance distances from the topographic features' No Activity Zones and live-bottom pinnacle features, as well as circumstances that require project-specific consultation, appear in the clarifying provisions of NTL 2004-G05.

Effective January 23, 2006, NMFS modified the identification and descriptions of EFH. One of the most important changes noted in the amendment is the elimination of the EFH description and identification from waters between 100 fathoms and the seaward limit of the EEZ.

Further programmatic consultation was initiated and completed for the 5-Year Program's lease sales included in the Multisale EIS. The NMFS concurred by letter dated December 12, 2006, that the information presented in the 2003-2007 Draft Multisale EIS satisfies the EFH consultation procedures outlined in 50 CFR 600.920 and as specified in NMFS's March 17, 2000, findings. Provided that BOEMRE's proposed mitigations, NMFS's previous EFH conservation recommendations, and the standard lease stipulations and regulations are followed as proposed, NMFS agrees that impacts to EFH and associated fishery resources resulting from activities conducted under the 5-Year Program's lease sales would be minimal. Following the DWH event, on July 30, 2010, BOEMRE requested reinitiation of ESA consultation with both NMFS and FWS. The NMFS responded with a letter to BOEMRE on September 24, 2010. The EFH consultation was also addressed in NMFS's letter. The reinitiated consultations are not complete at this time, although BOEMRE and NMFS have had discussions and are working on a new consultation document for the 2012-2017 Multisale EIS.

5.9. NATIONAL HISTORIC PRESERVATION ACT

In accordance with the National Historic Preservation Act (NHPA) (16 U.S.C. 470) Federal agencies are required to consider the effect of their undertakings on historic properties. The implementing regulations for Section 106 of the NHPA (16 U.S.C. 470f), issued by the Advisory Council on Historic Preservation (16 CFR 800), specify the required review process. The BOEMRE initiated a request for consultation with the affected Gulf States and Tribal Nations on November 12, 2010, via a formal letter. A timeline of 30 days was provided and two responses were received.

The State of Louisiana, in a letter to BOEMRE dated December 16, 2010, indicated that no known historic properties will be affected by this undertaking and that consultation regarding the proposed action is not necessary. The Seminole Tribe of Florida-Tribal Historic Preservation Officer (STOF-THPO) responded to BOEMRE's request for consultation on December 6, 2010. The STOF-THPO indicated that there was no objection to the proposed undertaking at this time. The STOF-THPO requested to review the impending remote-sensing survey reports that are to be conducted over the high-probability zones within the project area (which is not within the WPA or the subject of this Supplemental EIS). Additionally, the STOF-THPO requested to be notified if cultural resources that are potentially ancestral or historically relevant to the Seminole Tribe of Florida are inadvertently discovered at any point during this process. Neither of these responses requested consultation. No further responses were received beyond the 30-day timeline and no further requests for consultation were received.

This Section 106 consultation is concluded at this time. The BOEMRE will continue to impose mitigating measures, and monitoring and reporting requirements to ensure that historic properties are not affected by the proposed undertaking. The BOEMRE will reinitiate the consultation process with affected parties should such circumstances warrant further consultation.

5.10. Major Differences Between the Draft and Final Supplemental EIS's

Comments on the Draft Supplemental EIS were received during the public hearings and were received via written and electronic correspondence. As a result of these comments, changes have been made between the Draft and Final Supplemental EIS's. The text has been revised or expanded to provide clarification on specific issues, as well as to provide updated information. In addition, between the Draft and Final Supplement EIS, BOEMRE continued to update information and data relied on in this document and removed information determined to be irrelevant for this proposed action (e.g., information regarding DWH event that was not relevant to the WPA). None of the alterations between the Draft and Final Supplement EIS's changed the conclusions herein.

5.11. Letters of Comment on the Draft Supplemental EIS and BOEMRE's Responses

The Notice of Availability and announcement of public hearings were published in the *Federal Register* by BOEMRE on April 20, 2011 (USEPA Notice of Availability publication date, April 22, 2011), were posted on BOEMRE's Internet website, and were mailed to interested parties. Distribution of the Draft Supplemental EIS began on April 20, 2011. The comment period ended on June 6, 2011. Fourteen comment letters were received from the public and private agencies and groups listed below:

Federal Agencies
- Department of Commerce
  - National Oceanic and Atmospheric Administration
- Department of the Interior
  - Fish and Wildlife Service
  - National Park Service
- Environmental Protection Agency

State Agencies and Representatives
- Louisiana Department of Environmental Quality
- Texas Commission on Environmental Quality

Local Agencies
- No comments were received.

Organizations and Associations
- American Petroleum Institute
- Center for Biological Diversity, Defenders of Wildlife, Earthjustice
- Center for Regulatory Effectiveness
- International Association of Geophysical Contractors
- Oceana
- USA Citizen1

Industry
- Anadarko
- Chickasaw Distributors, Inc.

General Public
- Dwight David

Copies of these letters are presented on the subsequent pages. Each letter's comments have been marked for identification purposes. The BOEMRE's responses immediately follow each letter.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS TX 75202-2733

JUN 0 6 2011

Mr. Gary D. Goeke
Chief, Environmental Assessment Section
Leasing and Environment (MS 5410)
Bureau of Ocean Energy Management,
Regulation and Enforcement (BOEMRE)
Gulf of Mexico (GOM) Region
1201 Elmwood Park Boulevard
New Orleans, LA 70133-2394

Dear Mr. Goeke:

In accordance with our responsibilities under Section 309 of the Clean Air Act (CAA), the National Environmental Policy Act (NEPA), and the Council on Environmental Quality (CEQ) regulations for implementing NEPA, the U.S. Environmental Protection Agency (EPA) Region 6 office in Dallas, Texas, has completed its review of the Draft Supplemental Environmental Impact Statement (DSEIS) prepared by U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), Gulf of Mexico (GOM) Outer Continental Shelf (OCS) Region for the Western Planning Area (WPA) Lease Sale 218. EPA Region 6 is participating in the NEPA process as a Cooperating Agency in accordance with the requirements of the CEQ regulations.

Based on our analysis, EPA rates the DSEIS as "**EC-2**" i.e., EPA has "**Environmental Concerns and Requests Additional Information**" in the Final SEIS (FSEIS)". The EPA's Rating System Criteria can be found here: http://www.epa.gov/oecaerth/nepa/comments/ratings.html. Detailed comments are enclosed with this letter which more clearly identify our concerns and the informational needs requested for incorporation into the FSEIS.

EPA appreciates the opportunity to review the DSEIS. Please send our office five copies of the FSEIS when it is sent to the Office of Federal Activities, EPA (Mail Code 2252A), Ariel Rios Federal Building, 1200 Pennsylvania Ave, N.W., Washington, D.C. 20004. Our classification will be published on the EPA website, www.epa.gov, according to our responsibility under Section 309 of the CAA to inform the public of our views on the proposed Federal action. If you have any questions or concerns, please contact Michael Jansky of my staff at jansky.michael@epa.gov or 214-665-7451 for assistance.

Sincerely,

Rhonda Smith
Chief, Office of Planning
and Coordination

Enclosure

DETAILED COMMENTS
ON THE
DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (DSEIS)
FOR THE
U.S. DEPARTMENTOF THE INTERIOR, BUREAU OF OCEAN ENERGY MANAGEMENT, REGULATION AND ENFORCEMENT (BOEMRE)
GULF OF MEXICO OUTER CONTINENTAL SHELF REGION
WESTERN PLANNING AREA LEASE SALE 218

BACKGROUND:

The Draft Supplemental Environmental Impact Statement (DSEIS) has been prepared by U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), Gulf of Mexico (GOM) Outer Continental Shelf (OCS) Region for the Western Planning Area (WPA) Lease Sale 218. This DSEIS has been prepared to address the potential changes to the baseline conditions of the environmental and socioeconomic resources that took place as a result of the Deepwater Horizon (DWH) event that extended from April 20th to September 19th, 2010. This is not an EIS on the DWH event, although information on this event is analyzed as it applies to the resources in the WPA. Proposed WPA Lease Sale 218 is the Federal action addressed in this DSEIS and is the remaining area wide oil and gas lease sale within the WPA.

COMMENTS:

USEPA-1

Please note that there is substantial discussion in this DSEIS about the use of dispersants and the impacts of chemically dispersed oil. One of the purposes of the assessment is to review the potential changes to the baseline conditions of the environmental and socioeconomic resources as a result of the Deepwater Horizon oil spill. The DSEIS was prepared using the best information that was publically available at the time the document was written. In view of the fact that the time that has elapsed since the DWH event is rather short, timing for producing the document may be premature for achieving that purpose. In many instances, the environmental impacts of the oil spill upon key resources of concern are presented as either minor, based on a lack of data, or as unknown, due to studies and assessments that are still underway. Consequently, it may be difficult to develop significant new evaluations of the impacts of "low probability, high-impact catastrophic" events, such as the Deepwater Horizon oil spill, to coastal and marine biological resources as a result of this DSEIS.

EPA understands the legal limitations of using preliminary Natural Resource Damage Assessment (NRDA) or other data establishing resource damages from the oil spill. However, we are concerned that there may be an inconsistency between the stated purpose of this analysis and its execution. Without waiting for the ecological resource impact data to become available, without independently verifying the news reports, or without conducting interviews with the scientists studying the oil spill impacts, it may be difficult understanding how this document is fully satisfying public disclosure as envisioned by the CEQ regulations for implementing the NEPA.

As an example, the evaluation of impacts from the Deepwater Horizon oil spill on barrier islands are summarized on page 4-42 as being based primarily on "television news, magazines, and newspaper accounts based on interviews with scientists or personnel with the USCG's Oil Spill Response Team at the Unified Command Post overseeing cleanup operations." At the time this document was prepared, "there was little published information on the impacts of the spill." Although various studies are underway, including the Federal Natural Resource Damage Assessment (NRDS), the document notes that "none of this information is publically available." Although a potentially useful preliminary oil spill

2

USEPA-1 (continued)

risk analysis model was run as part of the DSEIS analyses, only preliminary data was available for consideration (page 3-35). Similarly, the impacts of the Deepwater Horizon oil spill on *Sargassum* mats are presented as unknown, while National Oceanic Atmospheric Administration (NOAA) and National Science Foundation-funded studies are currently under way (page 4-106 and 4-111). The document notes that large spills, presumably on the order of the Deepwater Horizon oil spill, could result in severe impacts to a sizable portion of the *Sargassum* community in the northern Gulf of Mexico (page 4-109). The potential for severe impacts on a significant biological resource, coupled with preliminary data from the oil spill, makes the conclusion that no measurable impacts are expected questionable.

To address this concern, we suggest that BOMERE make a commitment in the FSEIS that as any new information comes forth as result of completed ongoing studies or new physical evidence over time, that new information would be provided though a Supplemental Information Report and made available to the public. We recommend that this stipulation be included in the Record of Decision document.

Ocean Dredged Material Disposal Sites (ODMSD)

USEPA-2

The discussions on pages 3-59 and 3-71 about ocean dredged material disposal sites (ODMDS) should be corrected. The statement is made that dredged materials disposed offshore are not available for beneficial uses to restore and create habitat. These dredged materials often could be used for beneficial use projects if funds were available. Also, the listings of ocean disposal sites appear erroneously to combine non-ODMDS disposal sites (possibly placement areas designated under the Clean Water Act) with ODMDS areas designated under the Marine Protection, Research, and Sanctuaries Act. The U.S. Army Corps of Engineers New Orleans and/or Mobile Districts would be good sources of information. Clarification on the disposal sites should be incorporated in the FSEIS.

Environmental Justice (EJ)

USEPA-3

General: The SDEIS provides extensive technical detail about the coastal and deep water oil exploration and extraction process and possible implications involved, as well as the technical advances recently developed to prevent problems. As we have seen with the DWH blowout, disastrous accidents can have far-reaching impacts. In the event that spills, blowouts, vessel collisions, discharges, etc. occur, the entire Texas coastline (as well as much of Mexico's eastern coastline) and its residents would be affected to some degree or other. If a catastrophic spill or a blowout should occur, all coastal residents would feel the impact, but low-income and minority populations would experience the negative results of these events more deeply than middle or upper-class populations because of the limited resiliency of the poor. They would have less resources to recover from a disaster, just as was the case with the DWH in Louisiana and Mississippi. There are no Tribal concerns related to this action. No Paleo-Indian ruins/artifacts have been found in the coastal area or shallow coastal water. According to the DSEIS, a request for consultation with Tribal Nations was made under the National Historic Preservation Act (NHPA). Because there are no Tribes along the coast, no responses were received.

Demographics: The entire southern portion of the Texas coast, starting just north of Corpus Christi, has a majority Hispanic population and generally is a low income area (although many pockets of prosperity exist). Jefferson County, on the far eastern edge of Texas, is also heavily minority and low income. Harris County has clusters of low-income, minority communities, such as Galena Park, Manchester Community, Deer Park, etc. along the Houston Ship Channel, which could become a conduit for spilled oil. These communities could be adversely impacted by a major accident near the coast or by a

3

USEPA-3 (continued)

catastrophic event like the DWH blowout. Many of these residents work in service industries or other low-paying jobs that would be heavily impacted in such an event. Middle class residents are more likely to have adequate insurance or other resources to meet their needs in these unfortunate situations.

Recommendation: The FSEIS should include data pertaining to populations and persons with Limited English Proficiency (LEP) along the Gulf Coast who may be affected by a catastrophic spill event. The FSEIS should ensure that language-appropriate communication is supplied to LEP populations during the event and during recovery efforts. Examples of tools that could be utilized include supplying interpreters at public meetings and safety trainings and ensuring that English language documents are ranslated to other languages. Resources and tools regarding LEP populations can be found at the U.S. Department of Health and Human Services website: http://www.hhs.gov/ocr/civilrights/resources/specialtopics/lep/ and at the Federal Interagency Website for LEP: http://www.lep.gov/.

USEPA-1 The purpose of NEPA is to help inform the decisionmaker regarding environmental impacts of the proposed action. For this reason, the analyses in this Supplemental EIS considered changes to baseline conditions that may have occurred since the Multisale EIS and the 2009-2012 Supplemental EIS, including information that is now available since the DWH event. As acknowledged in this Supplemental EIS, credible scientific data regarding the potential short-term and long-term impacts of the DWH event and the associated oil spill are incomplete at this time. However, the NEPA regulations contemplate that agencies often do not have complete and perfect information on the impacts of their activities but recognize that a process is necessary to allow agencies to fulfill their missions and proceed to the decisionmaking stage. In light of the absence of this information, BOEMRE considered what information was relevant and essential to its analysis of alternatives based upon the individual resource analyzed. If essential to a reasoned choice among the alternatives, BOEMRE considered whether it was possible to obtain the information, if the cost of obtaining it is exorbitant, and, if it cannot be obtained, apply acceptable scientific methodologies to make reasoned estimates using available information in light of the otherwise incomplete or unavailable information. Information on many impacts of the DWH event and the associated oil spill, particularly as part of the NRDA process, may not be available for years, and certainly not within the contemplated timeframe of this NEPA process. In its place, subject-matter experts have used what credible scientific information is currently available and have applied this information using accepted scientific methodologies to evaluate impacts to the resources. Language in **Chapter 4.1**, “Incomplete or Unavailable Information,” was clarified to prevent any misperceptions on this issue.

Although BOEMRE appreciates the suggestion by USEPA to include a stipulation that a Supplemental Information Report be prepared, such a stipulation is not necessary given the current status of other lease sales in the Gulf of Mexico. The Gulf of Mexico OCS Region’s 2012-2017 Multisale EIS is currently in preparation. Subsequent NEPA documents for various OCS Program activities will be completed on regular intervals (approximately yearly) and will include new information that comes forth since the completion of the previous environmental documents. The EIS’s will be available for public review and comment. As such, a Supplemental Information Report would be redundant with these ongoing environmental reviews and an unnecessary diversion of resources.

USEPA-2 **Chapter 3.3.3** (“Dredged Material Disposal”) of this Supplemental EIS was revised to explain that dredged material is available for beneficial use if funds are available and to clarify that the ocean dredged material disposal sites listed in **Table 3-13** of this Supplemental EIS are those sites utilized by the U.S. Army Corps of Engineers.

USEPA-3 Comments noted. Additional information was added to **Chapter 4.1.1.18.4.3** to address information related to persons with limited English proficiency and to efforts that were made by the USCG (in their lead role in the Incident Command Center) to distribute news and information following the DWH event.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
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June 6, 2011 F/SER4:DD

Mr. Gary D. Goeke
Chief, Environmental Assessment Section
U.S. Department of the Interior
Bureau of Ocean Energy Management, Regulation and Enforcement
Gulf of Mexico OCS Region
Leasing and Environment (MS 5410)
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Dear Mr. Goeke:

On December 8, 2010 the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service, Southeast Region requested cooperating agency status for the proposed Outer Continental Shelf (OCS), Western and Central Planning Areas, Gulf of Mexico Oil and Gas Lease Sales for the 2007-2012 Five-Year OCS Program, in accordance with the Council on Environmental Quality's regulations, section 1501.6. Please find enclosed comments from NOAA in response to the April 22, 2011, Notice of Availability of the draft Supplemental Environmental Impact Statement for the OCS Western Planning Area, Gulf of Mexico Oil and Gas Lease Sale 218.

NOAA comments originate from two Line Offices within NOAA: the National Marine Fisheries Service (NMFS) and the National Ocean Service (NOS). The contacts for these offices respectively are:

NMFS: Steve Leathery
NEPA Coordinator
NOAA National Marine Fisheries Service
1315 East West Highway
Silver Spring, MD 20910-3282
301-713-2239
Steve.leathery@noaa.gov

NOS: Vicki Wedell
National Permit, NEPA and Consultations Coordinator
Office of National Marine Sanctuaries
NOAA/National Ocean Service
1305 East West Highway, SSMC4 11500
Silver Spring, MD 20910
301-713-3125 x-237
Vicki.Wedell@noaa.gov

If we can be of further assistance, please advise.

Sincerely,

Miles M Croom

for Roy E. Crabtree, Ph.D.
Regional Administrator

Enclosures

cc: (w/encl.) via electronic mail
F – Lindow, Leathery, Holmes
F/SER – Keys, Silverman
F/SER4 – Croom, Dale
F/SER3 – Bernhart, Baker
NOS - Wedell

NOAA NATIONAL MARINE FISHERIES SERVICE
SOUTHEAST REGIONAL OFFICE COMMENTS ON
U.S. DEPARTMENT OF INTERIOR/BUREAU OF OCEAN ENERGY MANAGEMENT, REGULATION AND ENFORCEMENT
DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT FOR THE OUTER CONTINENTAL SHELF WESTERN PLANNING AREA, GULF OF MEXICO OIL AND GAS LEASE SALE 218

June 6, 2011

BACKGROUND

The Department of Interior's Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) prepared a supplemental environmental impact statement (SEIS) for the Outer Continental Shelf (OCS) Western Planning Area, Gulf of Mexico Oil and Gas Lease Sale 218. The proposed sale is in the Gulf of Mexico's Western Planning Area (WPA) off the States of Texas and Louisiana. The SEIS updates the environmental and socioeconomic analyses in the Gulf of Mexico (GOM) OCS Oil and Gas Lease Sales: 2007–2012; WPA Sales 204, 207, 210, 215, and 218; Central Planning Area (CPA) Sales 205, 206, 208, 213, 216, and 222, Final Environmental Impact Statement (OCS EIS/EA MMS 2007–018). The SEIS also updates the environmental and socioeconomic analyses in the GOM OCS Oil and Gas Lease Sales: 2009–2012; CPA Sales 208, 213, 216, and 222; WPA Sales 210, 215, and 218; Final SEIS (OCS EIS/EA MMS 2008–041). The SEIS for 2009–2012 was prepared after the Gulf of Mexico Energy and Security Act, which required BOEMRE to offer approximately 5.8 million acres in the CPA (''181 South Area'') for oil and gas leasing.

This SEIS was drafted to consider new circumstances and information arising from the Deepwater Horizon (DWH) event with a focus on updating the baseline conditions and potential environmental effects of oil and natural gas leasing, exploration, development, and production in the Western Planning Area. NOAA National Marine Fisheries Service (NMFS) recognizes that BOEMRE has readdressed many procedures and policies following the DWH event related to drilling safety, oil-spill response, and compliance inspections.

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT (16 U.S.C. §1801 *et seq.*)

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act; 16 U.S.C. §1801 *et seq.*) requires Federal agencies to consult with the Secretary of Commerce, through NMFS, with respect to "any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such agency that may adversely affect any essential fish habitat (EFH) identified under this Act." 16 U.S.C. § 1855(b)(2). Under the Outer Continental Shelf Lands Act (OCSLA; 43 U.S.C. § 1331 *et seq.*), the BOEMRE is responsible for leasing tracts of the OCS for oil and gas exploration, and for regulating development and production. Certain OCS activities authorized by BOEMRE may result in adverse impacts to EFH, and therefore require EFH consultation. Actions taken by BOEMRE under the OCSLA are evaluated through the National Environmental Policy Act (NEPA). BOEMRE (formerly the Minerals Management Service) and NMFS cooperatively developed modified procedures to incorporate EFH consultation into existing NEPA processes by findings letters dated March 17, 2000, and

March 12, 2002. Our agencies consulted on a programmatic level by letters dated June 4, 1999, July 1, 1999, and August 12, 1999, to address EFH issues related to operational activities, including pipeline rights-of-way, plans for exploration and production, and platform removal in the Gulf of Mexico Central and Western Planning Areas. That programmatic EFH agreement was subsequently amended by a letter dated July 19, 2007, to also include operational activities within a small portion of the Eastern Planning Area.

Following the DWH event BOEMRE requested reinitiation of Endangered Species Act (ESA) consultation with both the U.S. Fish and Wildlife Service and NMFS. NMFS responded by letter dated September 24, 2010, requesting a periodic review of the EFH consultation as well. Regional agency staff are in the process of updating the EFH consultation for the 2012-2017 Multi-sale EIS.

By letter dated December 8, 2010, the NMFS provided comments to BOEMRE in response to a Notice of Intent to prepare the draft SEIS. Specifically we suggested: 1) that BOEMRE broaden the scope of its analysis to consider the impacts of all activities, including potential oil spills and the use of chemical dispersants in any oil spill response efforts, to EFH and other vulnerable deep-water habitats such as deep-sea corals; 2) EFH identifications and descriptions and EFH habitat areas of particular concern designated by the Gulf of Mexico Fishery Management Council and NMFS Highly Migratory Species be updated; and 3) the status and periodic review of the programmatic EFH consultation be included.

In the draft SEIS BOEMRE concludes that adverse effects from routine activities associated with oil and gas leasing, exploration and development are expected to be minimal. This conclusion is based on various mitigating factors including Notice to Lessees (NTL) #2009-G40 for Deepwater Benthic Communities, NTL #2009-G39 Biologically-Sensitive Underwater Features and Areas, and Topographic Features Stipulation in addition to the mitigative measures included in the existing programmatic EFH consultation.

EFH COMMENTS

NOAA-1

The draft SEIS proposes three alternatives. Alternative A, the proposed action, would offer for lease all unleased blocks within the WPA for oil and gas operations (excepting whole and partial blocks within the boundary of the Flower Garden Banks National Marine Sanctuary, and whole and partial blocks that lie within the former Western Gap portion of the 1.4 nautical mile buffer zone north of the continental shelf boundary between the U.S. and Mexico). Alternative B would offer for lease all unleased blocks in the WPA sale area as described for Alternative A, the Proposed Action, with the exception of any unleased blocks subject to the Topographic Features Stipulation. Although the Topographic Features Stipulation presently applies as a conservation recommendation in the EFH consultation currently in force with BOEMRE, NOAA notes the draft SEIS specifies that application of lease stipulations, including the Topographic Features Stipulation, will be considered by the Assistant Secretary of the Interior for Land and Minerals (ASLM). The ASLM may, or may not, require any lease stipulation to be included in a Final Notice of Sale for any lease that may result from this lease sale. To ensure certainty that topographic features receive maximum protection, NOAA recommends Alternative B be selected as the Proposed Action.

NOAA-2

Sections 2.3.1.2 (page 2-16) and 4.1.1.13.3 of the draft SEIS correctly note that the actual effects of the DWH event on fish populations are unknown at this time, and the total impacts are likely to be unknown for several years. However, this statement contrasts with one made on page xii, "*Fish Resources and Essential Fish Habitat*" and repeated in section 4.1.1.13 which says "[a] subsurface blowout would have a negligible effect on Gulf of Mexico fish resources." Given the present uncertainty regarding the potential effects of the subsurface blowout resulting from the DWH event on EFH and living marine resources, NMFS recommends the more conservative characterization expressed in sections 2.3.1.2 and 4.1.1.13.3 be used throughout the document

NOAA-3

The extent of EFH in the Gulf of Mexico described Section 4.1.1.13.1 (page 4-173; last sentence of paragraph two) should note that the EFH Regulations (50 C.F.R. Part 600) require NMFS to describe and identify habitats determined to be EFH for each life stage of each managed species. It is due to the number of managed species, each with several major life stages, in addition to the variety of habitats in the Gulf of Mexico that results in large portions of the Gulf of Mexico being designated as EFH.

NOAA-4

The first sentence of paragraph four in Section 5.8 (page 5-8) should be revised to clarify the identification and description of EFH for species managed by the Gulf of Mexico Fishery Management Council were modified effective January 23, 2006. This was not rulemaking nor did it revise EFH regulations found at 50 C.F.R. Part 600.

NOAA-5

The status of Atlantic bluefin tuna in Section 4.1.1.13.3 (page 4-180) should be updated in accordance with the announcement by NMFS on May 27, 2011, that Atlantic bluefin tuna currently does not warrant species protection under the ESA. NOAA formally designated both the western Atlantic and eastern Atlantic and Mediterranean stocks of bluefin tuna as species of concern. This places the species on a watch list for concerns about its status and threats to the species under the ESA. NOAA will revisit this decision by early 2013, when more information will be available about the effects of the DWH event, as well as a new stock assessment from the scientific arm of the International Commission for the Conservation of Atlantic Tunas, the international body charged with the fish's management and conservation. (http://www.nmfs.noaa.gov/pr/species/fish/bluefintuna.htm)

ENDANGERED SPECIES ACT (16 U.S.C. §§ 1531 *et seq.)*

Section 7 of the Endangered Species Act (ESA; 16 U.S.C. § 1536(a)(2)) requires Federal agencies to consult with the Secretary of Commerce, through NOAA, to ensure that "any action authorized, funded, or carried out by such agency ... is not likely to jeopardize the continued existence of any endangered species or threatened species or adversely modify or destroy [designated] critical habitat ...." *See also* 50 C.F.R. Part 402. Pursuant to NOAA regulations, if the proposed activity may affect a listed species or designated critical habitat, the Federal action agency must initiate consultation with NOAA pursuant to section 7 of the ESA. *See* 50 C.F.R. Part 402.14.

CONSULTATION BACKGROUND

Lease sale 218 falls under the June 29, 2007, biological opinion on the 2007-2012 lease sale plan that is currently in reinitiation of ESA consultation. Following the BP/DWH spill, BOEMRE requested reinitiation of ESA consultation on June 30, 2010. NMFS responded on September 24, 2010, with a request for additional information needed to assess the impacts to listed species that were previously not considered prior to the oil spill. Following a teleconference between NMFS and BOEMRE on June 2, 2011, BOEMRE indicated that it cannot provide all the information from the BP/DWH spill that is necessary to complete reinitiation of consultation in time for Sale 218. Consequently, BOEMRE does not intend to prepare a biological assessment under the ESA for this lease sale.

Although reinitiation of consultation is ongoing, NMFS and BOEMRE are working on an interim coordination and review process for lease sales until a new consultation is completed. Additional coordination and review may be required for programmatic environmental assessments, individual lease sales, new or usual technologies, and environmental or biological factors that may need to be considered at site-specific levels of review. These and other considerations are currently being discussed between NMFS and BOEMRE. NMFS is providing comments and reviewing proposed lease sale 218 for any additional recommendations for listed species that may be needed. BOEMRE has indicated it will continue to follow the mitigation measures established in the biological opinion, require the new safety rule changes that will, among other provisions, provide for increased prevention of future oil spills from blowouts, and may require any additional measures that may be recommended by NMFS to avoid or minimize potentially adverse impacts to listed species.

ESA COMMENTS

NOAA-6

Chapter 4-1, page 4-4 states that the effects of proposed WPA Lease Sale 218 on these resources [physical, biological, and socioeconomic] are expected to be substantially the same as those presented in the Multisale EIS, even when considered in the context of the DWH event. Page 4-5 supports that conclusion, stating, "the data obtained to support the conclusions within this Supplemental EIS indicate that, due to its geographical location and distance from the DWH site, the area to be offered for lease in the proposed WPA lease sale did not experience any significant adverse effects from the DWH event." NMFS agrees that while anticipated effects are the same, the natural resource damages remain undetermined at this time to support such a conclusion for listed species. Although such a conclusion may be correct regarding site specific effects resulting from lease sale 218, sea turtles and sperm whales range throughout the Gulf of Mexico in both areas affected and not affected by the DWH spill. Considering the unknown effects of exposure of wide-ranging individuals to the effects associated with the DWH spill, and effects associated with the response still being investigated, the impacts to listed species associated with the proposed lease sale must be considered as a stressor in addition to those resulting from the DWH spill. NMFS recommends that impacts to listed species from future oil and gas development consider the cumulative exposure to the DWH spill's effects along with other proposed oil and gas activities. The conservative approach would be to expect impacts from the lease sale to be greater than preceding the DWH spill; however, the magnitude of those effects cannot yet be fully determined.

NOAA-7

Deepwater leases may pose additional risks to the marine environment, and to listed species, when blowouts occur. BOEMRE believes the new safety rules will ensure greater protection against oil spills of the magnitude of DWH from occurring in the future. NMFS believes there are unknown factors surrounding new technologies used in deepwater environments, risks associated with producing oil reserves in the deepwater Gulf of Mexico due to their burial depth, high-temperature, high pressure in-situ conditions, and the technological challenges of containing spills when they occur.

NOAA-8

RECOMMENDATIONS
Until an interim coordination and review process is finalized between NMFS and BOEMRE, BOEMRE should request review and consult with NMFS on the following:

- BOEMRE should consult with NMFS on any new or unusual technologies used for oil and gas exploration, development, or production to identify and evaluate any potential risks to listed species.
- BOEMRE should consult with NMFS on development or production permits issued under the lease sale in deepwater areas.
- BOEMRE should consult with NMFS on spill response plans submitted under the lease sale in deepwater areas.
- BOEMRE should consult with NMFS if new species are listed or critical habitat is designated in the Gulf of Mexico.
- Once Natural Resource Damage Assessments are available, or any other new information on the effects to listed species in the Gulf of Mexico from the DWH spill is available, BOEMRE should consult with NMFS on the effects on this action.

NOAA-9

REQUIRED CONDITIONS
The following are measures that apply specifically to the protection of listed species that are either measures proposed by BOEMRE that NMFS has evaluated or terms and conditions required by NMFS in the July 29, 2007 biological opinion:

- BOEMRE will require that vessel operators and crews watch for marine mammals and sea turtles, reduce vessel speed to 10 knots or less when assemblages of cetaceans are observed, and maintain a distance of 90 m or greater from whales and a distance of 45 m or greater from small cetaceans and sea turtles (Vessel Strike Avoidance and Injured/Dead Protected Species Reporting, NTL 2007-G04).
- BOEMRE will make information available to vessel operators concerning species information on sea turtles in the GOM and reporting of vessel-struck, or injured and dead animals.
- BOEMRE will ensure that all vessel-struck, or injured or dead turtles with indications of vessel interactions are reported to the Sea Turtle Stranding Network Coordinator in the nearest coastal state. Any takes of listed species shall be reported to the NMFS Southeast Regional Office within no more than 24 hours of the incident to: takereport.nmfsser@noaa.gov. If a BOEMRE action is responsible for the injured or dead animals (e.g., because of a vessel strike), BOEMRE shall require the responsible parties to assist the respective salvage and stranding network as appropriate. Report dead or injured protected species to your local stranding network contacts. A list of sea turtle stranding responders is available at http://www.sefsc.noaa.gov/seaturtleSTSSN.jsp. A

NOAA-9 (continued)

list of marine mammal stranding network responders for each state is available at http://www.nmfs.noaa.gov/pr/health/networks.htm.

- BOEMRE will submit an annual report to NMFS Southeast Regional Office regarding the reports of vessel-struck sea turtles, and injured and dead sea turtles reported from oil and gas operators. Hardcopies of all annual reports will be submitted to the following address:

  Assistant Regional Administrator for Protected Resources
  National Marine Fisheries Service
  263 13th Avenue South
  St. Petersburg, FL 33701

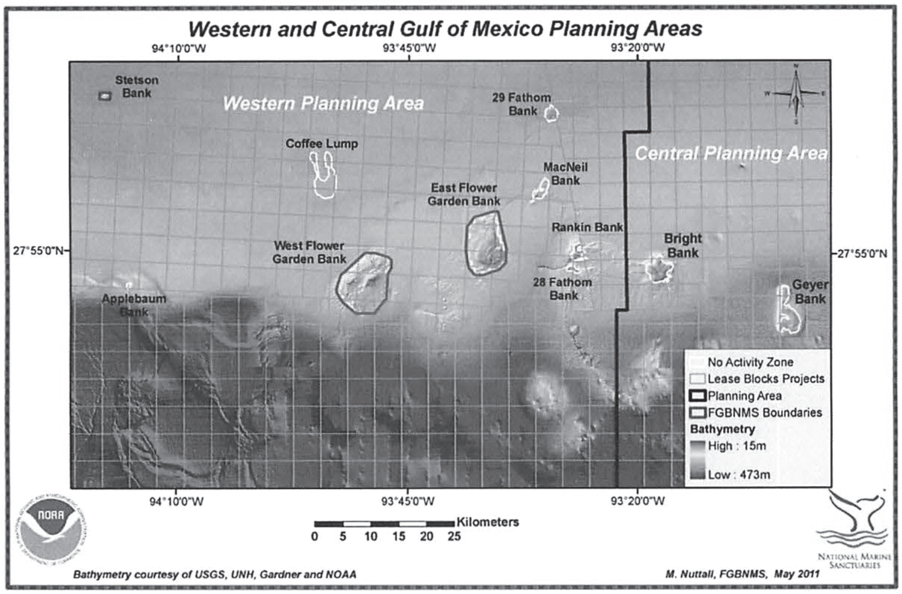
- BOEMRE will condition all permits issued to lessees and their operators to require them to post signs in prominent places on all vessels and platforms used as a result of activities related to exploration, development, and production of this lease detailing the reasons (legal and ecological) why the release of debris must be eliminated. BOEMRE will require the annual training and certification for marine debris education and elimination for all offshore personnel, including the potential for adverse effects to listed species (Trash and Debris Awareness and Elimination NTL 2007-G03. BOEMRE will also condition all permits issued to lessees and their operators to require them to collect and remove flotsam resulting from activities related to exploration, development, and production of this lease.

- Seismic Survey Mitigation Measures and Protected Species Observer Program (NTL 2007-G02). BOEMRE will require that all seismic surveys employ mandatory mitigation measures including the use of a 500-m "exclusion zone", ramp-up and shut-down procedures, visual monitoring, and reporting. Seismic operations must immediately cease when whales are detected within the 500-m exclusion zone. Ramp-up procedures and seismic surveys may be initiated only during daylight unless alternate monitoring methods approved by BOEMRE are used.

- BOEMRE will require lessees and operators to instruct offshore personnel to immediately report all sightings and locations of injured or dead protected species (marine mammals and sea turtles) to the appropriate stranding network. If oil and gas industry activity is responsible for the injured or dead animals (e.g., because of a vessel strike), the responsible parties should remain available to assist the stranding network. If the injury or death is caused by a vessel collision, the responsible party must notify BOEMRE within 24 hours of the strike.

- BOEMRE will require oil-spill contingency planning to identify important habitats, including designated critical habitat, used by listed species (e.g., sea turtle nesting beaches and piping plover critical habitat) and will require the strategic placement of spill cleanup equipment to be used only by personnel trained in less intrusive cleanup techniques on beach and bay shores.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
Silver Spring, Maryland 20910



For reference: Location of the demarcation between the Western and Central Planning Areas – Gulf of Mexico Lease Sales

ONMS Comments on BOEMRE Draft Supplemental EIS
Lease Sale 218 in the Western Planning Area of the Gulf of Mexico

These comments are in response to the publication by the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) of the Draft Supplemental Environmental Impact Statement (DSEIS) for the Western Planning Area (WPA) Lease Sale 218.

Concerning the DSEIS, ONMS submits the following recommendation:

ONMS requests that BOEMRE review the designation of "No Activity Zones" (NAZ) associated with the topographic features in the western planning area of the Gulf of Mexico, and re-establish these areas based on current bathymetric and biological data. Specifically we request that the NAZ for Stetson Bank be expanded to include the geological feature known as the Stetson "ring".

The Flower Garden Banks National Marine Sanctuary (FGBNMS) is located in the WPA and includes the East Flower Garden, West Flower Garden and Stetson Banks. These areas are part of a group of geologic formations that occur on and near the edge of the continental shelf in the central and western Gulf of Mexico. Collectively, they are designated as "topographic features" by BOEMRE and are generally protected by existing lease stipulations that prohibit direct offshore oil and gas exploration and development activities. These topographic features are described in the Draft Supplemental EIS for Western Planning Area lease sale 218 (MMS 2011-018) in section 4.1.1.6 (pp. 4-77 to 4-92).

The primary mechanism for protection of these sensitive biological features is the "Notice to Lessees" (NTL) regarding biologically-sensitive underwater features and areas (NTL No. 2009-G39), issued January 27, 2010. Regarding topographic features, the policy prohibits bottom-disturbing activities within 152 meters (500 feet) of a designated "No Activity Zone" (NAZ).

It is stated throughout the DSEIS that the existing stipulation regarding topographic features, and other biologically sensitive areas, are sufficient in providing the necessary protection from the potential impacts associated with oil and gas exploration and development. ONMS generally agrees with this assessment, but the protection provided by the topographic features stipulation would be enhanced by updating the boundaries of the NAZ's through revision of NTL 09-G39 and associated documents.

ONMS believes that the NAZ's are best defined by geographic descriptions, rather than general bathymetric isobaths. This will provide more certainty by potential leaseholders about what is included in the NAZ's. The list of topographic features covered under this lease stipulation is contained within Attachment 1 of NTL 2009-G39. The primary effect of this stipulation prohibits direct activity within a "No-Activity Zone" (NAZ) that is generally defined by an "isobath" (depth contour) surrounding a particular feature. The NAZ's are defined in more detail in the MMS document "Western and Central Gulf of Mexico Topographic Features Stipulation Map Package", dated June 2008. ONMS recognizes that these maps are only for planning purposes, and it is the responsibility of the lease holder to specifically determine the exact location of the isobath related to a proposed activity during the development plan process.

The designation of the NAZ's resulted from comprehensive studies of the reefs and banks of the northwestern Gulf of Mexico in the 1970's and 1980's. This approach has proved to be extremely effective in protecting these sensitive features from direct impact of oil and gas exploration and development. However, since the NAZ's were originally delineated, significant advances in bathymetric mapping and biological characterization have occurred. The location of the original NAZ's were based on the best available data at the time, but more recent data indicates that the NAZ locations should be updated to ensure that all significant portions of the features are included.

The following example from Stetson Bank is of specific concern to ONMS. Stetson Bank is a component of the FGBNMS. Figure 1 is a map of Stetson Bank. The background data is derived from information gathered from high-resolution multibeam bathymetry collected between 1997-2004. The approximate NAZ, as defined by BOEMRE, is indicated. For Stetson Bank, the NAZ is defined as the 52 meter isobath. As is evident from this map, there is a prominent "ring-shaped" bathymetric feature associated with Stetson Bank that is not included within the existing NAZ. This area is also not entirely contained within the current boundary of the FGBNMS. Sensitive biological habitats, including deepwater coral communities, have been documented associated with this ring feature.

NOAA-10

According to NTL 09-G39, no bottom-disturbing activities may occur within 500 feet of an NAZ. As Figure 1 indicates, it is therefore possible to carry out bottom-disturbing activities, including the placement of a platform or pipeline, outside of the sanctuary boundary and between the Stetson Bank NAZ and the surrounding ring-shaped feature. Due to the sensitivity of the geology and biology of this feature, we believe it is not advisable to consider bottom-disturbing activities within the area inside of the approximate circular area formed by the Stetson "ring". Currently, the ring feature itself is protected by the stipulation addressing "potentially sensitive biological features" (PSBF), also described in NTL 09-G39. PSBF's are defined as features outside of an NAZ that are of moderate or high relief (about 8 feet or higher). Lessees that propose bottom-disturbing activities within 100 feet of a PSBF must provide BOEMRE detailed information about the area. However, the locations of PSBF are not specifically defined in the NTL, and there are no buffer areas required for operations near these features.

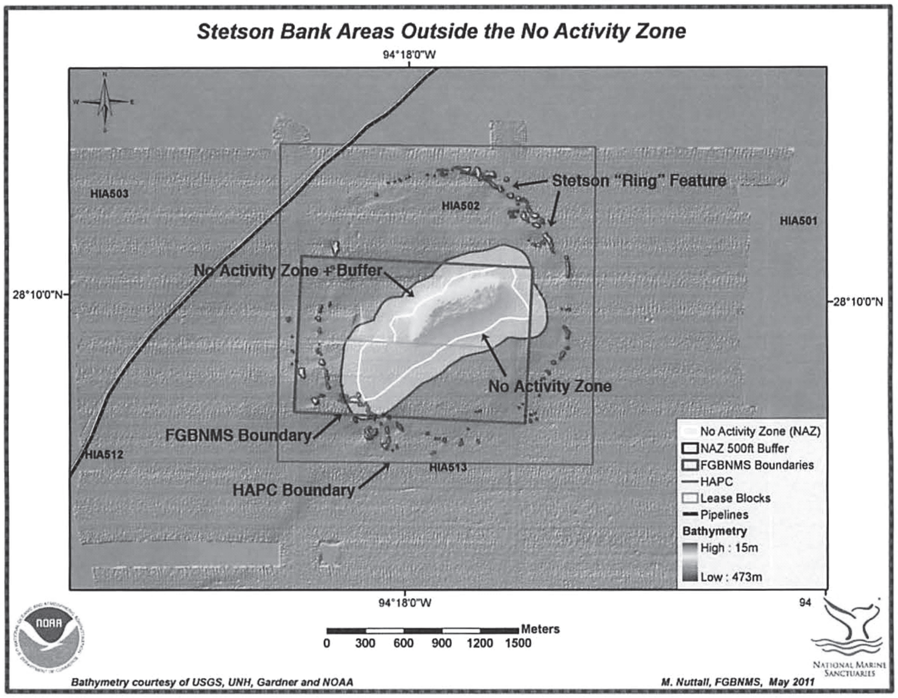


Figure 1. Stetson Bank bathymetry, showing BOEMRE existing "No Activity Zone".

In addition to Stetson Bank, there are several other topographic features in the western planning area that occur in the vicinity of the FGBNMS. These include MacNeil, 29 Fathom, Rankin (1 and 2) and Appelbaum Banks. Since 2007, the FGBNMS has been in the process of reviewing and updating its management plan. In October 2010, ONMS released a revised draft management plan for public review and comment. This plan includes a strategy to expand the boundaries of the FGBNMS by adding a number of reefs and banks of the northwestern Gulf of Mexico. The plan includes a recommendation for boundary expansion put forward by the FGBNMS Advisory Council. This recommendation includes MacNeil and the two Rankin Banks (Rankin #2 is also known as 28 Fathom Bank). The current NAZ's associated with these features should also be reviewed by BOEMRE in light of the more recent bathymetric data. It appears that, in general, the NAZ's should be expanded to include surrounding areas containing low and moderate relief features than are currently delineated.

NOAA-1 Comment noted. The decision on which alternative will be selected will be made and, if the decision is to hold a lease sale under either Alternative A or B, will be announced in the Final Notice of Sale.

NOAA-2 Information was added to the document to include the suggested revisions.

NOAA-3 Information was added to the document to include the suggested revisions.

NOAA-4 Information was added to the document to include the suggested revisions.

NOAA-5 Information was added to **Chapter 4.1.1.13.3** addressing the May 27, 2011, NOAA announcement that the Atlantic bluefin tuna does not warrant species protection under the ESA at this time.

NOAA-6 The BOEMRE has clarified the Supplemental EIS language in **Chapter 4.1** regarding "Incomplete or Unavailable Information" to address gaps in information on, among other things, mobile and nonmobile biological resources and endangered or threatened species. In compliance with CEQ's NEPA regulations on incomplete or unavailable information, BOEMRE has determined that this information may be relevant to reasonably foreseeable significant impacts. However, it is not essential to a reasoned choice among alternatives. In addition, in compliance with ESA Section 7(d), the action alternatives identified in this Supplemental EIS, if chosen, would not result in an irretrievable or irreversible commitment of resources that would foreclose the inclusion of reasonable and prudent measures. The BOEMRE will continue to consult with NMFS and, during the post-lease approval process, BOEMRE will consider imposing mitigations or conditions of approval to minimize or eliminate impacts on these species.

NOAA-7 Comment noted. The BOEMRE acknowledges that oil exploration and production on the OCS involves inherent risks. The BOEMRE, as the lead regulatory and enforcement authority for OCS exploration and production, is constantly evaluating new information and technological innovations that may reduce these risks. This Supplemental EIS evaluates these risks generally, but most are predicated on site-specific factors that BOEMRE evaluates in the post-lease process when it imposes conditions of approval, as appropriate.

NOAA-8 These recommendations will be considered as BOEMRE and NMFS develop a coordination and review strategy for BOEMRE-permitted activities, subject to the Memorandum of Understanding between BOEMRE and NMFS (May 23, 2011), and applicable statutory and regulatory requirements.

NOAA-9 Pursuant to the Biological Opinion, these listed conditions are implemented through lease stipulation and mitigations, and per guidance provided by NTL's.

NOAA-10 Comment noted. The stipulation and NTL 09-G39 would provide adequate protections for the Stetson "ring" feature by limiting bottom-disturbing activities within 100 ft (30 m) of the ring feature and requiring BOEMRE oversight. Although the stipulation and NTL do not specifically provide for a buffer area, hazard surveys post-lease would be required as part of the EP, DOCD, or pipeline application. The BOEMRE technical staff reviews the hazard surveys to identify additional potential sensitive biological features. If potential sensitive biological features are identified in the hazard survey, BOEMRE would require the operator to avoid the feature. These protections are more than adequate to protect potential sensitive biological features, including those areas around the Stetson ring, while potential changes to the No Activity Zone are considered by NOAA.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506

June 6, 2011

To: Chief, Environmental Assessment Section
Leasing and Environment (MS 5410)
Bureau of Ocean Energy Management, Regulation and Enforcement
Gulf of Mexico Outer Continental Shelf (OCS) Region
New Orleans, Louisiana

From: Acting Supervisor
U.S. Fish and Wildlife Service
Louisiana Ecological Services Office
Lafayette, Louisiana

Subject: Review of Draft Supplemental Environmental Impact Statement for the Proposed OCS Oil and Gas Lease Sale 218 in the Gulf of Mexico's Western Planning Area

The U.S. Fish and Wildlife Service (Service) has reviewed the subject Draft Supplemental Environmental Impact Statement (DSEIS) for the Gulf of Mexico OCS Oil and Gas Lease Sales 218 in the Western Planning Area (WPA), administered by the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), Gulf of Mexico OCS Region. Comments regarding the DSEIS are provided below by the Louisiana Ecological Services Office in behalf of the Service. This response does not address any section 7 consultation issues that may apply to this action. We will continue to work to address those issues as part of the reinitiation of consultation requested by BOEMRE dated July 30, 2010.

The DSEIS document is a notable improvement and provides greater discussion than past EIS documents for the OCS oil and gas lease sale program. We note the DSEIS discussion incorporates some of our comments found in our letters to you dated January 7, 2007, and January 24, 2011. We also note your reference to the new policies and regulations created in response to the *Deepwater Horizon* event that are designed to reduce the likelihood of another catastrophic spill occurring and improve spill response if such an event were to occur again. Thank you for meeting with us on January 26-27, 2011, to improve coordination between our two agencies in light of the *Deepwater Horizon* event. To further clarify and to improve the analyses of impacts discussed in the DSEIS, we recommend information provided or derived from the *Deepwater Horizon* response (including the number of birds and marine mammals collected) be updated as much as feasible. Specific comments follow.

TAKE PRIDE IN AMERICA

Specific Comments

FWS-1 Page 1-16 and 1-18: Please clarify the third paragraph under the *Exploration Plans* section that states categorical exclusion rules or selected exploration plans may include recommendations from the Service (under provisions of a DOI agreement). We are unfamiliar with the referenced DOI agreement.

FWS-2 Page 1-24: We recommend you identify what environmental information (e.g., location and descriptions of threatened and endangered species habitat) is available to oil spill response personnel prior to a spill occurring. For example, as highlighted on page 43 of your 2007 Biological Assessment for the 2007-2012 Programmatic Section 7 Consultation, BOEMRE provides annual updates to the U.S. Coast Guard (USCG) of threatened and endangered species locations beforehand to improve their response times to oil spills and to reduce the time required to gather information from multiple agencies.

FWS-3 Page 1-31: The reference to Appendix C in the first sentence of the second paragraph should be changed to Appendix E.

FWS-4 Page 3-13: We recommend you revise the first sentence of the second paragraph under the *Spills* section to read "...were responsible for 45 percent of the total *reported* spillage in ...." When discussing spill data collected from the USCG, please clarify that data is of reported spills to the USCG, not necessarily all spills that occur.

FWS-5 Page 3-15: Because the majority of impacts associated with Lease Sale 218 would most likely occur offshore or inshore of Texas, we recommend you provide the number of OCS-related pipeline landfalls that occur in Texas and a discussion of their impact-producing factors under section *3.1.1.4.1 Pipelines*.

FWS-6 Page 3-32: We recommend BOEMRE develop a method similar to Fraser and Ellis (2008) to estimate the difference between predicted oil spills versus actual oil spills from a proposed lease sale.

FWS-7 Page 3-35: We recommend you report the first-order results obtained for a spill of 90 days duration (similar in time as the *Deepwater Horizon* event) from each launch point modeled just as you have done for a spill of 30 days duration.

FWS-8 Page 3-35: We recommend the third sentence of the last paragraph be revised to read "...estimated to occur is <1 for the WPA proposed action" to reflect the data found in Table 3-5.

FWS-9 Pages 3-45 and 3-62: Please clarify references made on these pages to a Chapter 3.2.2.1. We cannot find the referenced chapter.

FWS-10 Page 4-46: When addressing risks from coastal spills in all sections of the document, we recommend the DSEIS provide justification why two 3,000 bbl spills are excluded from the risk probability of spills greater than or equal to 1,000 bbl occurring and how that affected the outcome. Otherwise, we recommend the two 3,000 bbl spills be included in calculating that probability.

FWS-11 Page 4-142: We recommend the green sea turtle description and discussion be expanded to include the same type of information provided in the discussion for the other sea turtle species, such as recent nesting numbers.

FWS-12 Pages 4-147 and 4-148: Please discuss the potential impacts of accidental events (section 4.1.1.11.3) and cumulative impacts (section 4.1.1.11.4) to nesting sea turtles and their nesting habitat.

FWS-13 Page 4-151: Please clarify the third sentence of paragraph five, "Birds that migrate through or winter along the northern Gulf of Mexico in fall likely have not yet experienced impacts from the DWH event..." Is that discussion regarding Texas migrating birds? We believe it highly likely that the on-going cleanup activities (which occurred through Fall 2010) as a result of the *Deepwater Horizon* event have and will continue to affect fall migrating birds from Louisiana to Florida.

FWS-14 Pages 4-152 and 155: Please update the information found in the second paragraph of both pages regarding the presence of endangered whooping cranes (*Grus Americana*) in Louisiana. A total of 10 whooping cranes have been reintroduced to Louisiana in the White Lake Conservation Area during Winter 2011 as a non-essential experimental population.

FWS-15 Page 4-153: Please add to the discussion of raptors in the second paragraph that the bald eagle (*Haliaeetus leucocephalus*) is also protected under the Bald and Golden Eagle Protection Act.

FWS-16 Page 4-158: We recommend BOEMRE fund a study that tests the impacts of produced water on birds as discussed in the fifth paragraph.

FWS-17 Page 4-164: Please expand your discussion of impacts to coastal and marine birds from oil-spill cleanup activities in section 4.1.1.12.3. For example, why does BOEMRE believe such impacts to coastal and marine birds are expected to be negligible (as stated in the last sentence of the second paragraph)?

FWS-18 Page 4-167: Please clarify your statement in the fourth paragraph that 32-47 OCS-related pipeline landfalls are anticipated. We understand that 0-1 pipeline landfall is anticipated as a result of the proposed lease sale in the WPA. Does the range of 32-47 landfalls mentioned include all pipeline landfalls that have occurred to date?

FWS-19 Page B-11: We recommend you identify and discuss actions (e.g., the new policies and regulations implemented as a result of the *Deepwater Horizon* event) that may reduce the BOEMRE's predicted duration of a catastrophic spill event in shallow water (2-4 months) and deep water (4-5 months) if any exist. Improved spill contingency planning may reduce the response time from that seen with the *Deepwater Horizon* event, possibly resulting in shorter spill durations or reduced impacts.

FWS-20 Page B-31: Please note that only the interior population of the endangered least tem *(Sterna antillarum)* is listed as endangered. The coastal population is not listed.

FWS-20 (cont)

Therefore, the least tern may be removed from the discussion of endangered and threatened species. We recommend you add a discussion of the endangered whooping crane (which occurs in Texas, Louisiana and Florida) and wood storks (*Mycteria americana*) which are listed as endangered in Alabama, Florida, Georgia and South Carolina.

FWS-21

Page B-34: We recommend you complete the last sentence of the diamondback terrapin discussion by listing examples of chronic effects to terrapins from oil contact.

FWS-22

Page C-3: You term the probabilities associated with your OSRA catastrophic spill run as *conditional probabilities*, meaning those probabilities are assuming a catastrophic event actually occurs. It may be possible to include a catastrophic event, such as the *Deepwater Horizon* event into BOEMRE's traditional OSRA model since historical spill data should now be able to capture that event. If that is not possible, we recommend BOEMRE evaluate the probability of a catastrophic event occurring using an alternative model.

Thank you for the opportunity to review the DSEIS. Please contact Rob Smith (337-291-3134) of this office if you have any questions regarding our comments.

Cc: NMFS, St. Petersburg, FL
FWS, Washington, DC (attn.: Rick Sayers)

Literature Cited

Fraser, G.S. and J. Ellis. 2008. Offshore hydrocarbon and synthetic hydrocarbon spills in eastern Canada: The Issue of follow-up and experience. Journal of Environmental Assessment Policy and Management 10(2):173-187.

FWS-1 The reference has been deleted.

FWS-2 The FWS comment was noted and revisions were made to the text.

FWS-3 A revision was made to the document to reflect the correction to Appendix E.

FWS-4 The text has been edited in multiple locations to indicate that the discussion is of reported spills, which may not include all spills.

FWS-5 The number of OCS-related pipeline landfalls that occur in Texas was added to **Chapter 3.1.1.4.1**.

FWS-6 Fraser and Ellis (2008) compared oil spill frequency predictions in advance of a project to observed data during and after. For this proposed action, the predicted number of spills is based on the estimated range of crude oil volume to be handled as a result of the lease sale. Because nearly all of the spills are 1 bbl or less (based on historical data) and the scenario includes such a wide range in oil production, BOEMRE's ability to correctly predict spills resulting from the proposed action in a manner similar to Fraser and Ellis (2008) is not compatible with a single lease sale within the context of multiple lease sales over time in a single planning area.

FWS-7 See Appendix C for first order results for 3, 10, 30, and 120 days for a 90-day spill event. The greatest increase in the percent chance of a spill contacting parish and county coastlines occurred between 3 and 30 days of the spill start. **Tables C-1 through C-4** in **Appendix C** show that, in most cases, there was up to a 5 percent increase in the percent chance of contact, with an individual parish or county coastline in the interval from 30 to 120 days after the spill start date.

FWS-8 The text has been revised so that the sentence reflects the data found in **Table 3-5**.

FWS-9 The text that references **Chapter 3.2.2.1** has been revised and all references to that chapter has been deleted.

FWS-10 The BOEMRE analyzes OCS spills using Anderson and LaBelle (2000), Poisson distributions, and the OSRA model. The BOEMRE analyzes coastal spills using historical data from USCG records. Although these USCG records include a source, such as pipeline or facility, they do not specify whether the oil is from State or Federal waters. The estimate of two 3,000-bbl spills on page 4-46 and in **Table 3-7** refers to coastal spills both in the CPA and WPA. The BOEMRE did not estimate two spills in the WPA at an assumed size of 3,000 bbl. The table gives an estimate of <1 to 1 spill in coastal waters. The comment that two 3,000-bbl spills be included in calculating probability cannot be accommodated because of the different ways in which BOEMRE analyzes coastal and OCS spills.

FWS-11 Additional information was added to **Chapter 4.1.1.11.1** describing additional information about green sea turtle nesting on the Texas coast.

FWS-12 Accidental and cumulative impacts to nesting sea turtles and their habitats are discussed in detail in the Multisale EIS and are not repeated in this document, but they are referenced in the 2009-2012 Supplemental EIS. No new information relevant to these impacts has been released regarding sea turtle nesting habitats and eggs since publication of the Multisale EIS and the 2009-2012 Supplemental EIS. The language in **Chapter 4.1.1.11.1** has been clarified.

FWS-13 Additional information was added to the document to discuss the DWH event, identified those bird groups or species found in the WPA that either could have been impacted or were unlikely to have been impacted (based on migration and residency patterns), and the potential impacts to migrating birds found in the WPA.

FWS-14 The document was revised to update information related to whooping cranes.

FWS-15 The document was revised to update information related to the Bald and Golden Eagle Protection Act.

FWS-16 Recommendation noted.

FWS-17 Information was added to the document to discuss the use of dispersants and training of cleanup personnel to reduce impacts to coastal and marine birds and their habitat.

FWS-18 Information was added to the document to discuss the total number of pipeline landfalls anticipated for the OCS Program from 2007 to 2046.

FWS-19 **Appendix B** is not an evaluation of risk and makes the assumption that a low-probability, catastrophic oil spill occurred in either shallow water or deep water. The primary intent is to present a conservative estimate of the duration of a catastrophic oil spill so that the magnitude of potential effects, however small the risk, is understood. While BOEMRE will not allow an operator to begin drilling until adequate oil-spill response and containment capabilities are in place, it would be impossible to predict with absolute certainty the efficiency and efficacy of that capability in the event of a spill or when complete containment would be possible. If a loss of well control event occurred in the future, it is possible that it could be contained in a best case scenario within weeks with the utilization of the rapid subsea containment packages, thereby greatly limiting the amount of oil potentially lost to the environment. However, there are rare situations where this equipment might not be able to be used to control the well, for example, if the drilling structure were to fall directly on top of the well as debris during a loss of well control event. For these reasons, BOEMRE has presented a conservative estimate of the duration, based on past blowouts of comparable scale, and the period of time required to kill those wells.

FWS-20 In **Appendix B**, the discussion of the least tern has been removed and discussions were added to address the endangered whooping crane and wood stork.

FWS-21 The BOEMRE appreciates this comment, which was an oversight. Section 4.2.2.5 (diamondback terrapins) of **Appendix B** was edited to reflect this comment. Since the actual effects from an oil spill are still unknown, some of the possible effects could include skin irritation from the oil or dispersants, respiratory problems from the inhalation of volatile petroleum compounds or dispersants, gastrointestinal problems caused by ingestion of oil or dispersants, and damage to other organs due to ingestion or inhalation of these chemicals.

The recommended change to Section 4.2.2.5 is to change the sentence to read, "The range of the possible chronic effects from oil and dispersants contact including lethal or sublethal oil-related injuries may include skin irritation from the oil or dispersants, respiratory problems from the inhalation of volatile petroleum compounds or dispersants, gastrointestinal problems caused by ingestion of oil or dispersants, and damage to other organs due to ingestion or inhalation of these chemicals."

FWS-22 Comment noted. A preliminary analysis, following the methodology of Anderson and LaBelle (2000), of oil-spill occurrence data through June 2010 (including the Macondo spill) indicates a spill rate decline in the last 15 years compared with the entire 1964 to June 2010 record. The results of this analysis have not been peer reviewed or published; therefore, the more conservative spill rates were used for this analysis.

From: Cheryl_Eckhardt@nps.gov
Sent: Wednesday, May 25, 2011 12:09 PM
To: WPA Supplemental EIS
Cc: waso_eqd_extrev@nps.govandstephen_spencer
Subject: No Comment DEC-11/0067, Western Planning Area (WPA) Lease Sale 218, Gulf of Mexico (GOM), Outer Continental Shelf (OCS), Oil & Gas Lease Sale for the 2007-2012 5-Year OCS Program

To Whom It May Concern -

NPS-1

NPS has no comment on DEC-11/0067, NOA of DEIS, Supplemental, Western Planning Area (WPA) Lease Sale 218, Gulf of Mexico (GOM), Outer Continental Shelf (OCS), Oil & Gas Lease Sale for the 2007-2012 5-Year OCS Program.

Thank you,
Cheryl

Cheryl Eckhardt
Environmental Compliance Specialist
NPS - Intermountain Regional Office
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EQ Intranet: http://inside.nps.gov/regions/orglist.cfm?lv=2&rgn=274

NPS-1 Comment noted.

From: Beth Altazan-Dixon [mailto:Beth.Dixon@LA.GOV]
Sent: Monday, May 16, 2011 3:15 PM
To: Goeke, Gary
Subject: DEQ SOV 110504/1185 US Dept of Interior-Oil and Gas Lease Sale: 2011

May 16, 2011

Joseph A. Christopher, Regional Supervisor
US Dept. of the Interior-Gulf of Mexico-OCS Region
1201 Elmwood Park Blvd
New Orleans, LA 70123
gary.goeke@boemre.gov

RE: 110504/1185 US Dept of Interior-Oil and Gas Lease Sale: 2011
Disk included in submittal Draft Supplemental EIS
Western Planning Area Lease Sale 218

Dear Mr. Christopher:

The Department of Environmental Quality (LDEQ), Business and Community Outreach Division has received your request for comments on the above referenced project.

LDEQ-1

After reviewing your request, the department has no objections based on the information provided in your submittal. However, for your information, the following general comments have been included. Please be advised that if you should encounter a problem during the implementation of this project, you should immediately notify LDEQ's Single-Point-of-contact (SPOC) at (225) 219-3640.

- Please take any necessary steps to obtain and/or update all necessary approvals and environmental permits regarding this proposed project.
- If your project results in a discharge to waters of the state, submittal of a Louisiana Pollutant Discharge Elimination System (LPDES) application may be necessary.
- If the project results in a discharge of wastewater to an existing wastewater treatment system, that wastewater treatment system may need to modify its LPDES permit before accepting the additional wastewater.
- All precautions should be observed to control nonpoint source pollution from construction activities. LDEQ has stormwater general permits for construction areas equal to or greater than one acre. It is recommended that you contact the LDEQ Water Permits Division at (225) 219-3181 to determine if your proposed project requires a permit.
- If your project will include a sanitary wastewater treatment facility, a Sewage Sludge and Biosolids Use or Disposal Permit application or Notice of Intent must be submitted no later than June 1, 2011. Additional information may be obtained on the LDEQ website at http://www.deq.louisiana.gov/portal/tabid/2296/Default.aspx or by contacting the LDEQ Water Permits Division at (225) 219- 3181.
- If any of the proposed work is located in wetlands or other areas subject to the jurisdiction of the U.S. Army Corps of Engineers, you should contact the Corps directly regarding permitting issues. If a Corps permit is required, part of the application process may involve a water quality certification from LDEQ.
- All precautions should be observed to protect the groundwater of the region.
- Please be advised that water softeners generate wastewaters that may require special limitations depending on local water quality considerations. Therefore if your water system improvements include water softeners, you are advised to contact the LDEQ Water Permits to determine if special water quality-based limitations will be necessary.

- Any renovation or remodeling must comply with LAC 33:III.Chapter 28, Lead-Based Paint Activities; LAC 33:III.Chapter 27, Asbestos-Containing Materials in Schools and State Buildings (includes all training and accreditation); and LAC 33:III.5151, Emission Standard for Asbestos for any renovations or demolitions.
- If any solid or hazardous wastes, or soils and/or groundwater contaminated with hazardous constituents are encountered during the project, notification to LDEQ's Single-Point-of-Contact (SPOC) at (225) 219-3640 is required. Additionally, precautions should be taken to protect workers from these hazardous constituents.

Additionally, based on the information provided, the Assessment Division has no comments regarding this project. However, if the project scope changes in the future, please notify LDEQ before implementation.

Please send all future requests to my attention. If you have any questions, please feel free to contact me at (225) 219-3958 or by email at beth.dixon@la.gov.

Sincerely,

Beth

Beth Altazan-Dixon
Performance Management
LDEQ/Business and Community Outreach Division
Office of the Secretary
P.O. Box 4301 (602 N. 5th Street)
Baton Rouge, LA 70821-4301
Phone: 225-219-3958
Fx: 225-325-8148
Email: ***beth.dixon@la.gov***

LDEQ-1 Comment noted. It is the applicant's responsibility to comply with all applicable Federal, State, and local laws and regulations.

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

April 29, 2011

U.S. Department of the Interior
Bureau of Ocean Energy Management,
Regulation and Enforcement Gulf of Mexico
OCS Region

Re: TCEQ Grant and Texas Review and Comment System (TRACS) #2011-179 - Proposed OCS Oil and Gas Lease Sale in the Gulf of Mexico's Western Planning Area

To Whom it May Concern:

The Texas Commission on Environmental Quality (TCEQ) has reviewed the above-referenced project and offers following comments:

TCEQ-1

We look forward to reviewing environmental assessment documents as they become available.

We have no comment on this project

Thank you for the opportunity to review this project. If you have any questions, please contact Ms. Tangela Niemann at (512) 239-3786 or tangela.niemann@tceq.texas.gov.

Sincerely,

Jim Harrison, Director
Intergovernmental Relations Division

P.O. Box 13087 • Austin, Texas 78711-3087 • 512-239-1000 • www.tceq.state.tx.us

TCEQ-1 Comment noted.

June 6, 2011

Mr. Gary D. Goeke
Chief, Environmental Assessment Section
Leasing and Environment (MS 5410)
Bureau of Ocean Energy Management, Regulation and Enforcement
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Via E-mail to WPASupplementalEIS@boemre.gov

Dear Mr. Goeke:

The American Petroleum Institute (API) offers the following comments on the Draft Supplemental Environmental Impact Statement (SEIS) for Gulf of Mexico (GOM) Western Planning Area (WPA) Lease Sale 218 in the 2007–2012 Five-year OCS Leasing Program that the Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE or Agency) published in the Federal Register on November 10, 2010 and corrected November 16, 2010. The API is a national trade association that represents over 470 members involved in all aspects of the oil and natural gas industry, including exploring for and developing oil and natural gas resources in the GOM. The API presented comments on the scoping of the SEIS, and we are pleased to provide these additional comments.

API supports the analysis made by the BOEMRE in the Western Planning Area Lease Sale 218 Draft Supplemental Environmental Impact Statement (OCS EIS/EA BOEMRE 2011-018). Last November, when announcing this SEIS, BOEMRE stated that the SEIS is intended to "update the environmental and socioeconomic analyses" in prior "tiering" EIS documents by considering "new circumstances and information arising, among other things, from the *Deepwater Horizon* blowout and spill." Corrected Notice of Intent to Prepare a Supplemental Environmental Impact Statement, 75 Fed. Reg. 70023 (Nov. 16, 2010). When completed, the SEIS will be used to "inform future decisions regarding the approval of operations, as well as leasing." *Id.* API believes that the detailed analysis provided in the draft SEIS, along with the other supporting environmental documents and additional assessments being conducted by BOEMRE, provide a thorough analysis upon which to make decisions related to Lease Sale 218, new or revised exploration and development plans in the Western Planning Area, and future permit applications, without delay. API also supports BOEMRE's continued practice of tiering Environmental Impact Statements and Environmental Assessments (EISs/EAs) under the National Environmental Policy Act (NEPA).

Alternatives Considered in the SEIS

API-1

The alternatives that the draft SEIS considers are those analyzed in the prior "tiering" EISs addressing the Western Planning Area. Of these, API supports Alternative A – the proposed action. Alternative A "would offer for lease all unleased blocks within the Western Planning Area for oil and gas operations, except whole and partial blocks within the boundary of the Flower Garden Banks National Marine Sanctuary." API is opposed to Alternatives B and C. Alternative B consists of a reduced leasing program, offering the unleased blocks included in the proposed action less those subject to the Topographic Features stipulation, while Alternative C is the no-action alternative.

Key Conclusions of the SEIS

API fully supports the Agency's fundamental conclusion in the draft SEIS that, "based on the information known at this time, there is no reason to believe that the conclusions [regarding potential environmental impacts of future oil and gas operations in the WPA] reached in the Multisale EIS and the 2009-2012 Supplemental EIS . . . have been altered or changed" as the result of either the Deepwater Horizon ("DWH") event or other newly-developed information (refer to page 4-6). As part of this analysis, the draft SEIS concludes that "the environmental baseline" in the WPA "remains essentially unchanged" since the prior "tiering" EISs were prepared. (Page 4-5 (noting that the WPA avoided "significant adverse impacts" from released oil from the DWH event "due to its geographic location and distance from the DWH site")). In addition, BOEMRE concludes that adequate information is available today to support the conclusions in the draft SEIS, and API further believes that the regulatory and operational changes that have been implemented since the DWH event effectively minimize the potential of future accidents to result in any significant effects. Many studies and data collection efforts are currently underway following the DWH event, which are helpful to the Natural Resources Damage Assessment process. The ongoing nature of these studies, which are likely to continue for decades, does not diminish or adversely affect the Agency's ability to conclude that "there is no incomplete or unavailable information that is deemed relevant to making a determination regarding reasonably foreseeable significant adverse impacts [of new leasing operations in the WPA] or that is essential to a reasoned choice among alternatives." (See page 4-6). This point is further discussed below.

Suggestions for Finalizing the SEIS

API-2

While API believes that BOEMRE's draft SEIS for Lease Sale 218 is well written and supported, as with any such endeavor, the document could be made even stronger. In particular, there is more recent scientific information related to the DWH oil spill that should be discussed. API recognizes the need for a "cut-off point" for new information so that the administrative process for finalizing the SEIS can proceed. Nonetheless, many of the scientific reports that have been published since the draft SEIS for Lease Sale 218 was originally prepared would be helpful in understanding the effects of the DWH event and could further inform the NEPA process for Lease Sale 218. Updating the SEIS to include reports published through the close of the draft SEIS comment period will provide for a more complete public disclosure.

To this end, API submits two enclosures to this letter that provide additional detailed comments citing additional sources and information for consideration in enhancing the draft SEIS issued for public comment. Enclosure 1, *API Comments on the DSEIS for Lease Sale 218,* is a table that presents API comments that generally reference a specific section or page within the draft SEIS or, in some cases, address more general issues. Enclosure 2, *API Comments Regarding Resources Discussed in Draft Supplemental Environmental Impact Statement for Western Planning Area Lease Sale 218,* is focused on describing recent scientific findings that are helpful in understanding the impacts of oil and gas operations on specific resource areas (*e.g.*, water quality, air, fish, marine mammals, etc.). Enclosure 2 describes a large body of recent scientific research concerning the DWH event that will be helpful in more fully describing the potential consequences of a large offshore oil spill. API offers both Enclosures 1 and 2 for the Agency's consideration in developing the final SEIS for Lease Sale 218.

In addition to the comments included in the enclosures, API offers the following additional suggestions for consideration by BOEMRE.

1. Particular areas in which additional information is available.

The following discussion identifies sources that we believe provide information that would be of particular value in updating the SEIS.

API-3

API notes that the Operational Science Advisory Team (OSAT) produced two important reports for the U.S. Coast Guard Federal On-Scene Coordinator, which should be included in the draft SEIS. The OSAT I report, *Summary Report for Sub-Sea and Sub-Surface Oil and Dispersant Detection: Sampling and Monitoring* (December 17, 2010), provides information on the behavior of oil spilled during the DWH incident and presents the results of extensive water column and sediment sampling for both oil and dispersant indicators. The OSAT II report, *Summary Report for Fate and Effects of Remnant Oil in the Beach Environment* (Feb. 10, 2011), includes the results of extensive sampling and predictive modeling regarding the fate and effects of oil spilled during the DWH incident that subsequently stranded on Gulf Coast beaches. Taken together, the two reports provide substantial information regarding oil and dispersants associated with the DWH oil spill. API recommends that the important information contained in these reports be summarized in the draft SEIS to help provide a more complete picture of the environmental consequences of a large oil spill in deep water.

Importantly, the OSAT reports, and other additional sources cited in the Enclosures, provide further information addressing a number of key issues referenced in the draft SEIS. Thus, in discussing subsea benthic communities (and, more generally, the fate and distribution of oil released as a result of the DWH event), the OSAT I report provides far more comprehensive water sampling data, and data characterizing impacts on subsea sediments, that supplement the data from the R/V *Weatherbird* cruise on May 23-26, 2010, cited in the draft SEIS. This additional data allows analysis of such questions as (1) to what extent have concentrations of oil and/or dispersants that exceed aquatic toxicity benchmarks been detected outside the area surrounding the DWH well, and for what time period did such concentrations persist after the well was capped, (2) at what distances from the well site, and over what time periods, have concentrations of oil been detected in subsea sediments, and (3) what does sampling data indicate as to the amounts of oil that may remain in the subsea environment today. Similarly, the OSAT II report provides information about the extent and effectiveness of shoreline response activities in removing oil from near-shore and onshore environments and what potential impacts may be anticipated from oil that remains in these area.

Moreover, sampling data collected by EPA and by OSHA/NIOSH provide extensive information indicating whether air quality was impacted at levels of regulatory concerns at myriad locations along the Gulf coastline, and at locations where response workers were. This data provides an objective basis to evaluate whether, and to what extent, coastal residents and response workers may have been exposed to harmful concentrations of air contaminants attributable to the DWH event. Similarly, data collected by the FDA provides much information helpful in evaluating whether seafood from the Gulf area has been found to contain detectable oil or dispersant residue.

2. Impacts from a catastrophic spill event

Appendix B is a critical component of the SEIS and should be more effectively highlighted in the executive summary and appropriate sections of the document. API recommends that a summary of the findings in Appendix B, *Catastrophic Spill Event Analysis,* be included in the executive summary (currently at pages vii through xiii) and in Section 2. Appendix B represents an analysis of the potential environmental effects of a high-volume, extended-duration, catastrophic oil spill from a well blowout in the Gulf of Mexico. The term, "catastrophic spill," is first referred to on pg. xii and is defined as "…such as the DWH event." The next time this term is used, it is discussed in terms of the effects analysis, with the finding that effects would be minor in scope "unless there is a catastrophic spill" (refer to pg. 2-10). At some point before this summary discussion, it would be helpful to refer the reader to the *Catastrophic Spill Event Analysis* in Appendix B, where a catastrophic spill is defined on pg. B-12.

3. Discussion of BOEMRE's recent rule changes

API4

API suggests that BOEMRE enhance Section 1.3.1, *Rule Changes Following the Deepwater Horizon Incident* (see page 1-6), to more completely describe the administrative and regulatory changes made by the Agency following the DWH blowout and oil spill. Collectively, these changes have been implemented in an effort to further reduce the risk of future blowouts and oil spills on the U.S. Outer Continental Shelf. In particular, API suggests that this section summarize the intent and requirements of Notice to Lessees (NTL) 2010-N05, NTL 2010-N06, and NTL 2010-N10. These NTLs are listed but not summarized or explained in Section 1.3.1. Further, this section describes the fact that the BOEMRE will institute "enhanced inspection procedures" but does not discuss any specifics regarding these enhancements. Any recent updates to the Agency's organization, procedures or regulations since publication of the draft SEIS for Lease Sale 218 should also be discussed. It would be helpful to have a paragraph at the end of this section that summarizes BOEMRE's recent regulatory, administrative, and procedural changes made to address the issues that have been identified with respect to the DWH incident and further reduce the risk of similar incidents in the future. The SEIS for Lease Sale 218 needs to fully describe the substantial actions taken by BOEMRE since the DWH incident to minimize the risk of future blowouts and oil spills.

4. References to potential future impacts from the DWH event

When discussing several resource categories, the draft SEIS mentions potential future impacts from the DWH event that are not fully supported by existing information and in a number of cases are inconsistent with such information. In discussing air quality impacts, for example, the Draft SEIS refers to a workshop held in New Orleans on June 22-23, 2010, and summarizes reports made there that "[d]ue to volatile chemicals that evaporated from the oil spill into the atmosphere, people in the coastal areas have been experiencing sickness, fever, coughing, and lethargy." (refer to page 4-16) This claim is inconsistent with the extensive body of personal breathing zone air quality data collected by the Unified Area Command, the US Coast Guard, and OSHA, for which the vast majority of the results were either non-detector well below relevant occupational exposure limits. Other examples are discussed in Enclosures 1 and 2. API suggests that statements discussing future effects that are not supported by reliable information be corrected or removed.

API-5

Discussion of "Incomplete and Unavailable" Information

At pp. 4-4 through 4-6, the draft SEIS discusses the instances in which the information available to BOEMRE is "incomplete or unavailable" within the meaning of 40 C.F.R. § 1502.22. Although "numerous" instances are cited, BOEMRE has determined, after careful analysis, that the currently unavailable information is not "relevant to making a determination regarding reasonably foreseeable significant adverse impacts" or is not "essential to a reasoned choice among alternatives." DSEIS, at 4-6; *see* 40 C.F.R. § 1502.22(a & b). This conclusion is an important one, since both CEQ regulations and case law spell out how an agency must proceed when confronted by information that is not currently available.

1. Standards for addressing information that is incomplete and unavailable

Under NEPA, agencies need not wait to finalize an EIS or other NEPA-mandated analysis until all possible potentially relevant information is available. *E.g.*, *Sierra Club v. Sigler*, 695 F.2d 957, 973 (5th Cir. 1983) ("Uncertainty as to environmental consequences need not bar action as long as the uncertainty is forthrightly considered in the decision making process and disclosed in the EIS"); *see State of Alaska v. Andrus*, 580 F.2d 465, 473 (D.C. Cir. 1978) (vacated in part on other grounds in *Western Oil & Gas Ass'n v. Alaska*, 99 S.Ct 303 (1978)); 40 C.F.R. § 1502.22. In *State of Alaska*, the Ninth Circuit held: "agencies may not be precluded from proceeding with particular projects merely because the environmental effects of that project remain to some extent speculative. NEPA simply does not specify the quantum of information that must be in the hands of a decisionmaker before that decisionmaker may decide to proceed with a given project." *Id.* The court stated:

> 'NEPA was intended to ensure that decisions about federal actions would be made only after responsible decisionmakers had fully adverted to the environmental consequences of the actions . . . .' One of the costs that must be weighed is the cost of uncertainty, i.e., the costs of proceeding without more and better information. Where that cost has been considered, and where the responsible decisionmaker has decided that it is

> outweighed by the benefits of proceeding with the project without further delay, the courts may not substitute their judgment for that of the decisionmaker and insist that the project be delayed while more information is sought.

Id.; *see, e.g.*, *Cabinet Res. Grp. v. United States Fish and Wildlife Serv.*, 465 F. Supp. 2d 1067, 1100 (D. Mont. 2006) (sufficient that "the Forest Service used available data to explore the potential impacts and articulated the basis for its decision").

In 40 C.F.R. § 1502.22, the CEQ specifies the steps that an agency should take when confronted with potentially relevant information that is not currently available. Initially, the agency must disclose that such information is not available: "When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment . . . and there is incomplete or unavailable information, the agency shall always make clear that such information is lacking." 40 C.F.R. § 1502.22. Here, the draft SEIS documents the instances in which the information currently available is incomplete, and identifies the subject areas in which ongoing or future studies may produce additional information. *See, e.g.*, draft SEIS at pp. 4-4 (ongoing studies in the Gulf of Mexico); 4-86 - 4-87 (Studies to Measure the Impact of the *Deepwater Horizon* Event); 4-104 (*sargassum*); 4-115 (chemosynthetic deepwater benthic communities); 4-127 (non-chemosynthetic deepwater benthic communities); 4-264 (cumulative impacts); 4-268 (impacts on soft bottom benthic communities), *inter alia*. The draft SEIS also acknowledges the extensive data collection and evaluation work now underway as part of the Natural Resource Damage Assessment process relating to the *Deepwater Horizon* event and other scientific endeavors. Draft SEIS at p. 4-5 ("it could be many years before" the conclusions of NRD assessment work and the "numerous studies by academia" become available).

Once the fact of currently unavailable information has been identified, an agency must evaluate the relevance and importance of this information. 40 C.F.R. § 1502.22(a). Where the agency determines that unavailable information (1) is not "*relevant* to reasonably foreseeable significant adverse impacts" from the alternatives before it or (2) is not "*essential* to a reasoned choice" between alternatives, the agency need not go further in seeking out or evaluating this information prior to issuance of the NEPA analysis document. *Cabinet Res. Grp.*, 465 F. Supp. 2d at 1100 (emphasis added) (citing 40 CFR § 1502.22(a)) ("The obligation to disclose and compensate for missing information is triggered only where the information is 'essential to a reasoned choice among alternatives.'"). In the present draft SEIS, BOEMRE addresses these issues through its discussion in Part 4 of the document, which reaches the conclusion that "there is no incomplete or unavailable information that is deemed relevant to making a determination regarding foreseeable significant adverse impacts or that is essential to a reasoned choice among alternatives." *Id.*, at 4-6.

Finally, even if the unavailable information is found to be both relevant and "essential" to a reasoned choice among alternatives, the agency may proceed to finalize an EIS or other NEPA analysis without waiting to obtain the information provided that, after weighing the need for and importance of the information in question against the costs and burdens required to obtain it, the agency concludes such costs and burdens would be "exorbitant." 40 CFR § 1502.22(b). Due to the draft SEIS' findings regarding the relevance and importance of the information at issue here, BOEMRE did not find it necessary to address this element of the 40 C.F.R. § 1505.22 test.

2. Additional Steps To Strengthen Analysis Of Unavailable Information

In the existing draft SEIS, BOEMRE has identified where information that is potentially relevant to the conclusions of its NEPA analysis is "unavailable or incomplete," assessed the possible relevance and importance of this information to a "reasoned choice" between the alternatives under study, and reached a determination that the unavailable information is either not relevant or not essential to its conclusions in this document. *E.g*, Draft SEIS, at pp. 4-5 to 4-6. The draft SEIS further addresses instances in which specific items of information are not currently available in Part 4 as part of discussions of how the project alternatives may impact particular categories of resources. Through this discussion, BOEMRE has appropriately addressed the requirements of 40 C.F.R. § 1502.22.

On May 20, 2011, BOEMRE issued its draft Chukchi Sea SEIS for Lease Sale 193 in the Chukchi Sea Planning Area in Alaska. This supplemental NEPA analysis was prepared in response to the 2010 decision, *Native Village of Point Hope v. Salazar*, 730 F. Supp. 2d 1009 (D. Alaska 2010), which found certain deficiencies in the manner in which the EIS originally prepared for Lease Sale 193 had addressed "incomplete or unavailable information." 730 F. Supp. 2d at 1018 (the EIS should be revised to "make the findings" required by 40 C.F.R. § 1502.22). In preparing the newly-issued draft SEIS, BOEMRE developed a thoughtful and very useful framework to evaluate information that is currently not available and to make any required findings under § 1502.22. This approach, if suitably modified for the different circumstances, requirements, and factual context of the present draft SEIS, offers an opportunity for BOEMRE to further strengthen its analysis of "incomplete or unavailable" information.

In Appendix A to the draft Chukchi Sea SEIS, BOEMRE describes the "structured analysis" used in making the 40 C.F.R. § 1502.22 findings called for by the *Native Village of Point Hope* decision. BOEMRE adopted more specific definitions of certain key terms used in § 1502.22. Thus, information "was considered *relevant* if it could be connected to reasonably foreseeable significant adverse impacts as stipulated by CEQ regulation and following the significance criteria" spelled out in the draft SEIS. App. A, at A1 (emphasis in original); *see, e.g., Mid States Coalition for Progress v. Surface Transp. Bd.*, 345 F.3d 520, 549 (8th Cir. 2003). If relevant, information was then evaluated "to determine whether the information was *essential* to a reasoned choice among alternatives. To be essential, the information must provide a clear distinction between two or more alternatives." App. A, at A1 (emphasis in original); *see Cabinet Res. Grp.*, 465 F. Supp. 2d at 1100. If information was found to be both relevant and essential, the agency "evaluated the potential means of obtaining the information to determine whether cost would be *exorbitant.*" App. A, at A1 (emphasis in original); *see State of Alaska*, 580 F.2d at 473.

Applying these definitions, BOEMRE proceeded to analyze the "hundreds of catalogued statements" mentioning incomplete or unavailable information compiled by parties challenging the original Chukchi Sea EIS. App. A, at A2. In doing so, the agency identified "common themes" concerning how such statements should be addressed under 40 C.F.R. § 1502.22. Among those most pertinent are:

- Sufficient information to support sound scientific judgments and reasoned managerial decisions is available even without the identified incomplete or unavailable information. As BOEMRE explained, although "there will always be some level of incomplete information (especially regarding dynamic ecosystems), there is often enough information to formulate and support sound scientific judgments." App. A, at A3.

- The realization that significant adverse effects would certainly occur under the circumstances to which the incomplete information applies. As an example, "it is already presumed that a large oil spill could cause significant adverse impacts to wildlife and other resources, through myriad direct and indirect effects. Thus, it is not essential for the decision-maker, who is already made aware of the probability and severity of these potential impacts, to understand every particular mechanism through which these adverse impacts could occur." App. A, at A3.[1]

- The existence of other environmental laws and regulations that would preclude significant adverse effects on particular resources. "For example, comprehensive regulatory standards under the Clean Air Act are sufficient to preclude air quality impacts from reaching a level of significance. Incomplete information regarding air quality issues is in this sense less useful to the decision maker . . . ." App. A, at A3.

- The understanding that certain presently missing or incomplete information will be known (and utilized to avoid or minimize impacts) at a later stage of the agency's environmental review. Due to the multi-stage process for "planning, leasing, exploration, and development and production of oil and gas" on the OCS, the fact that "certain information may, in fact, be essential at a later stage of OCS Lands Act [review]" does not imply that this information is "essential to a reasoned choice among alternatives at this lease sale stage." App. A, at A3.[2]

Equipped with these principles, BOEMRE proceeded to address, and make individualized findings as to each of the many "catalogued statements" in the original Chukchi Sea EIS. App. A, at A3-A98.

It is not necessary to prepare the level of detailed individualized findings contained in the draft Chukchi Sea SEIS to further strengthen BOEMRE's analysis of "incomplete and unavailable" information in the present draft SEIS. However, BOEMRE could include a discussion summarizing its analysis and conclusions regarding any incomplete or unavailable information potentially pertinent to a particular resource category (*e.g.*, water quality, benthic organisms) in its analysis in Part 4 describing how the project alternatives may impact such resources. Even

API-6

[1] *E.g.*, *No GWEN Alliance of Lane County, Inc. v. Aldridge*, 855 F.2d 1380 (9th Cir. 1988) (noting that when "everyone recognizes that . . . effect" may be catastrophic, requiring detailed delineation of the precise nature of the impacts "serve[s] no useful purpose").

[2] *See North Slope Borough v. Andrus*, 642 F.2d 589 (D.C. Cir. 1080).

where such discussion is not essential as a legal matter to comply with 40 C.F.R. § 1502.22, it could be helpful in further explaining and supporting the Agency's conclusions in this regard.

In closing, the American Petroleum Institute strongly urges BOEMRE to expedite completion of the SEIS. This will allow for a resumption of regular lease sales in a portion of the GOM. We anticipate the issuance of the SEIS for the Central Gulf of Mexico lease sales remaining under the 2007 – 2012 5-year Leasing Plan and will provide comments on that document once issued. Should you have any questions on these comments please contact me at (202) 682-8584 or by email at radforda@api.org.

Sincerely,

Andy Radford

Andy Radford

Enclosure (1) API Comments on the DSEIS for Lease Sale 218
(2) API Comments Regarding Resources Discussed in Draft Supplemental Environmental Impact Statement for Western Planning Area Lease Sale 218

Responses to Comments in API's Transmittal Letter

API-1 The decision on which alternative is selected will be made after this Supplemental EIS is finalized and, if the decision is to hold a lease sale under either Alternative A or B, it will be announced in the Final Notice of Sale.

API-2 Since publication of the Draft Supplemental EIS on April 22, 2011, the subject-matter experts incorporated relevant information and updated this Supplemental EIS accordingly. The incorporation of relevant information is time consuming, as it must be obtained and reviewed by subject-matter experts in the context of the source of the data, research methodology, and data quality. As is necessary under every NEPA analysis, at some point the subject-matter experts had to finalize their analyses to allow time for the Final Supplemental EIS to be prepared and presented to the decisionmaker.

API-3 Based on a review of the OSAT-1 report by BOEMRE's subject-matter experts, the data in the report does not change the conclusions regarding potential impacts in WPA waters because the OSAT reports targeted areas directly impacted by the DWH event, and no direct impacts have been identified in the WPA. Where relevant to a discussion of potential future impacts from an accidental event, OSAT-1 was referenced.

API-4 This Supplemental EIS already provides detailed descriptions of the administrative and regulatory changes made by BOEMRE following the DWH event and oil spill (**Chapter 1.3.1**), which are in effect to minimize the risk of future blowouts and oil spills. **Chapter 1.3** describes the regulatory framework already in place, requiring that the OCS leasing process and all activities and operations on the OCS comply with other Federal, State, and local laws and regulations. Since these documents are readily available from BOEMRE or on the Internet, detailed descriptions are unnecessary in this Supplemental EIS.

API-5 The document was revised in response to this comment.

API-6 **Chapter 4.1**, "Incomplete or Unavailable Information," has been expanded. Where relevant information on reasonably foreseeable significant adverse impacts is incomplete or unavailable, the need for the information was evaluated to determine if it was essential to a reasoned choice among the alternatives and, if so, was either acquired or, in the event it was impossible or exorbitant to acquire the information, accepted scientific methodologies were applied in its place. In addition, individual resource analyses highlight where information was incomplete or unavailable.

API ENCLOSURE 1, COMMENTS 1-5

API Comments on the DSEIS for Lease Sale 218

NO.	DSEIS Section No.	PAGE NO.	COMMENT
1	General	N/A	A change in wording is suggested throughout the document to convey the thought that while DWH did impact the environment, the impacts - if already defined - were not sufficient to alter the final conclusions presented in the Multisale EIS and the 2009-2012 Supplemental EIS. The use of the phrase "no substantial new information," though technically correct, suggests a somewhat arbitrary characterization of the "new information" generated by studies and analyses conducted since the DWH event.
2	General		BOEMRE states (in numerous places) that this document is not an EIS on the DWH event. It could be said once, if necessary, in the Summary section. It is suggested that different wording be used to clearly state what aspects of the environmental baseline have potentially changed between the earlier EIS documents and the present requiring the need for the Supplement. Emphasis on the "DWH event" could then be avoided.
3	General		The DWH effects studies are ongoing and new information that is in the public domain through the close of the comment period should be incorporated where appropriate in the final EIS.
4	Summary		A summation of the findings in Appendix B should be included in the executive summary or in Section 2 to support the statements made. For example, the term, "catastrophic spill," is first referred to on pg. xii and is defined as "…such as the DWH event." The next time this term is used, it is discussed in terms of the effects analysis, with the finding that effects would be minor in scope "unless there is a catastrophic spill" (DSEIS at 2-10). At some point before this summary discussion, the reader should be referred to the Catastrophic Spill Event Analysis in Appendix B, where a catastrophic spill is defined on p. B-12 of the DSEIS. Readers will be looking for this information and it would be helpful to provide this "framing" discussion early in the document.
5	Summary	viii	API supports Action Alternative A and opposes Action Alternative B The logic for this position is that both existing BOEMRE regulations/stipulations and industry experience has been that industry operations are protective of topographic features via existing 'no drill zones' and regulations governing placement of anchors and pipelines. Removing tracts from leasing is therefore not necessary. Furthermore, research over the last decade has identified an increasing number of topographic

API Comments on the DSEIS for Lease Sale 218

API ENCLOSURE 1, COMMENTS 6-10

			features and hard-bottom benthic communities in the GOM. These areas, once thought to be rare, are now recognized as common and the recent BOEMRE Information Transfer Meeting included scientific assessments that suggest there could be as many as 16,000 such places in the GoM. Labeling this many places as unique is inappropriate. A policy to remove tracts which may have such features without a seriatim ranking of sensitivity and a risk/impact assessment is unwarranted.
6	1.2	1-4	The study area of potential impacts should be clearly defined. Some confusion is possible after reading the text and reviewing the figures. For example, Figure 2-2, *Economic Impact Areas of the Gulf of Mexico,* covers the entire Gulf of Mexico. DSEIS at A-5.
7	1.3	1-5	Section 1.3 should be revised to address the regulations of the other cooperating and commenting agencies, from which the lessee will require approvals and are intended to further protect the environment from specific activities beyond the scope of BOEMRE's comprehensive regulations. The document identifies a list of regulations or laws (DSEIS at1-5) and with the exception of air, cultural resources, and marine mammals is silent about those regulations which the lessee must comply with and mitigate environmental impacts. Important regulations to address, for example, CWA-NPDES cooling water intake practices; MBTA - lighting practices; RCRA -waste handling; MSFCMA-helicopter flights over water are offered. The recent EISs prepared by the USCG for the Deepwater Ports offer a format to address those regulations that are not directly addressed under BOEMRE regulations or NTLs.
8	1.3	1-5 to 1-6	Recommend that the chart on pages 1-5 and 1-6 be assigned a table number comparable to other similarly formatted text. Furthermore the table could be expanded to show how each of the applicable regulations are tangibly addressed in the SEIS document and lease sale program
9	1.3.1	1-6	It would be helpful to include a brief description of the MMS reorganization resulting from the DWH incident into the three new Bureaus. The separate functions of the Office of Natural Resources Revenue, the Bureau of Ocean Energy Management (BOEM), and the Bureau of Safety and Environmental Enforcement (BSEE) should be described.
10	1.5	1-15	Section 1-5 exploration and production plans (DSEIS at1-15, paragraph 3) cites Regg et al 2000 as being used as a reference for NEPA compliance and environmental issues to be addressed in deep water areas. The age of this publication and wording in the DSEIS on use of this publication suggests that none of the

API Comments on the DSEIS for Lease Sale 218

API ENCLOSURE 1, COMMENTS 11-16

			more recent work has been used or even sought out for inclusion in this DSEIS. Two paragraphs later, NTL 2008-G06 is described suggesting that some new issues arose since 2000 that could be discussed. DSEIS at 1-15.
11	1.5	1-24	What is the relevance of the references to Florida consistency requirements related to Regional Oil Spill Response Plans and leases within the WPA? The discussion regarding subregional OSRPs appears to be specific to areas offshore Florida, and not relevant to the WPA.
12	1.5	1-23 to 1-25	Section 1.5 describing the oil spill response plans (DSEIS at1-23 - 1-25) revisions, submission, and review process should be presented more clearly. A lay person would be left with the impression that BOEMRE uses wide discretion in determining when a lessee's OSRP needs to be updated, and submitted to BOEMRE.
13	1.5	1-29	Section 1.5 describing structure removal and site clearance (DSEIS at1-29) references specific mitigation required for ESA and MMPA compliance that were included in the Multisale EIS. This text could be the basis for developing an environmental SOP similar to what has been presented for the operations in this Section of the DSEIS.
14	1.5	1-32 to 1-33	Section 1.6 describes interagency Memorandum of Understandings and Agreements (DSEIS at 1-32 - 1-33), but doesn't list Memorandums that BOEMRE has with EPA, NOAA Fisheries, and FWS etc. for environmental protection. For example, FERC and FWS recently completed a Memorandum of Understanding regarding Implementation of E.O. 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds". In fact the outcome of the NOI inviting the agencies to become cooperators in the preparation of the SEIS has not been stated. The May 25, 2011 MOU with NOAA on Coordination Collaboration should be added.
15	App. A	A-24	Table 2-1 (DSEIS atA-24) should be expanded to briefly highlight the significant findings of the various initiator's work and how BOEMRE intends to use the findings as they pertain to the WPA Lease Sale 218.
16	2.2.3.1	2-6	Section 2.2.3.1 (DSEIS at2-6) introduces the issues to be analyzed and states the baseline conditions of "some resources have been changed." The addition of a few sentences or inclusion of a table briefly describing the changed resources and the nature and extent of changes would aid the reader by avoiding the

Comment Matrix PAGE _3_ OF _11_ **Enclosure (1)**

API Comments on the DSEIS for Lease Sale 218

API ENCLOSURE 1, COMMENTS 17-23

			need to search each resource for "changes." These changes would then be repeated in the specific resource section.
17	2.3.1.2	2-9	Section 2.3.1.2 Water Quality (DSEIS at2-9, paragraph 2, second to last sentence) could be strengthened by adding "Chemicals used … are either nontoxic *(generally EPA approved for the specific use)*, used…".
18	2.3.1.2	2-8	Section 2.3.1.2 (DSEIS at2-8) introduces the issue of accidental events but does not provide a brief definition nor refer the reader to Appendix B where a catastrophic spill is analyzed. If the term average or worst case or catastrophic are used include a definition that is quantifiable the first time the terms are used and include them in the Glossary. Data from reportable spills (DSEIS, Table 3-5, at A-27) can be used to define the range of spills with the statistical metrics being included.
19	2.3.1.2	2-15 to 2-17	Section 2.3.1.2 (DSEIS at2-15 - 2-17) does not indicate that new information related to cooling water intake impingement and entrainment that is available from studies associated with the LNG Deepwater Ports. For example, studies by Galloway, *et al.* 2007 (TransAFS-Vol. 136 No. 3 pp. 655-677) assess the effects of industrial water intake on the plankton.
20	2.3.1.2	2-21	Suggest explaining "the project 0-1 new gas processing plant and 0-1 new pipeline landfall" meaning or better simply state the projection is for "no more than 1"plant and pipeline
21	2.3.1.2	2-24	This following statement, though probably valid and from a respected scientist, should be deleted in light of the DWH event and also because the reference (1982) is so old. "Although an oil spill may have some detrimental impacts, especially closest to the occurrence of the spill, the impacts may be no greater than natural biological fluctuations (Clark, 1982), and impacts will be to an extremely small portion of the overall Gulf of Mexico"
22	2.3.3.2	2-26	Section 2.3.3.3 (DSEIS at 2-26) discusses other sources of energy but fails to include wind and wave energy projects by name that the White House is encouraging as a substitute for oil.
23	3.1.1.2.2.2	3-9	FPSO EIS is mentioned and introduces unresolved challenge of the fate of gas with options being considered. A conclusion is needed. One could be simply "the selected option would be project specific".

API ENCLOSURE 1, COMMENTS 24-25

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24	3.1.2.2	3-29	Gas processing facilities are discussed in much detail here and throughout the document, even though the document explains that gas production on the OCS continues to decline and 0-1 facilities are forecast; yet, no mention is made of oil processing facilities or their refining capacity.
25	3.2	3-31	Section 3.2 - Impact-producing Factors and Scenario – Accidental Events & Appendix C). BOEMRE's present spill modeling exercises used for trajectory analysis use the OSRA modeling tool for predicting areas of potential concern from spilled oil. The OSRA model has been used historically to provide trajectory analysis for determining where surface spilled oil has the highest likelihood of contacting land (http://www.gomr.boemre.gov/homepg/lsesale/osra/OSRA.html). To evaluate hypothetical subsurface oil trajectories, BOEMRE should consider usingnewer spill trajectory modeling capabilities, as appropriate, to assess and predict potential impacts to sensitive topographic features such as hardbottom communities and corals. For instance, the University of South Florida has recently developed several 3-dimensional spill trajectory models (http://ocgweb.marine.usf.edu/~liu/Drifters/latest_rtofs.htm) – Liu, Y., R. H. Weisberg, C. Hu, and L. Zheng (2011), Tracking the Deepwater Horizon Oil Spill: A Modeling Perspective, *Eos Trans. AGU*, *92*(6), doi:10.1029/2011EO060001. Similarly, BOEMRE (as MMS) contracted SINTEF to model spill trajectories using a similar 3-dimensional model has been developed by SINTEF for assessing discharges from underwater pipelines (personal communication, Dr. Mark Reed).[1] [1] This project produced a model to predict a discharge from a pipeline. It also included a pocket guide to quickly make an estimate of a worst case discharge from a pipeline. The model is known as the Minerals Management Service Pipeline Oil Spill Volume Estimation Model (POSVEM). POSVEM is a computer-based methodology to estimate discharges from seafloor pipelines. The system is composed of a Release Module and a Near Field Module, linked together with necessary databases through a Graphical User Interface (GUI). The GUI allows the user to sketch a platform-pipeline layout, enter characteristic parameters, and run a quasi-3-phase flow model to estimate the volume of potential or actual leaks. Inputs to the model are parameters describing the configuration and characteristics of a pipeline system, the fluid it contains, and the leak or break from which the discharge occurs. Key outputs are the evolution of the release rate over time, the total mass of oil released, and the mean thickness of any eventual surface slick being formed. A user's manual is also available below. http://www.boemre.gov/tarprojects/390.htm [2] Richard Camilli, Christopher M. Reddy, Dana R. Yoerger, Benjamin A. S. Van Mooy, Michael V. Jakuba, James C. Kinsey, Cameron P. McIntyre, Sean P. Sylva, & James V. Maloney (2010). Tracking Hydrocarbon Plume Transport and Biodegradation at Deepwater Horizon *Science*:10.1126/science.1195223

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API ENCLOSURE 1, COMMENTS 26-29

26	3.2.2	3-46	The last sentence of paragraph 2 ("Industry challenges remain as operators move into ultra-deepwater areas and seek deeper geologic prospects with little knowledge of the subsurface environment and with the use of new technologies in both familiar and unfamiliar environments.") is too open-ended and gives the impression that industry, as a whole, is not capable of working in deepwater, which is not the case.
27	4.1	4-5 to 4-6	The draft SEIS concludes that there is "no incomplete or unavailable information" that is "relevant to making a determination regarding reasonably foreseeable significant adverse impacts" or that is "essential to a reasoned choice among alternatives." This conclusion is important because, at many points in its discussion of potential impacts, the draft SEIS refers to information being developed as part of the Natural Resource Damages ("NRD") assessment process or other ongoing government or private efforts that is either not yet available or still is collected. *See* DSEIS, at 4-5 (noting that "it could be many years before" the conclusions of NRD assessment work and the "numerous studies by academia" become available). A statement is needed to address the potential data gap between now and when the NRD data become available and the potential significance of the gap to the conclusions made at this time. Similar statements are made on pages 4-20 and 4-21, pages 4-139, 4-153 to 4-154 and 4-147 of the DSEIS.
28	4.1.1.1	4-15	The SEIS based on the Multisale EIS and the 2007-2009 supplemental EIS has concluded that there are insignificant direct and cumulative impacts from potential emissions from routine and accidental events. 'Catastrophic Spill Event Analysis' (Appendix B (2.2.1.1)) qualitatively describes the air quality emissions during a catastrophic event such as DWH. The results of air monitoring by the USEPA and others during the DWH incident are now available and should be used to enhance the discussion in this section. Details and additional discussion on this topic is included in Enclosure 2, pages 8-11.
29	4.1.1.1.4	4-17	When discussing many resource categories, the report mentions potential future impacts that are not supported by any existing information and in a number of cases that are inconsistent with such information. In discussing air quality impacts, for example, the draft SEIS refers to a workshop held in New Orleans on June 22-23, 2010, and summarizes reports made there that "[d]ue to volatile chemicals that evaporated from the oil spill into the atmosphere, people in the coastal areas have been experiencing sickness, fever, coughing, and lethargy." DSEIS at 4-17. This claim is inconsistent with the extensive body of air monitoring data in shoreline areas collected by EPA throughout the DWH event, which showed virtually no exceedances of air quality standards anywhere along the coast. In fact available data indicate that the lighter more soluble hydrocarbons in MC252 oil preferentially dissolved during transit from the wellhead

API ENCLOSURE 1, COMMENTS 30-33

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			to the surface as shown in water column data.
30	4.1.1.3	4-38	The Operational Science Advisory Team (OSAT) produced two important reports for the U.S. Coast Guard Federal On-Scene Coordinator for the DWH response in December 2010 and February 2011, respectively. The OSAT I report *Summary Report for Sub-Sea and Sub-Surface Oil and Dispersant Detection: Sampling and Monitoring* (December 17, 2010) provides information on the behavior of oil spilled during the DWH incident and presents the results of extensive water column and sediment sampling for both oil and dispersant indicators. The OSAT II report, *Summary Report for Fate and Effects of Remnant Oil in the Beach Environment* (Feb. 10, 2011), includes the results of extensive sampling and predictive modeling regarding the fate and effects of oil spilled during the DWH incident that stranded on Gulf Coast beaches. The results of the OSAT II report should be used to enhance the discussion regarding the potential impact of a significant oil spill on coastal beaches and barrier islands.
31	4.1.1.3.1	4-42	The DWH drilling rig was located 40 miles off the coast not 90 miles.
32	4.1.1.8.1	4-116	A careful review of the sections discussing individual resource categories suggests that this part of the draft SEIS was prepared some months ago (perhaps as long ago as last fall), and has not been fully updated. Currently available information on the resources should be presented in the FSEIS. For example, in discussing subsea benthic communities, the draft SEIS repeatedly cites water sampling data from the R/V *Weatherbird* cruise on May 23-26, 2010, but not the much more comprehensive data reported and analyzed in the OSAT I report published in December 2010.
33	4.1.1.12	4-154	The SEIS states "*Lighter PAH's like naphthalene and anthracene are volatile and water-soluble, but they are somewhat more persistent* compared *with lighter, more volatile, and more water-soluble hydrocarbons like benzene*." DSEIS at 4-154. A more accurate statement would be that "Lighter PAHs, like naphthalene, phenanthrene, and anthracene, are significantly less volatile and water soluble than hydrocarbons like benzene, but they are somewhat volatile and water-soluble and are more persistent in air and seawater than compounds like benzene." *See* http://www.chemicalland21.com/industrialchem/organic/anthracene.htm; http://chemicalland21.com/industrialchem/organic/PHENANTHRENE.htm.

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34	4.1.1.12	4-160	The SEIS states "*Lighter PAH's like napthlalene and phenanthrene are volatile and water-soluble, but they are somewhat more persistent* compared *with lighter, more volatile, and more water-soluble hydrocarbons like benzene.*" DSEIS at 4-160. A more accurate statement would be that "Lighter PAHs, like naphthalene, phenanthrene, and anthracene, are significantly less volatile and water soluble than hydrocarbons like benzene, but they are somewhat volatile and water-soluble and are more persistent in air and seawater than compounds like benzene." *See* http://www.chemicalland21.com/industrialchem/organic/anthracene.htm; http://chemicalland21.com/industrialchem/organic/PHENANTHRENE.htm).
35	4.1.1.13.2	4-176	Based on the potential/probable need for offshore exploration and/or production facilities to require an NPDES permit, Section 316(b) of the Clean Water Act will be relevant (http://water.epa.gov/lawsregs/lawsguidance/cwa/316b/). Presently EPA's Phase III rule, as proposed, provides directives for minimizing harmful impacts on aquatic life caused by cooling water intake structures. This rule establishes categorical requirements for new offshore oil and gas extraction facilities that have a design intake flow threshold of greater than 2 million gallons per day (MGD) and that withdraw at least 25 percent of the water exclusively for cooling purposes. Section 316(b) requires NPDES permits to ensure that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available to minimize adverse environmental impact. Such impacts include death or injury to aquatic organisms by impingement or entrainment. It is expected that the 316(b) rule will likely be in effect when activities take place as a result of Lease Sale 218 and that future NEPA documents would tier off of the SEIS. As a result, it is suggested that the SEIS evaluate the impacts of water use on fish, invertebrates and EFH at offshore facilities and list this condition within section '*4.1.1.13.2. Impact of Routine Events*'. Subsequent sections should discuss the impacts to marine biota as a result of cooling water intakes. Similarly, this impact should be addressed to some extent under *Routine Events* for sections related to both **Commercial Fishing** (4.1.1.14) and **Recreational Fishing** (4.1.1.15).
36	4.1.1.14	4-184	Considering the ramifications of the DWH event on commercial fishing, it would be prudent in the SEIS to provide documentation (if available) for statements that suggest that "*Area closures* [from blowouts or oil spills] *may, therefore, have a positive impact on inshore commercial fisheries populations.*"
37	4.1.1.15.	4-196	The statement "*A spill farther from shore would primarily affect species such as red snapper, king*

API ENCLOSURE 1, COMMENTS 37-41

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	3		*mackerel, and spotted seatrout*" is inaccurate. Spotted seatrout are not typically considered a representative species in offshore fisheries. Although its occurrence in near-shore portions of the Gulf of Mexico is not rare, this species is generally considered an estuarine species (http://www.tpwd.state.tx.us/huntwild/wild/species/strout/).
38	4.1.19.2.3	4-292 to 4-293	(DSEIS at 4-292 last paragraph). The statement "*The best available information does not* provide *a complete understanding of the effects of the spilled oil and active response/cleanup activities on the affected marine mammal environment*" should be edited to refer to "the affected terrapin environment." There is a similar typographical error in the final paragraph under **Cumulative Impacts** (DSEIS 4-293).
39	4-2	4-298	Section 4.2 paragraph 1 opening sentence states that impacts are expected to be "primarily short term and localized . . . ." DSEIS at 4-298. This opening paragraph should note the exception of impacts from catastrophic spill impacts and reference the conclusions of Appendix B, which indicates that although catastrophic oil spill impacts to air and water quality may be short term, effects to some marine ecosystems and resources could last for decades (DSEIS , Appendix B Section 5.2 at B-40). The proposed action and subject of the SEIS is leasing for oil and gas. The topic of sand borrowing is discussed as part of the cumulative impacts on the OCS in Sections 3 and 4. It is also introduced as a replacement for sand removal from clean-up activities in the *Sensitive Coastal Habitats* and *Archaeological Resources* (Section 4.3) sections. The magnitude of the borrow potentially needed to restore sand resources removed during the oil spill clean up should be estimated relative to that used in major beach replenishment projects. The sand needs of the DWH beach restoration should be projected for analysis of another event occurring. (*See* DSEIS, Table 3-14, at A-35).
40	4.2	4-299	Section 4.2 *Water Quality* (DSEIS at 4-299) uses the word "exolved" in the last sentence of the first paragraph. The word may be technically correct but it not a layman's term of choice for the well gas in the water column.
41	4.2	4-299	Section 4.2 *Air Quality* in the last sentence calls out "nonroutine spill events" and leaves the impression that spills are routine events, but only the nonroutine ones are a concern. It is suggested that "nonroutine" be deleted.

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42	4.2	4-299	*Sensitive Coastal and Offshore Biological Habitats* concludes with "… and dispersant chemicals that at this time are not well understood." DSEIS at 4-299. The dispersants used, however, had undergone extensive evaluation and were pre-approved by EPA for use. This pre-approval infers that the effects are understood beyond the level of "not well." It is suggested that the sentence end after "chemicals" and the remainder of the phrase be deleted.
43	4.2	4-299	Section 4.2 *Endangered and Threatened Species* addresses "large oil spill events" and the impacts on the individual. It is suggested that any size spill event reaching the environment could have those impacts depending on site specific circumstances and therefore the word "large" could be deleted.
44	4.2	4-300	Section 4.2 *Archaeological Resources* introduces the topic of mitigation (Required archaeological surveys significantly reduce the ….) to support the impact finding. Similar language included in the other resource sections would strengthen the case for the reported findings.
45	4.3	4-301	Section 4.3 *Loss of Human and Animal Life* last sentence should be revised to include a phrase that recognizes the fact that structural removal using explosive charges is done according to strict protocols so that harassment or individual deaths are the exception rather than the norm.
46	4.4	4-302	Section 4.4 *Relationship Between the Short-Term use of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity* (third paragraph, last sentence) states the impacts "could be reduced" by the mitigation measures. It is suggested that "could" be replaced with "would" since the measures are BOEMRE requirements.
47	4.4	4-302 to 4-303	Section 4.4 *Relationship to Long-Term Productivity* cites references from 1999 to 2009. It would be better to cite more recent thoughts or indicate that these works are the most recent published information.
48	4.4	4-303	Section 4.4 *Relationship to Long-Term Productivity* concluding paragraph could be strengthened by adding "The OCS Program provides, in addition to structures, the improved knowledge and mitigation practices used in offshore development that also maintain or enhance future productivity for public use."
49	5-1	5-4	Section 5.3.1 and Section 5.3.2 indicates that all scoping comments received, "which were appropriate" were considered. This appears to conflict with earlier statements in Section 1.4 (DSEIS at 1-11, paragraph

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			2) which states that all scoping comments received were considered in preparation of the SEIS.
50	5.3	5-3	Do the records of the comment meetings clearly show that all parties who registered were given the opportunity to be heard? This is important to specify because the meeting notice did not state an adjournment time. A brief statement on the meeting protocol to emphasize that all registered speakers were given time to speak and no one was turned away is suggested.
51	5.3.2	5-4	Section 5.3.2 contains a statement that only "scoping comments received that were appropriate for the lease sale NEPA document were considered" and summarized in Table 5-1. Were those comments not considered appropriate documented in the record and if so where? For completeness, it is suggested that a brief description of the type of comments received but not addressed be provided in text or tabular format.
52	5.6 to 5.8	5-7 to 5-8	Sections 5.6, 5.7, and 5.8 discuss interagency consultations that are underway. Please provide an update on these consultations in the Final SEIS. This update would also be discussed in Section 2.3.1.2 (DSEIS at 2-14 and 2-15)
53	App. A	Fig-ures. and Tables	The figures and tables should be reviewed to address missing or inadequate and unnecessary information. For example Figure 3.2 should be revised to show the pipeline routes in the WPA rather than the Central Planning Area. and resources along the Texas and Louisiana coast. State the significance of why MS, AL and FL are included in the Tables and Figures.

Responses to Comments in API's Enclosure 1 Document

API-1 The Supplemental EIS was developed to update the Multisale EIS to determine if new information since the publication of the Multisale EIS would change the conclusions of the Multisale EIS. The term "substantial" is used to quantify the degree rather than define a level of importance to this new information; in any event, the information did not change the conclusions of the Multisale EIS or the 2009-2012 Supplemental EIS.

API-2 The BOEMRE provided qualifying statements throughout the document regarding the relationship of this Supplemental EIS to the DWH event, where deemed appropriate. The baselines of all resources were analyzed for potentially effects from the DWH event. It is not the intent of this document to de-emphasize the DWH event. Few reviewers read the entire EIS. If it was stated only in the Summary that the Supplemental EIS provides an analysis of the proposed action, and not the DWH event, few reviewers would notice it. We feel it is important to make this clear because it appears that some reviewers are under the impression that this document is a Supplemental EIS on the DWH event.

API-3 Since publication of the Draft Supplemental EIS on April 22, 2011, the subject-matter experts incorporated relevant information and updated this Supplemental EIS accordingly. The incorporation of relevant information is time consuming, as it must be obtained and reviewed by subject-matter experts in the context of the source of the data, research methodology and data quality. As is necessary under every NEPA analysis, at some point the subject-matter experts had to finalize their analyses to allow time for the Final Supplemental EIS to be prepared and presented to the decisionmaker.

API-4 Comment noted. The **Summary** is designed to be a brief overview of the Supplemental EIS and not an exhaustive reiteration of all of the findings in the Supplemental EIS. As such, appendices are not summarized in the **Summary**.

API-5 Comment noted. The decision on which alternative will be selected will be made and, if the decision is to hold a lease sale under either Alternative A or B, it will be announced in the Final Notice of Sale.

API-6 It is not possible to define one study/impact area for all resources. Certain resources can occur throughout the Gulf and others are mobile that may move through or within the WPA. The NEPA requires that the impacts from the proposed action must be considered wherever they may occur. The area of potential impacts is resource dependent and can extend beyond the leasing area defined by the proposed action.

API-7 This Supplemental EIS is tiered from the Multisale EIS, and Chapter 1.3 of the Multisale EIS provides a more detailed discussion of the regulatory framework. In addition, BOEMRE prepared a publication entitled *OCS Regulatory Framework for the Gulf of Mexico Region* (Matthews and Cameron, 2010) to provide guidance on applicable Federal laws and regulations. It is not the intent of this Supplemental EIS, nor is it required by NEPA, to provide an exhaustive list of all the possible regulations and laws of other Federal, State, and local commenting agencies.

API-8 The chart was provided as a quick reference for potentially applicable Federal laws and is not meant to provide substantive analysis. No assignment of a table number is required. The regulations relevant to the discussion of alternatives and impacts in this Supplemental EIS and the lease sale program generally are discussed in detail in **Chapter 1.4**.

API-9 The reorganization of BOEMRE is an ongoing process that is not complete at this time. The current schedule for the reorganization is to be in effect on October 1, 2011. In any event, the reorganization of BOEMRE is not relevant to a discussion of the reasonably foreseeable impacts of the proposed action or alternatives in this Supplemental EIS, which remain the same.

API-10 The citation (Regg et al., 2000) is used to reference the different types of structures that may be employed in exploration and production in deep water. It is not a reference to NEPA compliance. The NTL 2008-G06 provides guidance on ROV surveys and does not suggest nor infer anything regarding new issues.

API-11 The erroneous reference to Florida has been removed. The discussion regarding subregional OSRP's was not specific to offshore Florida, but it was generally applicable to the WPA. This section has been clarified with the removal of the reference to Florida.

API-12 Comment noted, but BOEMRE believes that the discussion regarding the OSRP process is clear and consistent with the statutory and regulatory requirements for OSRP's.

API-13 Comment noted.

API-14 The MOU described in the Supplemental EIS between BOEMRE and USCG was listed because it is specific to jurisdictional authorities established under the OCSLA and OPA relevant to this proposed action. A listing of all nonjurisdictional agreements that BOEMRE has with other agencies can be found at http://www.boemre.gov/MOU/MOUindex.htm. Cooperating agencies are discussed in **Chapter 5.3.3** of this Supplemental EIS.

API-15 **Table 2-1** provides a chronology of inquires and is not intended as a summary of findings.

API-16 Comment noted. The BOEMRE has determined that this change is unnecessary and may confuse readers by oversimplifying the analysis in **Chapter 4**.

API-17 Comment noted. The subject-matter expert on this issue stands by their statement as drafted.

API-18 The purpose of **Chapter 2.3.1.2** is to provide impact summaries for routine activities and accidental events expected to occur from the proposed action. The analyses that support these impact summaries are contained in **Chapter 4** and the chapter numbers for each resource are included in parentheses behind each resource heading in **Chapter 2** so that the reader can easily locate them in **Chapter 4**. The reader is already referred to **Appendix B** numerous times in this Supplemental EIS, where deemed appropriate. Additional references would be unduly repetitive. Accidental, average, worst-case and catastrophic events are all described and analyzed in **Chapter 4**.

API-19 The study API cites was determined by the subject-matter experts to be irrelevant in the context of oil and gas exploration and development on the OCS. The difference in order of magnitude of impacts from LNG deepwater ports when compared with oil and gas platforms is such that the conclusions from the Galloway studies are not relevant to reasonably foreseeable impacts of the proposed action.

API-20 Comment noted, but BOEMRE feels the reference is sufficiently descriptive.

API-21 This is in reference to soft bottoms, which are analyzed for the first time in this Supplemental EIS because of the DWH event. As such, this information is not tiered from prior NEPA documents. Despite the age of the reference, the statement is still valid when considering the vast expanse of soft bottoms in the Gulf of Mexico in proportion to that affected by the DWH event and to that affected by natural seeps.

API-22 As stated in **Chapter 1**, the purpose of the proposed action is to offer for lease certain blocks located in the WPA that may contain economically recoverable oil and gas resources. The purpose is not to identify all potential energy sources on the OCS or otherwise. The no action alternative considers the effect of cancelling the proposed lease sale in the WPA, not the effect of cancelling oil and gas production. Therefore, alternative methods of energy production are beyond the scope of this NEPA document and are not considered alternatives to cancelling the lease sale.

API-23 The purpose of **Chapter 3.1.1.2.2.2** is to briefly introduce the kinds of structures that may contribute to impact-producing factors and not unduly burden the reader with information easily obtained in other NEPA documents. The reader is referred to the EIS on FPSO's. This document would have the specific conclusions, along with detailed analysis.

API-24 Information was added to **Chapter 3.2.2**, updating the total number of OCS-related gas processing plants along the Gulf Coast. In addition, the following sentence was added to **Chapter 3.1.2** of this Supplemental EIS: "As described in Chapter 4.1.2.1.4.1 of the Multisale EIS, no new oil refineries are expected to be constructed as a result of the WPA proposed action."

API-25 Modeling spill trajectories is a complex process that requires agency review and testing. The modeling group in BOEMRE is currently investigating changes and improvements to our oil-spill modeling efforts as a result of the DWH event. The BOEMRE believes that the OSRA model included in this Supplemental EIS remains current and accurate, and it would be premature to abandon this model for models that have not been subject to a review process and remain untested.

API-26 It is accurate that industry faces additional challenges working in ultra-deep waters. Over the years, industry has faced many challenges and has dealt with them very successfully. This sentence is not intended to infer that industry is not capable of working in deep water.

API-27 Where relevant information on reasonably foreseeable significant adverse impacts is incomplete or unavailable, the need for the information was evaluated to determine if it was essential to a reasoned choice among the alternatives, and if so, was either acquired or in the event it was impossible or exorbitant to acquire the information, accepted scientific methodologies were applied in its place. This may include information unavailable until the NRDA action is complete, if relevant, and has been identified in this Supplemental EIS.

API-28 The air data has been incorporated into this Supplemental EIS.

API-29 The document was revised in response to this comment.

API-30 Based on the subject-matter experts' review of the OSAT-1 report, the DWH impacts did not extend into WPA waters, including the subsurface plume. Although this plume did come very close to the WPA/CPA boundary, there is no evidence that impacts occurred within the WPA. The OSAT-2 report, as well as other reports related to coastal beaches and barrier islands, has been reviewed by subject-matter experts, and it has been determined that the data from those reports do not provide any relevant information that would change the results of this Supplemental EIS for this section. The Agency will be using future OSAT reports in subsequent NEPA documents, as appropriate.

API-31 A change was made in **Chapter 4.1.1.3.1** to correct the distance from 90 mi to 40 mi.

API-32 Since publication of the Draft Supplemental EIS on April 22, 2011, the subject-matter experts incorporated relevant information and updated this Supplemental EIS accordingly. The incorporation of relevant information is time consuming, as it must be obtained and reviewed by subject-matter experts in the context of the source of the data, research methodology, and data quality. As is necessary under every NEPA analysis, at some point the subject-matter experts had to finalize their analyses to allow time for the Final Supplemental EIS to be prepared and presented to the decisionmaker.

API-33 This statement has been clarified in the Supplemental EIS.

API-34 This statement has been clarified in the Supplemental EIS.

API-35 When the proposed rule is final, the impact of water usage may be evaluated in future NEPA documents. This determination will be made by subject-matter experts upon their review of the requirements of the final rule. Without a final determination on the scope and applicability of this proposed rule, BOEMRE feels it would be premature to determine its relevance at this stage. In any event, if the rule is finalized and relevant, its effect would be expected to reduce impacts; thus this analysis remains conservative.

API-36 The statement was updated to clarify the reasoning for the positive effect of fishery closures: "Closure areas imposed by State or Federal agencies may also impact the commercial fisheries positively in the long term by easing fishing pressure on commercially (especially annually) harvested populations."

API-37 It is noted that speckled trout are typically an estuarine species, and this change has been made in this Supplemental EIS. They are, however, common around oil and gas structures in offshore State waters as well as some OCS platforms adjacent to State waters.

API-38 The suggested changes were made in the document.

API-39 The opening statement is valid when considering reasonably foreseeable impacts of the proposed action. However, the following statement has been added to account for catastrophic events: "Adverse impacts from catastrophic events could be of longer duration and extend beyond the local area." Due to the high costs of transporting OCS sand, the alternate usage of non-OCS sand resources, the uncertainty of sand volume required, and numerous other factors affecting the use of OCS sand resources, it would be difficult to estimate the amount of sand needed for proposed replenishment projects that would come from the OCS relative to sand need for beach replenishment from spills. In any event, this data, if available, would not be expected to result in relevant information on significant impacts from accidental or catastrophic events or reasonable methods for oil-spill response.

API-40 The subject text was revised to explain the release of well gas in a layman's term.

API-41 This change was made to document. The term "nonroutine" has been removed.

API-42 These changes were made to document. The sentence now reads, "There could be some adverse impacts on organisms contacted by oil, dispersant chemicals, or emulsions of dispersed oil droplets and dispersant chemicals that, at this time, are not completely understood, particularly in subsurface environments."

API-43 The BOEMRE believes the description remains appropriate.

API-44 Similar language is included in other resource sections where appropriate.

API-45 Although strict protocols described in this Supplemental EIS are followed to protect marine mammals and sea turtles, explosives removals always result in the loss of marine life. The invertebrates attached to structures are lost when the rigs are removed from the marine environment and fish in close proximity to explosive charges will suffer mortality. This is expected in explosive structure removals and would not be considered the exception. It should be noted, however, that many of these structures have been in place for decades and have provided valuable hard substrate and habitat for a wide variety of fish and invertebrates.

API-46 The ultimate decision on what, if any, mitigation measures are imposed are outside the scope of this Supplemental EIS. Determinations on mitigation are made by the decisionmaker or the ASLM as appropriate. As such, the statement remains accurate and is unchanged.

API-47 The cited references are considered adequate and appropriate by the subject-matter experts.

API-48 Clarifying changes were made to the document. The following statement was added to **Chapter 4.4**: "Additionally, the OCS Program continues to improve the knowledge and mitigation practices used in offshore development."

API-49 Clarifying changes were made to the document.

API-50 All public hearings have a court reporter present, and it is clearly documented that all who had verbal comments were afforded the opportunity to speak. There were relatively few comments, but all attendees were given the opportunity to be heard.

API-51 The purpose of scoping meetings is to give the public an opportunity to provide comments on issues that should be considered in the Supplemental EIS, and these comments must be considered by the Agency. Often comments are made that have nothing to do with the Supplemental EIS. All comments are retained for the administrative record, even if they are not germaine to the Supplemental EIS.

API-52 Consultations are still underway and may not be concluded prior to the printing of the Final Supplemental EIS. The status of these consultations has been updated in this Supplemental EIS. Because this is a lease sale that does not in and of itself make any irreversible or irretrievable commitment of resources that would foreclose the development or implementation of any reasonable and prudent alternative measures to comply with the Endangered Species Act (ESA), BOEMRE may proceed with publication of the Supplemental EIS and finalize a decision among the alternatives even if consultation is not complete, consistent with Section 7(d) of the ESA.

API-53 All figures and tables have been reviewed, and revisions or updates have been made where appropriate. **Figure 3-2** has been revised to include Texas and Louisiana OCS pipelines.

API Comments Regarding Resources Discussed in Draft Supplemental Environmental Impact Statement for Western Planning Area Lease Sale 218

General Statements

Page Numbers: *See* DSEIS generally.

Analysis:

API-1 1. The DSEIS frequently references "current" information that is dated from the fall of 2010, including in the figures and tables in Appendix A. Should all such statements be revised and updated to reflect information through May 2011?

API-2 2. The DWH drilling rig was located approximately 40 miles off the coast, not 90 miles as stated at p. 4-42 of the DSEIS.

API-3 3. The DSEIS states that "as of this writing (October 27, 2010), remnant oil is still being detected intermittently in the Gulf environment as a result of the DWH event." DSEIS at 4-42. Should this statement be revised to reflect more current Shoreline Cleanup Assessment Team ("SCAT") data as well as the conclusions of the Operational Science Advisory Team Summary Report for Sub-Sea and Sub-Surface Oil and Dispersant Detection: Sampling and Monitoring (December 17, 2010) ("OSAT I"), which indicate that very little oil remains in the Gulf environment with the potential to impact humans or natural resources?

API-4 4. The DSEIS states, "Much of the seafloor likely did not experience any impact from the event." DSEIS at 4-271. Should this important statement be stated more prominently? In particular, could the OSAT I report results be summarized to support this finding?

API-5 5. The DSEIS states that the "acute impacts of any large-scale blowout will likely be limited in scale, and any additive impacts of several blowouts should have acute effects in only small areas, with possible sublethal impacts occurring over a larger area." DSEIS at 4-289. Should this important conclusion be highlighted elsewhere in the document?

Additional Resources to Consider:

Water Quality

Page Numbers: 4-180, 4-188, 4-178

Analysis:

API-6

1. Additional information concerning the long-term impacts of the spill on coastal and offshore water quality is available beyond that discussed in Sections 4.1.1.2.2.1 (180, 188) of the SEIS. The SEIS was apparently prepared before the Operational Science Advisory Team (OSAT) prepared its report on water column, sediment, and beach conditions. The SEIS also only cites one of the reports prepared by the Joint Analysis Group (JAG). The JAG and OSAT reports are major sources of data on water column conditions during and after the spill. Major water column findings relevant to this SEIS from these reports include:

- "The dissolved oxygen measurements showing anomalies around 1000 m and extending to 1300-1400 m (identified in previous JAG reports) are interpreted as actual low values consistent with the depths of occurrence of the MC252 #1 hydrocarbons. These depressions range from approximately 0.1 mL/L to 2.6 mL/L." (JAG DO report, p. 7).
- "The DO_2 depression has been found more than 80 km from the wellhead based on CTD DO_2 measurements." (JAG DO report, p. 7).
- "DO_2 depressions do not appear to be increasing over time, suggesting that the rate of hydrocarbon BOD is compensated by mixing with higher DO_2 waters surrounding the DO_2 depleted water layer." (JAG DO report, p. 8).
- "No exceedances of EPA's Human Health benchmarks in water." (OSAT1, p. 48).
- "No exceedances of EPA's dispersant benchmarks." (OSAT1, p. 48).
- "Since 3 August, no exceedances of the aquatic life benchmark for PAHs in water that were consistent with MC252 oil." (OSAT 1, p. 48, referring to nearshore, offshore, and deepwater sampling). Note: Subsurface water sampling was conducted as far as 500 km to the southwest and 200 km to the northeast. (OSAT 1, p. 34).
- References
  - Joint Analysis Group (JAG). Review of Preliminary Data to Examine Oxygen Levels In the Vicinity of MC252#1, May 8 to August 9, 2010. August 16, 2010. http://ecowatch.ncddc.noaa.gov/JAG/files/JAG_Oxygen_Report%20FINAL%20090410.pdf.
  - Operational Science Advisory Team. Summary Report for Sub-Sea and Sub-Surface Oil and Dispersant Detection: Sampling and Monitoring. December 17, 2010. http://www.restorethegulf.gov/sites/default/files/documents/pdf/OSAT_Report_FINAL_17DEC.pdf

API-7

2. The nature of the deepwater blowout, not the subsea injection of chemical dispersants (as implied by Section 4.1.1.13.3 page 4-180), may provide an alternative explanation for the subsurface clouds of dispersed oil and gas. Based on pre-spill research into deepwater blowouts, a persistent underwater plume was anticipated. However, the use of subsea dispersants, which was not included in prior experiments or models, did decrease droplet sizes and contributed to greater dispersion at depth.

- DeepSpill model simulations and field experiments conducted by SINTEF before the DWH spill had suggested that not all oil droplets rise to the surface. Instead, a portion of the oil droplets (varying by droplet size) are carried by cross-currents laterally. SINTEF also found that the gas underwent dissolution before reaching the surface.
- "Together, these factors will cause a significant reduction in buoyancy flux, and as a consequence, the plume may become more sensitive to cross currents and the presence of density stratification in the water masses. In such cases, even small stable density gradients in the ambient water may be expected to cause trapping of the plume. However, the oil may finally arrive at the sea surface due to the buoyancy of individual oil droplets. The resulting surface spreading of the oil will then depend on the size distribution of the oil droplets and the strength and variability of the ambient current." (p. 123 of Johansen et al 2001.).
- References
  - Johansen, O., et al. 2003. DeepSpill – Field Study of a Simulated Oil and Gas Blowout in Deepwater. Spill Science & Technology Bulletin. 8(5-6): 433–443
  - Reed, M., et al. Deepwater Blowouts: Modeling for Oil Spill Contingency Planning, Monitoring, and Response. International Oil Spill Conference. http://www.iosc.org/papers/00429.pdf
  - Johansen, O., et al. 2001. Deep Spill JIP – Experimental Discharges of Gas and Oil at Helland Hansen – June 2000. http://www.boemre.gov/tarprojects/377.htm;
  - Zheng, L., et al. 2002. A model for simulating deepwater oil and gas blowouts – Part I: Theory and model formulation. Journal of Hydraulic Research. 41(4): 339-351. http://www.iahr.org/publications/assets/jhr41-4/2397-i.pdf

API-8

3. The SEIS states that water column analyses are in their "preliminary stages" (Section 4.1.1.2.2.3) and mentions that hydrocarbon concentrations were in the parts per million range or less (Section 4.1.1.8.1), without noting that concentrations in the ppm range were restricted to the area immediately surrounding the well or noting that concentrations fell rapidly after the well was capped. Review of data indicates that concentrations were on the order of parts per billion or less at greater distances from the well even while the well was flowing, and rapidly fell to the ppb range even near the wellhead once the well was capped. While analyses of the water column conducted for purposes of Natural Resource Damage assessments may be in early stages, extensive chemical analyses have been conducted and reported in the water column.

- Based on sampling conducted on the R/V Brooks McCall, May 8-August 24, up to 185 km from the wellhead: "While the concentration of BTEX solvent compounds (benzene, toluene, ethylbenzene, and xylene) was detected at concentrations up to a maximum level of ~500 ppbm in the water, the majority of samples were below 10 ppbm" (Lee et al. 2011).
- Based on sampling conducted on the R/V Brooks McCall, May 8-August 24: "Despite a sustained period of oil release (thought to be 8,400 m^3/day) with concurrent additions of dispersant over a prolonged period of time, the field data showed a rapid decrease in the concentration of the plume with distance (ppb levels within 50 km, Figure 4) due to physical dilution processes and the biodegradation of oil" (Lee et al. 2011, p. 5).
- "And so what we're seeing are in our water sampling of concentrations of oil that's right now what we're seeing at the higher end is about 0.5, one half part per billion hydrocarbon, which is again, it's clearly not a recoverable amount of oil. And even in the sediments, we're seeing similar very low concentrations of oil as well. And we've – this grid that we've done the sampling extends roughly 300 miles in radius around the well site itself." (Zunkunft 2010).
- Water column monitoring conducted during the response (May 7-26, 2010) indicated that maximum hydrocarbon concentrations (based on fluorometry) were on the order of 10s ppb (R/V Brooks McCall Cruises #1-4).
- References
    - Lee, K., et al. 2011. Time-series Monitoring the Subsurface Oil Plume released from Deepwater Horizon MC252 in the Gulf of Mexico. Presented at International Oil Spill Conference. Portland, OR. May 23-26.
    - Lee, K., et al. 2011. Biodegradation of Dispersed Oil in Marine Environments is Substantial and Rapid, and Not Significantly Limited by Either Oxygen, Nutrients or Temperature. Presented at International Oil Spill Conference. Portland, OR. May 23-26.
    - Transcript: Operational Update with FOSC Rear Adm. Paul Zunkunft. 2010. October 19. http://www.restorethegulf.gov/release/2010/10/19/transcript-operational-update-fosc-rear-adm-paul-zukunft.
    - Vessel Data: http://www.noaa.gov/sciencemissions/bpoilspill.html
    - Cruise summaries: http://usresponse.bp.com/go/doc/2911/962607/; Brooks McCall Cruises #1-4: http://usresponse.bp.com/external/content/document/2911/962707/1/Summary_of_Water_Column_and_Dispersed_Oil_Plume_data_5-30-2010.pdf.

API-9

4. The fate and transport of the dispersant component, DOSS (dioctyl sodium sulfosuccinate) has been studied by Kujawinski et al. They provide estimated concentrations of Corexit that deepwater or pelagic biota could have been exposed to.

- "Here we show that DOSS was sequestered in deepwater hydrocarbon plumes at 1000−1200 m water depth and did not intermingle with surface dispersant applications. Further, its concentration distribution was consistent with conservative transport and dilution at depth and it persisted up to 300 km from the well, 64 days after deepwater dispersant applications ceased." (Kujawinski, E. B., et al. 2011, Abstract).

- "Our calculations of dispersant concentrations near the wellhead (or in the deepwater plume) indicate that deepwater, or pelagic, biota traveling through the deepwater plume likely encountered 1 - 10 $\mu g/L^{-1}$ DOSS or 10-100 $\mu g/L^{-1}$ Corexit, between ~ 1 and 10 km from the actively flowing wellhead, with concentration decreasing with distance. The dispersant was applied at an effective dispersant-to-oil ratio of 0.05%, based on published volume estimates for the spill, but ratios were likely ~10x higher in the plume itself, based on volume estimates for the southwestern plume. Regardless, these concentrations and dispersant-to-oil ratios are lower than those tested in published toxicology assays." (Kujawinski, E. B., et al. 2011, p. H)
- References
    - Kujawinski, E. B., et al. 2011. Fate of Dispersants Associated with the Deepwater Horizon Oil Spill. Environmental Science and Technology. 45(4): 1298-1306.

API-10

5. Water and surface oil sampling results indicate that by the time the oil reached the sea surface, lighter hydrocarbons had been lost through weathering. Further weathering occurred once the oil surfaced and reached the shoreline.

- The highest concentrations of BTEX measured were associated with samples collected at depth: "BTEX showed similar results to the DPnB analytical results: the highest concentrations of BTEX compounds were found at the 1,100- to 1300-m depth (Figures 6–9). Dispersants and turbulent mixing led to the dispersion of the lighter end hydrocarbons into the water column (CRRC 2010). These BTEX compounds were measurable both before and after the well was capped. The BTEX compounds were found at below detection limit values soon after the well was capped and in fact, the last detection of BTEX was on July 21, 2010. This interval of measureable BTEX was documented to the southwest of the well head. Figure 10 shows the sampling locations where benzene was detected. The farthest sample was approximately 36 km from the well. Toluene, ethylbenzene, and xylenes show similar patterns with maximum distances of 36–42 km to the southwest." (Johns and Beckman 2010). The Johns and Beckman poster figures also show the decreasing BTEX concentrations with distance from the wellhead and decreasing depth. The same dataset is also the subject of a more recent SETAC poster. (Johns et al. 2011).
- As part of SMART monitoring for dispersant application, water samples were collected at 1 to 10 meter depths below surface slicks before and after surface dispersant application. A BP report stated: "As was the case for the samples in May 2010 (BenKinney and Brown 2010), BTEX concentrations in all samples were either not detected or were detected at levels below reporting limits, with the exception of three values reported for toluene. Although still below reporting limits, the highest total BTEX levels measured were found in three samples collected from the same sampling event (MP-229). The samples with the highest total BTEX levels included a background sample, a predispersant application sample (10 m depth), and a post application sample (1 m depth). The distribution of BTEX in all three samples was very similar and is likely a spurious result associated with the collection of these

samples. The total polycyclic aromatic hydrocarbons (tPAH) and TPH measurements followed similar trends in both pre and post dispersant application samples. In general, tPAH and TPH were greater in the slick after dispersant addition." (BenKinney et al. 2010, p. 11).

- SMART monitoring was also discussed in an IOSC presentation: "BTEX levels were below method detection limits in all samples collected from surface oil slicks." (BenKinney et al. 2011, p. 3).
- Based on field samples of MC252 surface oil and emulsion collected near the spill site in July 2010 by S.L. Ross: "The majority of the oil and emulsion samples collected in the field had parent oil densities that would indicate that in excess of 55% of the initial oil volume had been lost through evaporation or dissolution prior to the sampling" (Belore et al. 2011, p. 18).
- "Approximately 18 percent% of total PAHs in the oil was lost between the subsurface release (riser) and the ocean surface . . . ." "Based on percent depletion calculations, the majority of the oil that impacted the shoreline was substantially depleted (>80%) in total PAHs." (Brown et al. 2011).
- "MC252 fluid lost up to 40% of its weight from the wellhead to the sea surface due mostly to dissolution in water. Subsequent evaporation and less importantly, dissolution and biodegradation, at sea surface depleted up to ~63% of its weight on its journey to beaches and marshes, which affected compounds up to C21." (Gong et al. 2011).
- References

  - Johns, M. W., and D. Beckman. 2010. Deepwater Dispersant Uses and Evaluation of Subsea Monitoring and Analytical Laboratory Results for the MC252 Spill. SETAC North America 31st Annual Meeting. Portland, OR. November 7-11.
  - Johns, M.W., et al. Weathering of MC252 Oil in the Water Column of the Gulf of Mexico from May through September 2010: Fluorometry, Dissolved Oxygen, and Quantitative Chemistry Evaluation. Gulf Oil Spill SETAC Focused Topic Meeting. Pensacola, Florida. April 26-28.
  - CRRC. 2010. Deepwater Horizon dispersant use meeting report, May 26-27, 2010. Revision 3. Available at: http://www.crrc.unh.edu/dwg/dwh_dispersants_use_meeting_report.pdf. University of New Hampshire, Coastal Response Research Center.
  - BenKinney, M., et al. 2010. Dispersant Studies of the Deepwater Horizon Oil Spill Response, Surface Application Evaluations June 10-27, 2010.
  - BenKinney, M., et al. 2011. Monitoring Effects of Aerial Dispersant Application During the MC252 Deepwater Horizon Incident. Presented at International Oil Spill Conference. Portland, OR. May 23-26.
  - Belore, R., et al. 2011. Weathering, Emulsification and Chemical Dispersibility of Mississippi Canyon 252 Crude Oil: Field and Laboratory Studies. Presented at International Oil Spill Conference. Portland, OR. May 23-26.

- Brown, J.S., D. Beckmann, L. Bruce and S. Mudge. 2010. PAH depletion ratios document the rapid weathering and attenuation of PAHs in oil samples collected after the Deepwater Horizon incident. Presented at International Oil Spill Conference. Portland, OR. May 23-26.
- Gong, C., A.V. Milkov, D. Grass, M. Sullivan, T. Searcy, L. Dzou, and P. Depret. 2010. The significant impact of weathering on MC252 oil chemistry and its fingerprinting of samples collected from May to September 2010. Presented at International Oil Spill Conference. Portland, OR. May 23-26.

API-11

6. The NOAA Oil Budget does not quantify the percentage of surfacing oil that dissolves vs. evaporates, but Ryerson et al. quantifies the fractions based on NOAA overflight measurements taken on June 10, 2010.

- "As mentioned above, dissolution also affects oil composition and so losses to dissolution must be considered as contributing to the measured values. Measurements reported here constitute lower bounds to the possible combined losses to evaporation and dissolution of oil that reached the surface. Loss fractions range from 36% to 50% and are self-consistent. The authors of this report believe that these data provide a close lower bound to the fraction of surface oil lost to the combination of evaporation and dissolution." (Federal Interagency Solutions Group, p. 19)
- "This analysis quantifies the fraction of surfacing hydrocarbons that dissolves in the water column (~33% by mass), the fraction that does not dissolve, and the fraction that evaporates promptly after surfacing (~14% by mass)." (Ryerson et al. 2011, Abstract).
- References
  - Federal Interagency Solutions Group, Oil Budget Calculator Science and Engineering Team. 2010. Oil Budget Calculator Technical Documentation. November. http://www.restorethegulf.gov/sites/default/files/documents/pdf/OilBudgetCalc_Full_HQ-Print_111110.pdf
  - Ryerson et al. 2011. Atmospheric emissions from the Deepwater Horizon spill constrain air-water partitioning, hydrocarbon fate, and leak rate. Geophysical Research Letters.

API-12

7. Concentrations of total PAHs dropped off rapidly with greater distance from the wellhead and after the well was capped.

- Based on the analysis of approximately 6000 offshore water samples (more than 3 miles from shore): "Concentrations of TPH attenuated rapidly with distance from the release point (the wellhead) and were seen to reach <1.0 ppb within 15-20 miles in all directions except the southwest, where a small number of samples exceeded 1ppb out to a distance of 40 miles. TPH reductions were due to dilution and biodegradation, the latter clearly evidenced by depletion of normal alkanes relative to the isoalkane in the water samples. Several samples were seen to exceed 1 ppb sporadically beyond that distance, mostly to the southwest." (Boehm et al. 2011, IOSC).

- Also about the same dataset: "Highest concentrations of PAH (i.e., >1ppb) largely observed only during the release (May–July) and close to wellhead." (Boehm et al. 2011, SETAC).
- References
    - Boehm, P.D., et al. 2011. Measuring Oil and Aromatic Hydrocarbon Concentrations in Seawater – Preliminary Assessment of Deepwater Horizon Oil Spill Hydrocarbon Chemistry. Presented at International Oil Spill Conference. Portland, OR. May 23-26.
    - Boehm, P.E., et al. 2011. Polynuclear Aromatic Hydrocarbons from MC252 in the Water Column: Preliminary Exposure Assessment, Weathering, and Biodegradation. Gulf Oil Spill SETAC Focused Topic Meeting. Pensacola, Florida. April 26-28.

Air

Page Numbers: 2-8; 4-13; 4-14; 4-16; 4-17; B-15; B-16; B-30; B-47

Analysis:

API-13

1. The DSEIS states that Deepwater Horizon responders and the public may have been exposed to toxic chemicals, particulate matter, or ozone and that such individuals may have experienced short-term or long-term health effects. *See, e.g.*, DSEIS at 4-16. Should this characterization be revised in light of available data to the contrary? For instance, of thousands of personal breathing zone samples taken by the Unified Area Command, the US Coast Guard, and OSHA, the vast majority of the results were either non-detect or well below relevant occupational exposure limits. The DSEIS also acknowledges this fact, observing that the United States Environmental Protection Agency took "air samples at various locations along the length of the Gulf coastline" during the response and that all but one sample was below the federal OSHA permissible exposure limit for worker safety and also below the more conservative American Conference of Governmental Industrial Hygenists (ACGIH®) standard. DSEIS at B-30.

API-14

2. The DSEIS references the potential for volatile organic compounds (VOCs) to impact spill responders in a catastrophic spill. DSEIS at B-15. It discusses strategies for minimizing this kind of exposure and references the low levels of VOCs detected during the Deepwater Horizon event. *Id.* Should the fact that potential hazards to workers were also reduced through institutional controls such as rotations, work shifts, and pointing vessels into the wind also be mentioned?

Additional Resources to Consider: National Institute of Occupational Safety and Health ("NIOSH") Deepwater Horizon Response Health Hazard Evaluation, *available at* http://www.cdc.gov/niosh/topics/oilspillresponse/gulfspillhhe.html; National Institute of Health Gulf Long Term Follow-Up Study (Gulf Study), *available at* http://nihgulfstudy.org/; Abstract, Tremmel, *et al.*, "Exposure Monitoring During the Deepwater Horizon Response," presentation presented at American Industrial Hygiene Conference (May 14-19, 2011), *available at* http://www.aihce2011.org/aihce11/.

API-15

3. Section 4.1.1.14.3 (page 4-188) reports that methane "rapidly dissolves in the water column or escapes into the air." Several publications indicate that the vast majority of methane dissolved in the water column and that there was not a substantial flux to the atmosphere.

- "[T]he atmospheric data from shipborne [*Kessler et al.*, 2011; *Yvon-Lewis et al.*, 2011] and P-3 airborne measurements demonstrate essentially complete dissolution of CH_4 in the water column, substantiating an early prediction [*Valentine*, 2010] on CH_4 fate in the subsurface water column." (Ryerson et al. 2011, p. 4).
- "The results indicate a low flux of methane to the atmosphere (0.024 μmol m^{-2} d^{-1}) with atmospheric and seawater equilibrium mixing ratios averaging 1.86 ppm and 2.85 ppm, respectively within the survey area. The oil leak, which was estimated to contain 30.2% methane by weight, was not a significant source of methane to the atmosphere during this study." (Yvon-Lewis et al. 2011, p. 1).
- "In terms of carbon supply to the water column, methane is likely to be the biggest contributor since essentially all of it dissolves before reaching the surface." (Adcroft et al. 2010, p. III/x).
- References
  - Kessler, J.D., et al. 2011. A persistent oxygen anomaly reveals the fate of spilled methane in the deep Gulf of Mexico. Science.
  - Yvon-Lewis, S. A., et al. 2011. Methane flux to the atmosphere from the Deepwater Horizon oil disaster, Geophysical Research Letters, 38 (L01602).
  - Valentine at al. 2010. Propane respiration jump-starts microbial response to a deep sea spill. Science. 3: 208-211. October 8.
  - Ryerson et al. 2011. Atmospheric emissions from the Deepwater Horizon spill constrain air-water partitioning, hydrocarbon fate, and leak rate. Geophysical Research Letters.
  - Adcroft, A., et al. 2010. Simulations of underwater plumes of dissolved oil in the Gulf of Mexico, Geophys. Res. Lett., 37 (L18605).

API-16

4. The SEIS does not discuss the impact of weathering in the subsurface on the availability of compounds to evaporate once they reach the surface (Section 4.1.1.1.4). Available data indicate that the lighter, more soluble hydrocarbons in MC252 oil preferentially dissolved during the transit from the wellhead to the surface. This is also borne out in the water column data.

- "The evaporation of freshly surfaced oil was the dominant source of the VOCs measured downwind of DWH (*4*). In laboratory analyses of oil spilled at DWH (*14*), the first 23% of the mass evaporated within 2 hours (fig. S1). During a 2-hour period, the sea surface transport of oil is a few kilometers at most, which explains why the VOCs were emitted from only a small area and confined to a narrow plume (Fig. 1C). As described elsewhere in detail (*4*), the composition of VOCs measured in canister samples collected in the plumes was dominated by alkanes and aromatics. The relative abundance of the VOCs measured in the atmosphere reflected the composition of the spilled oil itself, with the exception of a subset of lighter VOCs that dissolved either completely or partially during transport from the sea bottom to the surface." (de Gouw et al. 2011, p. 1296).

- From a study of MC252 oil weathering and fingerprinting, Gong et al. concluded:
  - "MC252 fluid lost up to 40% of its weight from the wellhead to the sea surface due mostly to dissolution in water."
  - "Subsequent evaporation and less importantly, dissolution and biodegradation, at sea surface depleted up to ~63% of its weight on its journey to beaches and marshes, which affected compounds up to C21."
  - "Weathering has a much bigger impact on aromatic components than saturate components for MC252 oil due to higher solubility of aromatics in water." (Gong et al 2011).
- Reference

  - de Gouw, J.A., et al. 2011. Organic Aerosol Formation Downwind from the Deepwater Horizon Oil Spill. Science. 331(6022): 1295-1299.
  - Gong C., et al. 2011. The Significant Impact of Weathering on MC252 Oil Chemistry and Its Fingerprinting of Samples collected from May to September 2010. Poster Presentation at International Oil Spill Conference. Portland, OR. May 23-26. #2011-372.

API-17

5. The SEIS discusses potential short-term and long-term effects to response workers. Additional data is available relating to some health assessments of worker exposures. NIOSH Health Hazard Evaluation reports are available for a variety of response worker tasks. Data from OSHA's sampling efforts is also available.

- Symptoms such as headache, upper respiratory irritation or congestion, nausea, elevated self-monitored blood pressure, fatigue, and chest pain or pressure were reported in some workers. The symptoms were initially attributed to dispersants, but NIOSH investigators later concluded that dispersant use was unlikely to be the cause; instead, unpleasant odors, heat, and fatigue played a significant role (Interim Report #1). NIOSH monitored response workers in different roles (e.g. skimming, decontamination) for VOCs, dispersant compounds, CO, and other compounds, and found that personal and area concentrations were below occupational exposure limits. The NIOSH reports discuss their evaluation of acute health effects (NIOSH 2010).
- "Exposure to any of these hazards depends on what you are actually doing and where you are working. For example, heat stress is a real concern for all outdoor activities because the weather is hot and humid. If you are pulling in oil-covered booms, then contact with weathered oil, drowning, and back injuries are also concerns. Most jobs will only involve contact with weathered oil, which no longer has high levels of hazardous chemicals that can get into the air. To make sure, OSHA is monitoring the air that workers breathe for the hazardous chemicals common in oil and dispersants, as well as other chemicals like carbon monoxide. To date, no air sampling by OSHA has detected any hazardous chemical at levels of concern" (OSHA 2010).
- In response to concerns about airborne exposures to dispersant components (particularly 2-butoxyethanl, a component of Corexit 9527), OSHA noted, "Approximately 80% of the 1048 samples BP analyzed showed 'no detectable level' of 2-butoxyethanol. Of the

remaining 20% (n=213) of the samples with any detectable 2-butoxyethanol, the highest level measured was 0.8 ppm, and 90% of these were 0.2 ppm or less. Every measurement was well below the NIOSH recommended limit of 5.0 ppm…. Most exposure measurements found no exposure to the chemical, and all exposure levels detected were well below any occupational exposure limit." (OSHA Statement on 2-Butoxyethanol & Worker Exposure, 2010).

- References
  - NIOSH. 2010. Interim Reports 1-9: Health Hazard Evaluation of Deepwater Horizon Response Workers. http://www.cdc.gov/niosh/topics/oilspillresponse/gulfspillhhe.html
  - OSHA. 2010. OSHA Fact Sheet: General Health and Safety Information for the Gulf Oil Spill. August 19. http://www.osha.gov/oilspills/deepwater-oil-spill-factsheet-ppe.pdf
  - OSHA. 2010. OSHA Statement on 2-Butoxyethanol & Worker Exposure. July. http://www.osha.gov/oilspills/oilspill-statement.html

API-18

6. The SEIS cites Aurell and Gullett's USEPA report on dioxin measurements taken by the Aerostat sampling (Section 4.1.1.1.4), but could also refer to the related Environmental Science and Technology publication. The SEIS states, "The estimated levels of dioxins and furans produced by the in-situ burns were similar to those from residential woodstove fires and slightly lower than those from forest fires, according to USEPA researchers (Schaum et al., 2010)" (Section 4.1.1.1.4) but this was not verified by Schaum et al. Aurell and Gullett provide an alternative comparison:

- "These values are roughly 25-65 times higher than those observed for controlled combustion of waste engine oil (*19*), within the range of PCDD/PCDF emission factors determined for open biomass burning (*20-22*), and over 2 orders of magnitude lower than open burning of residential waste (*10*)." (Aurell and Gullet 2010, p. E).
- Reference
  - Aurell, J., and B. K. Gullett. 2010. Aerostat Sampling of PCDD/PCDF Emissions from the Gulf Oil Spill In Situ Burns. Environmental Science and Technology. 44(24): 9431-9437.

Benthic Communities

Page Numbers: 4-111; 4-115 - 4-117; 4-268; 4-269; 4-270; 4-271; 4-273; 4-289

Analysis:

API-19

1. The DSEIS references studies from 1981 regarding the behavior of dispersed oil. DSEIS at 4-115, 4-116. Should emphasis be placed on the more recent studies regarding the behavior of dispersed oil?

API-20

2. The DSEIS states that "[d]irect contact with high concentrations of oil may have resulted in acute toxicity to organisms. . ." DSEIS at 4-268. Should this statement be revised in light of the fact that there is no evidence of acute toxicity in data received from the Operational Science Advisory Team (OSAT) and concentrations of polycyclic aromatic hydrocarbons

(PAHs) were detected in amounts below acute and chronic levels of concern in all areas except around the wellhead?

API-21

3. The DSEIS speculates that exposures to lower concentrations of oil "may have resulted in sublethal impacts such as altered reproduction, growth, respiration, excretion, chemoreception, feeding, movement, stimulus response, and susceptibility to disease." DSEIS at 4-116, 4-268. In doing so, it cites to a 1993 publication. *Id.* Is this conclusion appropriate given (1) the very low concentrations and short duration of exposures shown by water quality monitoring data regarding the Deepwater Horizon event and (2) the age of the study?

API-22

4. The DSEIS states that there are "no data on the concentrations of hydrocarbons in sediments or on benthic community structure on the seafloor of the Gulf of Mexico" after the Deepwater Horizon event. DSEIS at 4-116. Does this statement reflect recent information, *e.g.*, OSAT I?

API-23

5. The DSEIS states that "water column data may be used to speculate the exposures benthic organisms may have experienced at the sediment/water interface." DSEIS at 4-269. Should this statement be reviewed in light of the sediment sampling data that has become available? Moreover, should this discussion be reviewed in light of the absence of evidence of a mechanism for water in the water column to transport PAHs to the sediment, especially since the highest concentrations of oil that were detected in the water column were at or around 1,100 meters, well above the ocean floor?

Additional Resources to Consider: OSAT I report.

API-24

6. Several sections of the SEIS (e.g., Section 4.1.1.19.1.1) mention benthic communities and suggest a lack of spill-specific data. A recent survey of the seafloor within 2 km of the wellhead provides some information about pre- and post-spill species richness and abundance.

- From the abstract of a presentation on marine organisms in the vicinity of the spill: "Once the MC252 well had been capped on July 15, 2010 there was a need to characterize the species composition and abundance of marine life in the vicinity of the spill. Two remotely operated vehicles were used to survey the distribution and abundance of marine organisms at four sites around the MC252 well. Three sites were located 2000 m due N, W, and S of the well and an additional site was located 500 m due N of the well. Video transect surveys of the water column documented the species composition and depth distribution of zooplankton and micronekton at strata from 500–4500 ft. On the seafloor, a series of radial 250 m transects on bearings separated by 15° were conducted. A subsea navigation system allowed the position of each organisms to be mapped. The sea floor sites were dominated by echinoderms (seastars), cnidarians (sea pens), crustaceans (*Plesiopenaeus, Glyphocrangon, Chaceon*) and squat lobsters, and a variety of fish species including eels (*Synaphobranchus*), tripodfish (*Bathypterois quadrifilis* and *B. grallator*), species of Moridae and Macrouridae. Comparisons with pre-spill ROV surveys at MC252 suggest similar species dominated before and after the spill. Evidence of mortality included carcasses of planktonic pyrosomes (*Pyrosoma atlanticum*), salps and sea pens. Species richness and abundance were reduced at the site located 500 m from the well relative to the more distant sites" (Putt 2011, SETAC).

- Putt, R. 2011. Species Composition, Distribution, and Abundance of Planktonic, Benthic and Demersal Megafauna in the Vicinity of MC252 during August 2010. Gulf Oil Spill SETAC Focused Topic Meeting. Pensacola, Florida. April 26-28. http://gulfoilspill.setac.org/sites/default/files/abstract-book-1.pdf

API-25

7. The SEIS mentions ongoing work to assess hydrocarbon biodegradation: "While there is more analysis to be done to quantify the rate of biodegradation in the GOM after the DWH event, early observations and preliminary research results seemed to indicate that the oil biodegraded quickly; however, there are still ongoing studies assessing this issue" (Section 3.2.1.5.2). In addition to Hazen et al. 2010, which is already mentioned elsewhere in the SEIS, the study by Graham et al. (2010) provides information about this issue. Also, several presentations at the American Society for Microbiology in New Orleans, LA in May 2011 discussed the role of oil-degrading microorganisms in the beach and deepwater environments during the DWH incident.

- "Carbon isotopic depletion in mesozooplankton and suspended particulate samples throughout the water column (figures 1(D) and (E)) indicates trophic transfer of oil carbon into the planktonic food web. A similar response found in benthic communities around natural seeps [5] suggests that carbon isotopic shifts in the plankton fractions are likely due to the duration and magnitude of depleted carbon released into the system. These data provide strong evidence that labile fractions of the oil extended throughout the shallow water column during northward slick transport and that this carbon was processed relatively quickly at least two trophic levels beyond prokaryotic hydrocarbon consumers given our understanding of microbial-zooplankton trophic linkages [6, 17]." (Graham et al. 2010, p. 6).
- At a presentation during the 2011 International Oil Spill Conference, Boehm et al. noted that an analysis of alkane and aromatic oil component fingerprinting showed extensive biodegradation of alkane and aromatic fractions in water. (Boehm et al. 2011).
- See also the publications of Kessler and Valentine on methane degradation, referenced in the air summary.
- References
  - Boehm et al. 2011. Aromatic Hydrocarbon Concentrations in Seawater Deepwater Horizon Oil Spill. 2011 International Oil Spill Conference Presentation. May 23-26.
  - Graham et al. 2010. Oil carbon entered the coastal planktonic food web during the Deepwater Horizon oil spill. Environ. Res. Lett. 5(4): 045301.
  - Hazen, T. C., S.B. Joye, D. Valentine, C. N. Johnson, and J.E. Kostka. Plenary Session: Deepwater Horizon and Beyond. American Society for Microbiology 111th General Meeting. New Orleans, LA. May 21-24,

2011. Multiple talks and posters. http://gm.asm.org/ (Go to Online Program Planner)

Biodegradation

Page Numbers: 3-41

API-26 ***Additional Resources to Consider:*** OSAT I; Valentine, *et al.*, "Propane Respiration Jump-Starts Microbial Response to a Deep Oil Spill," 30 SCIENCE, at 208 - 211 (Oct. 8, 2010); American Society for Microbiology, "Deepwater Horizon and Beyond," Plenary Session, ASM 2011 General Meeting (May 22, 2011).

Birds

Page Numbers: 2-15; 4-149 - 4-151; 4-153; 4-154; 4-164; 4-172; B-31

Analysis:

API-27 1. New technologies and new ways of using old technologies in responding to the Deepwater Horizon event would have reduced impacts to birds. For example, the use of dispersants and in situ burning of oil in the Deepwater Horizon event response may have resulted in reduced impacts. The relationship of response methods with mitigated impacts on birds should be acknowledged in the Final SEIS.

API-28 2. The statement at p. 4-150 of the DSEIS that "[i]mpacts of widespread dispersed oil from the DWH event may have had serious impacts on pelagic birds feeding in oiled waters and/or on oiled prey" is not supported by any citation or data. Is there evidence that demonstrates such impacts? If not, should this statement be revised to state only that it is possible that data developed in the future could suggest some impacts on pelagic birds?

API-29 3. Should the statement at p. 4-151 of the DSEIS that birds that "migrate through or winter along the northern Gulf of Mexico in fall likely have not yet experienced impacts from the DWH event" be updated?

API-30 4. Data presented in Table 4-6, "Birds Collected and Summarized by the U.S. Fish and Wildlife Service Post-*Deepwater Horizon* Event in the Gulf of Mexico," at pp. A-46 - A-49 may contain a large number of double-counts, *i.e.* birds that transitioned from live to dead while in custody, as well as birds collected as part of telemetry studies. This table's data should be revised to reflect an accurate grand total of affected birds.

API-31 5. References to the Consolidated Fish and Wildlife collection report (Nov. 2, 2010) in the DSEIS appear to be outdated. More recent data is available.

API-32 6. Generally, should the conclusions of OSAT II regarding further shoreline cleanup activities be referenced more broadly?

Additional Resources to Consider: OSAT I; Operational Science Advisory Team Summary Report for Fate and Effects of Remnant Oil in the Beach Environment (Feb. 10, 2011) (OSAT II); NMFS Commercial and Recreational Fisheries Data for the Northern Gulf of Mexico, *available at* http://www.st.nmfs.noaa.gov/st1/index.html; Seafood Fishing and Monitoring Data *available at* http://www.noaa.gov/deepwaterhorizon/data/seafood_safety.html; SETAC Special Session, Wakefield, J., Reilly, P., Swindell, W, Hansen, A., Bass, A., Clare, A., Deepwater Horizon Data Collection: Telemetry Data for Use in Evaluating Acute Avian Mortality (April 28, 2011)[1]; Cardno ENTRIX, Wakefield, J, Reilly, P., Holley, L., Klosowski, R, Deepwater Horizon Ephemeral Data Collection: Carcass Stranding Data to be used in Estimating Acute Avian Mortality (March 13-16, 2011); Cardno ENTRIX, Wakefield, J, Reilly, P., Elmore, L., LaLancette, P., Deepwater Horizon Ephemeral Data Collection: Oiling Rate Data for Use in Evaluating Acute Avian Mortality (March 13-16, 2011); Deepwater Horizon Bird Impact Data from the DOI-ERDC NRDA Database 12 May 2011, *available at* http://www.fws.gov/home/dhoilspill/pdfs/Bird%20Data%20Species%20Spreadsheet%2005122011.pdf

API-33

6. The SEIS cites the Deepwater Horizon Response Consolidated Fish and Wildlife Collection Report, but provides references to older versions of the report (Section 4.1.1.12.3-4.1.1.12.4). There are also uncited bird counts and maps available from the USFWS and NOAA.

- The most recent Deepwater Horizon Response Consolidated Fish and Wildlife Collection Report (dated April 20, 2011) states that 2086 live, visibly oiled birds have been collected along with 960 live birds without visible evidence of oiling. Of the 6147 dead birds collected, 2303 showed visible evidence of oiling, 3830 showed no visible evidence of oiling, and 14 cases remain pending. No birds were collected in Texas (USFWS 2011, Consolidated Wildlife Table).
- Live and dead bird counts are also available by species, and was last updated on May 12, 2011 (USFWS 2011, Bird Impact Data).
- References
    - US Fish and Wildlife Service. 2011. Deepwater Horizon Response Consolidated Fish and Wildlife Collection Report. April 20. http://www.fws.gov/home/dhoilspill/pdfs/ConsolidatedWildlifeTable042011.pdf
    - US Fish and Wildlife Service. 2011. Bird Impact Data. May 12. http://www.fws.gov/home/dhoilspill/pdfs/Bird%20Data%20Species%20Spreadsheet%2005122011.pdf
    - NOAA Environmental Response Management Application (ERMA). 2010. Cumulative Avian Observations (USFWS) 21-Dec-2010. http://gomex.erma.noaa.gov

[1] Note: all SETAC data and analysis presented here are preliminary and subject to change.

Corals

Page Numbers: 4-115 - 4-117; 4-120; 4-124; 4-125; 4-127; 4-128; 4-132; 4-269; 4-289

Analysis:

API-34

1. The DSEIS states that "some impacts have occurred to corals within 7 mi (11 km) of the well." DSEIS at 4-289. To date, there is no known data demonstrating that the Deepwater Horizon event damaged corals. Should this statement be revised in light of the lack of available data?

API-35

2. The observation that "[s]ensitive deepwater communities appear to be widely scattered" and that any contact with a subsea oil plume would result in only "localized" effects, DSEIS at 4-125, is important and should be incorporated into all sections that address this issue.

API-36

3. The DSEIS states, "Underwater currents are directional, making it unlikely that oil would be distributed in all directions around the well site." DSEIS at p. 4-117. Does this statement mean that the distribution would not be uniformly distributed around the well site? If so, should the statement be clarified to reflect this fact?

Additional Resources to Consider: OSAT I report.

Economic

Page Numbers: 4-199; 4-200; 4-205; 4-206; 4-227; B-26; B-38; B-45; B-46; B-50

Analysis:

API-37

1. The methodology used in the Oxford Economics Report cited at various points in the DSEIS entitled "Potential impact of the Gulf oil spill on tourism" should be critically reviewed, particularly the assumptions used in developing the report. Does it rely on case studies that are appropriate to compare to the Deepwater Horizon event?

API-38

2. The DSEIS states that the "DWH event has apparently caused a noticeable fall in property values in some areas in the Gulf of Mexico . . ." DSEIS at 4-203. The DSEIS cites to information provided by CoreLogic. Is this information accurate and validated?

API-39

3. The DSEIS states that "a large spill is more likely to dissuade travelers from visiting a broader economic region . . ." DSEIS at 4-205. The document also references "misperceptions" about a spill as potentially impacting tourism. *Id.* It states that the "role of perceptions on tourism activity was a particularly important feature of the DWH event . . ." DSEIS at 2-17. Recent information indicates a strong tourism business in the Gulf region in 2011. Should these statements be revised to the extent that this strong tourism business is inconsistent with any lasting impact on tourism in the Gulf based on perceptions?

Additional Resources to Consider: Market Dynamics Research Group, Oil Spill Research Report (April 7, 2011), *available at* http://www.crt.state.la.us/tourism/research/Documents/2010-11/OilSpillReport_regional_nationwide20110407.pdf).

Fish

Page Numbers: 2-16; 4-172 - 4-186; 4-188; 4-189; 4-191 - 4-194; 4-196 - 4-198; B-6; B-17; B-19

Analysis:

API-40

1. The DSEIS states that the application of dispersants at the seafloor and the surface was "alleged to have had the potential to produce larger areas of subsurface anoxic water because of the degradation of oil by bacteria." DSEIS at 4-180. Should the data collected, including that by OSAT I demonstrating that hypoxia conditions were not detected after extensive sampling, be used to revise this statement?

API-41

2. The DSEIS states, "Subsurface blowouts, such as the DWH event, that include both oil and natural gas have the potential to affect fish populations, particularly eggs, larvae, and juveniles." DSEIS at 4-183, 4-191. Should this statement be qualified to indicate the fact that the effects of subsurface blowouts are localized and limited in time?

API-42

3. The DSEIS cites to a publication entitled "Economic impacts of recreational fishing closures resulting from the *Deep Horizon* oil spill: Preliminary estimates." DSEIS at 4-196. This publication was commissioned by the American Sportfishing Association and should be evaluated critically. Additionally, the duration of any fishing closures as a result of an oil spill are only relevant insofar as they coincide with fishing seasons. Offsets occur with respect to the impacts of spill-related fishery closures because fish populations recover as a result of no depredation by fishermen during the closure. Should the discussion of recreational fishing be revised to reflect these points?

API-43

4. The DSEIS states that whale sharks were seen "swimming among slicks from the Deepwater Horizon spill." DSEIS at B-17. Has this information been scientifically validated or is it anecdotal evidence?

API-44

5. Should the DSEIS explain that due to the mobility of fish in the Gulf of Mexico and the high population numbers and species diversity that exist, unless species are confined to spatially explicit areas where Deepwater Horizon oil accumulated, mobile fish populations could relocate to other areas in the event of a spill?

API-45

6. The DSEIS states that the "recreational fishing industry in Texas will be affected to the extent that the fish ecology in the Gulf of Mexico changes due to the spill." DSEIS at 4-194. In the absence of sufficient evidence of impacts from the Deepwater Horizon event to indicate that the fish ecology of the entire Gulf will be affected, should the phrase "will be affected" be revised to "could be affected"?

API-46

7. Should the document mention that all fishing areas have been reopened?

Additional Resources to Consider: OSAT I; NMFS Commercial and Recreational Fisheries Data for the Northern Gulf of Mexico, *available at* http://www.st.nmfs.noaa.gov/st1/index.html

Marine Mammals

Page Numbers: 2-14; 4-134 - 4-140; B-19; B-33

Analysis:

API-47

1. References to the Consolidated Fish and Wildlife collection report (Nov. 2, 2010) in the DSEIS are outdated.

API-48

2. The DSEIS appears to infer that each of the marine mammal carcasses collected were related to the Deepwater Horizon event. DSEIS at B-19. Should it be clarified that many of these animals may have died from other causes? Should the fact that only a fraction of the carcasses showed visible signs of oiling be referenced? Do the known numbers of affected dolphins warrant the DSEIS's conclusion that a catastrophic spill may impact dolphins, and other marine mammals, on a "population" level? *Id.* Are such effects "reasonable to assume," or are they merely possible?

API-49

3. The DSEIS states that the "[p]rotected Species Lease Stipulation and several suggested mitigating measures, including onboard observers and airgun shut-downs for whales in the exclusion zone were included in NTL 2007-G02" and that the "[i]mplementation of Seismic Survey Mitigation Measures and Protected Species Observer Program" minimize the potential of harm from seismic operations to marine mammals. DSEIS at 4-137. Should the results of these programs be reported? Should the final SEIS include data on the number of takes that have occurred? The BOEMRE should have access to take data because it must immediately notify NMFS's Office of Protected Resources if a take occurs.

Additional Resources to Consider: Deepwater Horizon Response Consolidated Fish and Wildlife Collection Report, April 20, 2011, *available* through "Consolidated Wildlife Table" link *at* http://www.fws.gov/home/dhoilspill/collectionreports.html.

Oil Spill Trajectory

Page Numbers: 3-34

Additional Resources to Consider: Abstract, Liu, Y. *et al.*, Trajectory Forecasts Based on Numerical Ocean Circulation Models and Satellite Observations: A Rapid Response to Deepwater Horizon Oil Spill, presented at the American Geophysical Union (AGU) Convention (Fall Meeting 2010), *available at* http://adsabs.harvard.edu/abs/2010AGUFMOS33C1480L; Abstract, Ji, *Z. et al.*, Oil Spill Risk Analysis Model and Its Application to Deepwater Horizon Oil Spill, presented at the AGU Convention (Fall Meeting 2010), *available at* http://adsabs.harvard.edu/abs/2010AGUFMOS42A..01J; Abstract, Barker, C.H., A Statistical

Model of the Deepwater Horizon Oil Spill, presented at the AGU Convention (Fall Meeting 2010), *available at* http://adsabs.harvard.edu/abs/2010AGUFMOS42A..02B; Abstract, MacFadyen, A. *et al.*, Tactical modeling of oil transport and fate in support of the Deepwater Horizon Spill Response, presented at the AGU Convention (Fall Meeting 2010) *available at* http://adsabs.harvard.edu/abs/2010AGUFMOS42A..03M; Abstract, He, R. *et al.*, Hindcasting of the Gulf of Mexico Circulation and Age and Distribution of the Oil Plume Arising from the Deepwater Horizon Spill, presented at the AGU Convention (Fall Meeting 2010), *available at* http://adsabs.harvard.edu/abs/2010AGUFMOS42A..04H; Abstract, North, E.W., *et al.*, Simulating the three dimensional dispersal of aging oil with a Lagrangian approach, presented at the AGU Convention (Fall Meeting 2010), *available at* http://adsabs.harvard.edu/abs/2010AGUFMOS42A..07N.

Recreation

Page Numbers: xii; 2-17; 4-198; 4-199; 4-202 - 4-204; 4-206 - 4-208; 4-225; B-26; B-38; B-45

Analysis:

API-50

1. The SEIS includes several different statements about tarballs found near Galveston, with one statement indicating that the tarballs were associated with DWH (4.1.1.2.1.1) and others indicating that their origin is still unconfirmed (4.1.1.3.3, 4.1.1.4). Extensive fingerprinting of tarballs has occurred and has been reported at SETAC and IOSC conferences.

- Several tarballs collected by August 1, 2010 on the Texas shoreline, including locations on Galveston Island, were chemically fingerprinted as weathered MC252 oil (Benton et al. 2011). Tarballs fingerprinted to MC252 were identified between Galveston Island and the Texas-Louisiana border. Benton et al. did not identify any tarballs fingerprinted to MC252 on the Texas coastline south of Galveston.
- Reference
  - Benton, L., et al. 2011. Tracking Oil Samples from the MC252 Deepwater Horizon Incident Along the Louisiana/Texas Coastlines. Presented at the International Oil Spill Conference. Portland, OR. May 23-26. #2011-386.

API-51

2. The SEIS notes that analysis of tarballs in Texas has not been completed (4.1.1.4). Efforts to fingerprint oil sheens, slicks, and tarballs from five states have resulted in the analysis of over 1500 samples as of December 2010.

- Of the more than 1500 samples of slicks, oils, and tarballs collected, 37% were not fingerprinted to the MC252 oil spill, 57% were "probably" from the MC252 oil spill, and 6% "may be" from the MC252 oil spill. (Milkov et al. 2011)
- "Among the samples analyzed to date, those that appear to be MC 252 oil occurred primarily within the areal extent of sea surface oil and along coastlines of Louisiana and Alabama where the most oil emulsion reached the shore. Oil samples outside these areas were more likely to be classified as definitively not from the MC252 spill. These non-MC 252 oil samples, mostly from tar balls, were collected in all five states

and apparently originated from natural petroleum seeps in the Gulf of Mexico, bypassing vessels, onshore or offshore petroleum infrastructure, destroyed asphalt roads or other sources." (Milkov et al. 2011).

- References
    - Milkov, A.V., et al. 2011. Identification of the Sources of Oil Sheens, Slicks, and Tarballs Collected in Response to the MC 252 Oil Spill. Presented at the International Oil Spill Conference. Portland, OR. May 23-26. #2011-374.

API-52

3. While tarballs were reportedly found on Texas beaches, they were not necessarily all attributable to the Deepwater Horizon event. Some tarballs were identified as originating from non Deepwater Horizon sources such as natural seeps.

Additional Resources to Consider: Juan A. Lozano, "Tar balls found on Galveston beach are confirmed to be from BP oil spill" Dallas News (July 14, 2010), *available at* http://www.dallasnews.com/news/state/headlines/20100714-Tar-balls-found-on-Galveston-beach-245.ece.

Sargassum

Page Numbers: 2-12; 4-106; 4-110; 4-111

Analysis:

API-53

1. The DSEIS's statements regarding *Sargassum* appear to be speculative and unsupported by post-event data. *See, e.g.*, DSEIS at 4-106, 4-110. Are such statements appropriate to include without better data? Is there any data to support the claim that, for example, "[d]ead *Sargassum* would have sunk to the seafloor, possibly affecting localized areas of benthic habitat?" Is there any data to support the claim that "it can be presumed that oil has damaged or destroyed some *Sargassum* mats and associated organisms?"

SAV (Submerged Aquatic Vegetation)

Page Numbers: 2-11; 4-70; 4-72; 4-74; 4-75

Analysis:

API-54

1. The DSEIS states that seagrasses behind the Chandeleur Island chain and SAV communities within Plaquemines and St. Bernard Parishes "had considerable physical stress from various prevention and cleanup efforts" and that as a result, there is "potential for significant shifts in community structure. . ." DSEIS at 4-72. Are there any specific, documented injuries to SAV that can be shown to have resulted from prevention or cleanup efforts in these regions?

Seafood

Page Numbers: 4-14

Analysis:

API-55 1. The lack of fishery closures in Texas, DSEIS at 4-185, may be documented by NOAA Fishery Closure maps.

API-56 2. The SEIS mentions ongoing studies of the impacts of consuming contaminated seafood (Section 4.1.1.18.4.4, "Deepwater Horizon Event"), but it does not mention the results of federal or state seafood sampling. In addition to seafood sampling conducted by the FDA, individual states conducted seafood sampling.

- FDA prepared a Questions and Answers page that reported the following: "Most of the seafood samples tested had no detectible oil or dispersant residue. For the few samples in which some residue was detected the levels were far lower than the amounts that would cause a health concern, even when eaten on a daily basis. When oil residue was found, the levels were 100 to 1,000 times lower than the levels of concern. In the 1% of samples in which dispersant was detected, the levels were more than 1,000 times lower than the levels of concern. To better understand what this means, the Louisiana Department of Wildlife and Fisheries and the Louisiana Department of Health and Hospitals calculated the amount of seafood the average person could eat, each day, for 5 years, based on the actual contamination levels, without there being a health concern from the oil. A person could eat, each day, the following: 63 lbs of peeled shrimp (1,575 jumbo shrimp); OR 5 lbs. of oyster meat (130 individual oysters); OR 9 lbs. of fish (18 8-ounce fish filets)." (FDA 2011).
- From an abstract reporting the results of over 250 seafood samples analyzed by the state of Mississippi since the end of May 2010: "PAHs have not been detected in any sample collected to date at levels above the Level of Concern (LOC) as established in the reopening protocol. PAHs were routinely detected in most samples at low part-per-billion levels and are consistent with values commonly detected in samples measured in other studies unrelated to the oil spill." (Brown et al. 2011).
- References:
  - US Food and Drug Administration. 2011. Deepwater Horizon Oil Spill: Questions and Answers. April 20. http://www.fda.gov/food/foodsafety/product-specificinformation/seafood/ucm221563.htm
  - Brown, A. et al. 2011. Monitoring Polycyclic Aromatic Hydrocarbons (PAHs) in Seafood in Mississippi in Response to the Gulf Oil Spill. Gulf Oil Spill SETAC Focused Topic Meeting. Pensacola, Florida. April 26-28. http://gulfoilspill.setac.org/sites/default/files/abstract-book-1.pdf

Additional Resources to Consider: NOAA Fishery Closure Maps, *available at* http://sero.nmfs.noaa.gov/ClosureInformation.htm; Seafood Fishing and Monitoring Data *available at* http://www.noaa.gov/deepwaterhorizon/data/seafood_safety.html; FDA, Deepwater Horizon Oil Spill: Questions and Answers. April 20 (2011), *available at* http://www.fda.gov/food/foodsafety/product-specificinformation/seafood/ucm221563.htm; Abstract, Brown, A. *et al*, Monitoring Polycyclic Aromatic Hydrocarbons (PAHs) in Seafood in Mississippi in Response to the Gulf Oil Spill, Gulf Oil Spill SETAC Focused Topic Meeting. Pensacola, Florida. April 26-28, 2011, *available at* http://gulfoilspill.setac.org/sites/default/files/abstract-book-1.pdf. .

Sea Turtles

Page Numbers: 2-14: 2-15; 4-140 - 4-149; 4-291 - 4-293, B-19

Analysis:

API-57

1. References to the Consolidated Fish and Wildlife collection report (Nov. 2, 2010) in the DSEIS are outdated.

API-58

2. The DSEIS refers to the number of sea turtles collected by date. DSEIS at 4-146 and Figure 4-6 at A-16. Should this number reflect the fact that only a small number of dead sea turtles that were collected showed visible evidence of oiling? Turtles strand each year in the Gulf for a multitude of reasons not related to oiling. Necropsy results indicate that forced submergence in shrimping nets, not oil, appears to have been the major cause of sea turtle mortalities.

Additional Resources to Consider: Deepwater Horizon Response Consolidated Fish and Wildlife Collection Report, April 20, 2011 *available* through "Consolidated Wildlife Table" link *at* http://www.fws.gov/home/dhoilspill/collectionreports.html; John Collins Rudolf, "On Our Radar: Fishing Nets Killed More Turtles than BP Oil, Official Says," NY Times (Dec. 29, 2010), *available at* http://green.blogs.nytimes.com/2010/12/29/on-our-radar-fishing-nets-killed-more-turtles-than-bp-oil-official-says/; Lubchenco, Oil Spill Clarifies Road Map for Sea Turtle Recovery, NOAA, *available at* http://leopardshark.nmfs.noaa.gov/search?q=oil_spill_clarifies_road_map_for_sea_turtle_recovery+.pdf&output=xml_no_dtd&sort=date%3AD%3AL%3Ad1&ie=UTF-8&client=default_frontend&oe=UTF-8&proxystylesheet=default_frontend&site=default_collection&as_sitesearch=; NOAA, Probing the Deaths of Sea Turtles in the Gulf of Mexico, http://www.noaa.gov/deepwaterhorizon/news/pdf/deathseaturtles.pdf

API-59

3. The SEIS cites the Deepwater Horizon Response Consolidated Fish and Wildlife Collection Report, but provides references to older versions of the report (Sections 4.1.1.11.1-4.1.1.11.3). Additional information from NOAA suggests that many of the sea turtles collected may have been killed in fishing operations.

- The most recent Deepwater Horizon Response Consolidated Fish and Wildlife Collection Report (dated April 20, 2011) states that 456 live, visibly oiled sea turtles have been collected along with 80 live turtles without visible evidence of oiling. Of the 613 dead sea turtles collected, only 18 showed visible evidence of oiling, 517 showed no visible evidence of oiling, and 78 cases remain pending (USFWS 2011).
- "A number of the necropsies conducted on sea turtles with no visible evidence of oil have suggested that they may have drowned by being caught in fishing nets, unable to ascend to the surface to breath. Necropsy results have been shared with state and federal enforcement officials who have stepped up efforts to prevent turtles from being incidentally captured and killed in fishing operations." (NOAA).
- References

- US Fish and Wildlife Service. 2011. Deepwater Horizon Response Consolidated Fish and Wildlife Collection Report. April 20. http://www.fws.gov/home/dhoilspill/pdfs/ConsolidatedWildlifeTable042011.pdf
- NOAA. Probing the Deaths of Sea Turtles in the Gulf of Mexico http://www.noaa.gov/deepwaterhorizon/news/pdf/deathseaturtles.pdf

Sediments

Page Numbers: 4-269

Analysis:

API-60

1. The SEIS reports that there is "no data to date on the concentrations of hydrocarbons in sediments…" (e.g., Section 4.1.1.19.1.1, p. 469). This statement could be updated with information available from the OSAT-1 report and other studies:

- "No deposits of liquid-phase MC252 oil were identified in sediments beyond the shoreline." (OSAT 1, p. 2).
- "Since 3 August, no exceedances of the aquatic life benchmark for PAHs in sediment beyond 3 km of the wellhead that were consistent with MC252 oil." (OSAT 1, p. 48).
- "Based on the analysis of extensive data collected in the nearshore, offshore, and deepwater zones, the OSAT concludes that sampling was adequate to address the presence or absence of sub-surface oil and dispersants (with the exception of the nearshore sampling gap identified in Key Finding 8 above)." (OSAT 1, p. 3).
- "Evaluation of OSAT sediment data indicate only seven samples exceed sediment toxicity benchmarks (all are within 2 miles of the well)." "Fingerprinting of sediment samples within 20 miles of the MC252 well reveals the presence of Macondo oil and drilling mud <2 miles from well." "Sediments from other stations within 20 miles indicate background hydrocarbons (including seep influences – Biloxi Salt Dome to the SW)" (Brown et al. 2011, SETAC).
- From the abstract of a study investigating DWH impacts on USACE dredging operations at the Mississippi River Southwest Pass, 40 miles northwest of the well, based on sediment sampling collected October 2010: "The concentration of PAHs in surface water, sediment elutriates, and whole sediment was below detection limit or minimal, and lower than any available effects criteria or guidelines values. Except for modest fish mortality in one elutriate sample, no toxicity to fish or invertebrates was observed and no organic chemicals were found above detection limits in test organism tissues. The evaluation concluded that MRSWP dredged material was suitable for open water disposal. Comparison with historic data from that site and post-spill subtidal sediment chemistry data for the Gulf Coast indicates that the frequently dredged areas at the MRSWP and adjacent areas were not contaminated, at least at measurable levels, by the DWH spill." (Lotufo and Corbino 2011, SETAC).
- From report describing nearshore sampling conducted by University of South Florida between Gulf Shores Alabama eastward to the eastern end of Santa Rosa Island between September 23 and September 27: "During the investigation, no visually

identifiable oil was found lying on or buried within the shallow substrate in the nearshore zone." (Wang et. al 2010).

- References
  - Operational Science Advisory Team. Summary Report for Sub-Sea and Sub-Surface Oil and Dispersant Detection: Sampling and Monitoring. December 17, 2010. http://www.restorethegulf.gov/sites/default/files/documents/pdf/OSAT_Report_FINAL_17DEC.pdf
  - Brown, J., et al. 2011. Deep-water Sediments Collected after the MC252 Oil Spill Reveal a Small Footprint of Macondo Oil Associated with Drilling Mud near the Well-head. Gulf Oil Spill SETAC Focused Topic Meeting. Pensacola, Florida. April 26-28.
  - Lotufo, G.R., and J. M. Corbino. 2011. Evaluation of Potential Impacts of the Deep Water Horizon Oil Spill on the Benthic Environment at the Mississippi River Southwest Pass and Adjacent Areas. Gulf Oil Spill SETAC Focused Topic Meeting. Pensacola, Florida. April 26-28. TP010. http://gulfoilspill.setac.org/sites/default/files/abstract-book-1.pdf
  - Wang et. al. 2010. No Significant Visually Identifiable Oil Was Found in the Nearshore Sediment along Alabama and Northwest Florida Coasts. University of South Florida. October 2010. http://news.usf.edu/article/articlefiles/2840-Wang_horwitz_kirby.pdf

Shoreline

Page Numbers: 4-45; 4-53; 4-50; 4-60; 4-64; 4-173; 4-174; 4-185; 4-205; B-27 - B-29

Analysis:

API-61

1. The DSEIS states in some places that tarballs have been confirmed as originating from the Deepwater Horizon event, DSEIS at 4-202, and in other places that the origins of the tarballs are unconfirmed, DSEIS at 4-45. While tarballs were reportedly found on Texas beaches, they were not necessarily all attributable to the Deepwater Horizon event. Some tarballs were identified as originating from non Deepwater Horizon sources such as natural seeps. For instance, of more than 1500 samples of slicks, oils, and tarballs collected in the Gulf, 37% were not fingerprinted to the MC252 oil spill, 57% were "probably" from the MC252 oil spill, and 6% "may be" from the MC252 oil spill. (Milkov et al. 2011)

API-62

2. The DSEIS states that a "fair amount of oil from the Deepwater Horizon event may be buried below the beach surfaces. . ." DSEIS at 4-205. Should this statement be updated to reflect the conclusions in OSAT II?

API-63

3. The DSEIS appears to use an obsolete oil budget. DSEIS at B-28. Should this information be updated to reflect the government's most recent oil budget from November 2010?

API-64

4. Should the government's November 2010 oil budget be qualified by noting that the success of particular response methods in collecting oil depends on the incident and

situation-specific factors, such as sea state, weather, simultaneous operations, oil encounter rates, wave height, the nature of the oil, *inter alia*? Should the government's oil budget be qualified to reflect the fact that the model does not account for biodegradation; underestimates the volume of oil dispersed by the use of chemical dispersants; underestimates the level of uncertainty in its assumptions; and assumes that 4.9 million barrels of oil were released?

API-65

5. The DSEIS refers to the length of shoreline oiled over the course of the Deepwater Horizon event. DSEIS at B-28. How was this calculated? Should the Final SEIS include citations?

API-66

6. The DSEIS states that oiling of estuaries from the Deepwater Horizon event "depending on the severity, can destroy nutrient-rich marshes and erode coastlines, adding to the destruction caused by the recent hurricanes." DSEIS at 4-174. Should this statement be revised to reflect the fact that most of the oiling that occurred as a result of the Deepwater Horizon event was light, *i.e.*, very little heavy oiling occurred.

Additional Resources to Consider: OSAT II; Juan A. Lozano, "Tar balls found on Galveston beach are confirmed to be from BP oil spill" Dallas News (July 14, 2010), *available at* http://www.dallasnews.com/news/state/headlines/20100714-Tar-balls-found-on-Galveston-beach-245.ece; Nov. 2010 Oil Budget, *available at* http://www.restorethegulf.gov/release/2010/11/23/federal-interagency-group-issues-peer-reviewed-%E2%80%9Coil-budget%E2%80%9D-technical-documentati; Milkov, A.V., et al. 2011. Identification of the Sources of Oil Sheens, Slicks, and Tarballs Collected in Response to the MC 252 Oil Spill. Presented at the International Oil Spill Conference. Portland, OR. May 23-26. #2011-374.

Terrapins

Page Numbers: 2-24; 4-290 - 4-293

Analysis:

API-67

1. The DSEIS states, "As of October 14, 2010, two other reptiles have been collected alive and one has been collected dead (RestoreTheGulf.gov, 2010l)." DSEIS at 4-291. The wildlife report from October 14 did report three reptiles, however the next (October 27th) and latest report (FWS DH Response Consolidated Fish and Wildlife Report, dated April 20, 2011) only list two reptiles which were found during the response. One was found alive and "pending" from Louisiana and a second collected dead and "pending" from Alabama. The third reptile was evidently a misreport. Should the reference to three reptiles therefore be revised?

Additional Resources to Consider: FWS DH Response Consolidated Fish and Wildlife Reports, dated October 27, 2010 and April 20, 2011.

Topographic Features

Page Numbers: 2-11; 4-86; 4-87; 4-102

Analysis:

API-68

1. The DSEIS states that "very few reports containing data have been released as of the preparation of this Supplemental EIS" regarding topographic features. DSEIS at 4-86. Should this statement be updated to reflect the sediment data found in OSAT I and data discussed at the SETAC Focused Topic Meeting, April 26-28, 2011 (Pensacola, FL)?

Additional Resources to Consider: OSAT I; Brown, J., et al. 2011. Deep-water Sediments Collected after the MC252 Oil Spill Reveal a Small Footprint of Macondo Oil Associated with Drilling Mud near the Well-head. Gulf Oil Spill SETAC Focused Topic Meeting. Pensacola, Florida. April 26-28, 2011.

Water and Water Column

Page Numbers: 2-8; 2-9; 3-32; 3-33; 4-20; 4-28; 4-33; 4-95; 4-115 - 4-117; 4-174; 4-178; 4-179; 4-180; 4-188; 4-269; 4-270; 4-289; B-5; B-6; B-13; B-16; B-17; B-27; B-30; B-31

Analysis:

API-69

1. The DSEIS states, "Although response efforts have decreased the fraction of oil remaining in Gulf waters and reduced the amount of oil contacting the coastline, significant amounts of oil remain . . ." DSEIS at 4-29. Should this statement be revised in light of the conclusions of OSAT I and OSAT 2?

API-70

2. The DSEIS states that the "greatest concentrations [of oil] are expected to be near the wellhead and to decrease with distance from the source." DSEIS at 4-116, 4-268, 4-289. Should this statement be clarified to reflect OSAT I's finding that no oil has been detected near the wellhead since late summer 2010?

API-71

3. The DSEIS states that "measurable amounts of hydrocarbons (dispersed or otherwise) are being detected in the water column as subsurface plumes and perhaps on the seafloor in the vicinity of the release." DSEIS at 3-32, 4-33. Should this and similar statements be revised to reflect OSAT I data, including the fact that subsea "plumes" have not been detected since fall 2010? Moreover, should the use of the term "plumes" be reevaluated in light of the fact that it is likely that most PAHs in the water column are in dissolved rather than in droplet form?

API-72

4. The DSEIS refers to an experiment conducted in the North Sea regarding the behavior of oil during a deepwater blowout. *See, e.g.*, DSEIS at pp. 3-32, 3-33, 4-33, B-13 (citing Johansen, et al. 2001). Should the discussion of this experiment be qualified to reflect the fact that it did not involve the application of dispersants near the wellhead, as occurred during the Deepwater Horizon event?

API-73

5. The DSEIS appears to indicate that two oil plumes (one at 1,100 - 1,300 m and the other at 200 m) occurred. DSEIS at 4-95. Is this accurate?

API-74

6. The DSEIS states that "[r]ecent data from studies of the DWH event and resulting spill showed that oil treated with dispersant at depth remained at a water depth between 1,100 and 1,300 m . . ." DSEIS at 4-95. The DSEIS describes this as a "subsea plume." *Id.* Similarly, the DSEIS states that as a result of large quantities of subsea dispersants being applied, "clouds or plumes of dispersed oil may occur near the blowout site." DSEIS at B-16. Much research is ongoing, however, and includes the role of factors such as temperature, salinity, turbidity, and the particular mechanics of the release. Given the current uncertainty, should this statement be revised so as not to state that dispersants were the sole or even the principal factor in this process?
Additional Resources to Consider: OSAT I; OSAT 2; Human Health Benchmarks for Chemicals in Water, EPA, *available at* http://www.epa.gov/bpspill/health-benchmarks.html; Nov. 2010 Oil Budget, *available at* http://www.restorethegulf.gov/release/2010/11/23/federal-interagency-group-issues-peer-reviewed-%E2%80%9Coil-budget%E2%80%9D-technical-documentati.

Responses to Comments in API's Enclosure 2 Document

API-1 Since publication of the Draft Supplemental EIS on April 22, 2011, the subject-matter experts incorporated relevant information and updated this Supplemental EIS accordingly. However, the incorporation of relevant information is time consuming, as it must be obtained and reviewed by subject-matter experts in the context of the source of the data, research methodology, and data quality. As is necessary under every NEPA analysis, at some point the subject-matter experts had to finalize their analyses to allow time for the Final Supplemental EIS to be prepared and presented to the decisionmaker.

API-2 Appropriate changes have been made to the document to provide the correct location of the DWH event.

API-3 Comment noted. Appropriate changes have been made to the Final Supplemental EIS.

API-4 Based on subject-matter expert review of the OSAT-1 report and other updated available data and information, the DWH spill did not extend into the WPA waters or sediments. Though the subsurface plume was close to the WPA/CPA boundary, there is no evidence that impacts occurred within the WPA. The statement has been corrected to reflect that there was no evidence of remnant oil in the WPA.

API-5 The section that this comment refers to (**Chapter 4.1.1.19.1.4**) was specifically reviewed for the purpose of cumulative impacts on soft bottoms. The statement is specific to soft bottoms and, given the vast expanse of soft bottoms in the Gulf of Mexico, it is accurate. Each subject-matter expert reviews and bases their conclusions on the best data and information available and provides a write-up specific to that resource. Therefore, this conclusion may not be appropriate for all resources.

API-6 See the response Comment API-1 in regards to incorporation of new information into the Supplemental EIS. Based on the subject-matter experts' review of the OSAT-1 report, the DWH spill did not extend into WPA waters or sediments. The OSAT-2 report, as well as other reports related to coastal beaches and barrier islands, has been reviewed by subject-matter experts and they determined that the data from those reports do not provide any relevant information that would change the conclusions presented in the Multisale, 2009-2012 Supplemental EIS, or this Supplemental EIS. This Agency will be using future OSAT reports in subsequent NEPA documents, as appropriate.

API-7 The BOEMRE does not agree that the language referenced makes the implication proffered by API. The subject-matter experts stand by their analysis.

API-8 Since publication of the Draft Supplemental EIS on April 22, 2011, the subject-matter experts have incorporated relevant information and have updated this Supplemental EIS accordingly. However, the incorporation of relevant information is time consuming, as it must be obtained and reviewed by subject-matter experts in the context of the source of the data, research methodology, and data quality. As is necessary under every NEPA analysis, at some point the subject-matter experts had to finalize their analyses to allow time for the Final Supplemental EIS to be prepared and presented to the decisionmaker.

API-9 New information becomes available on a continuous basis. It must be obtained and reviewed by subject-matter experts in the context of the source of the data, research methodology, and data quality. This process is ongoing and new information that was determined relevant has been used to finalize this Supplemental EIS. The report referred to in the comment (Kujawinski et al., 2011) indicates that regardless of the amount of dispersant applied, the concentrations and dispersant-to-oil ratios are lower than those tested in published toxicology assays, and if impacts to deepwater and pelagic biota were impacted by the dispersants, it could take a number of years to fully understand the impacts. As such, the subject-matter experts felt this report was not relevant at this time. In regards to possible informational gaps, BOEMRE has identified where relevant information on reasonably foreseeable significant adverse impacts is incomplete or unavailable and has evaluated the need for the information to determine if it was essential to a reasoned choice among the alternatives, and if it was, either acquired the information or, in the event it was impossible or exorbitant to acquire the information, accepted scientific methodologies were applied in its place. The BOEMRE has the credible scientific information necessary to make a reasoned choice among the alternatives and to evaluate the effects of the proposed action and its alternatives.

API-10 Comment noted. As the referenced information is similar to what was already provided in the Draft Supplemental EIS and **Appendix B** with regards to weathering oil and BTEX, BOEMRE feels that the Supplemental EIS has already adequately described the issue and potential impacts.

API-11 Comment noted. The discussion regarding the oil budget is ongoing, and the information provided by the commenter is part of this preliminary discussion. As new information becomes available, it will be reviewed by subject-matter experts in the context of the source of the data, research methodology, and data quality, and it will applied to subsequent NEPA documents. Since the DWH spill did not reach WPA waters or sediments, complete information from the oil budget is not essential for this Supplemental EIS. Where relevant, BOEMRE applied credible scientific information that is available applied using accepted methodologies to supplement the oil budget.

API-12 Comment noted. As noted in the Supplemental EIS, the DWH spill did not reach WPA waters or sediments.

API-13 The referenced data on sampling results does not alter the fact that exposure did occur and that there may be health effects for those that were exposed.

API-14 The reference and information identified in the comment has been added to **Appendix B**, although similar information is included elsewhere in the Supplemental EIS when addressing air quality issues.

API-15 Comment noted. Kessler et al. (2011) was determined by the subject-matter experts to be relevant and has been referenced to this Supplemental EIS (**Chapter 4.1.1.14.3**).

API-16 Comment noted. The following sentence has been added to **Chapter 4.1.1.1.4**: "It has been noted in de Gouw et al. (2011) and Gong et al. (2011) that lighter, more soluble hydrocarbons, like that seen in the DWH event, was dissolved or biodegraded during the transit from the wellhead to the surface."

API-17 Comment noted. The BOEMRE feels that the Supplemental EIS already adequately addresses relevant information on the potential effects to response workers and, thus, addition of the referenced information would be redundant.

API-18 The BOEMRE's subject-matter experts included in the Supplemental EIS the reports and information they found credible and relevant to the individual resource analysis. This NEPA analysis is not meant to be an exhaustive compilation of literature available, where not relevant to the resources analyses and the proposed action and alternatives.

API-19 See the response to Comment API-1.

API-20 As in the Supplemental EIS, the DWH spill did not reach WPA waters and sediments, including soft-bottom benthic communities in the WPA. It would, however, be hard to support a statement that, if direct contact of soft-bottom benthic organisms with high concentrations of oil occurred, it would not result in acute toxicity. Therefore, the possibility exists that, if this occurred, some acute toxicity is likely. But again, the OSAT-1 report indicates that the spill did not reach these communities in the WPA. The referenced statement in the Supplemental EIS remains accurate.

API-21 The analysis discusses the impact should the resource receive an exposure to lower concentrations of oil. It does not speculate on the amount or duration of oil from the DWH event that may have impacted the resource. The impact of exposure to oil by benthic resources has been studied extensively for decades, and more recent research has not changed the conclusions that exposure to oil can result in sublethal impacts. The referenced statement in the Supplemental EIS remains accurate.

API-22 The statement has been clarified to relate to the WPA. However, the Supplemental EIS has been updated to indicate that based on OSAT-1 and NOAA data, the DWH spill did not reach WPA waters or sediments.

API-23 The area considered in the soft-bottom analysis is expansive and extends into the coastal shoreline because the Gulf of Mexico is comprised primarily of soft-bottoms. It is acknowledged that using water column data to determine the exposure of benthic organisms would be somewhat speculative, but reasonable under the circumstances, given that the soft-bottom community can be affected by low dissolved oxygen levels caused by the interaction between oil and the microorganisms that consume oil, as well as by the oil that may settle out of the water column. Oil must first be in the water column to have this effect on benthic communities. The OSAT reports, as well as other similar reports, have been reviewed by subject-matter experts, and it has been determined that the data from those reports do not provide any relevant information that would change the conclusions in regards to soft bottoms.

API-24 The subject-matter experts have updated the Supplemental EIS since its publication date (June 6, 2011), utilizing data published since the DWH event and through the end of the comment period. New information becomes available on a continuous basis. It must be obtained and reviewed by the subject-matter experts in the context of the source of the data, research methodology, and data quality. This process is ongoing, and new information made available and that was determined relevant has been used to finalize this Supplemental EIS.

API-25 Comment noted. The section noted is a description of impact-producing factors from accidental impacts and not a discussion quantifying the rate of hydrocarbon biodegradation, which would be difficult or impossible to quantify at this time. Therefore, the incorporation of the findings of these referenced studies would not be appropriate for this discussion.

API-26 See the response to Comment API-25.

API-27 New information that was available and was determined relevant has been used to finalize this Supplemental EIS. The relationship of these new and newly employed response methods to minimizing impacts on birds has been clarified/added to the Supplemental EIS.

API-28 The impact upon birds feeding in oil-coated waters and consuming oil-coated prey is well established and supported, in part, by the number of birds and bird carcasses that were recovered after the DWH event. As such, the statement remains accurate, but the basis for the conclusion has been clarified/added to the Supplemental EIS.

API-29 The subject-matter experts has clarified in the Supplemental EIS where and under what circumstances the migration and residency of birds informs whether they could have been impacted by the DWH event.

API-30 When a complete breakdown of the number of birds and how they were affected by the DWH event, as well as recovery rates, sublethal effects, nesting success, recolonization of affected habitat, and mortality attributed to the DWH event over successive nesting cycles becomes available, it will be incorporated into future NEPA documents. Until final numbers and breakdowns are published, the data that was available through the end of the comment period for this Supplemental EIS has been incorporated into the document.

API-31 New information that was available and was determined relevant has been used to finalize this Supplemental EIS.

API-32 The BOEMRE's subject-matter experts have referenced OSAT-2 where relevant to the individual resource analyses.

API-33 New information that was available and was determined relevant has been used to finalize this Supplemental EIS.

API-34 The statement allows for the possibility that some impact to corals may have occurred due to their proximity to the spill. Additional research is required to state if corals this close to the spill were impacted and to what degree. In any event, the DWH spill did not reach WPA waters and sediments, and thus would not impact corals in the WPA.

API-35 Comment noted. The subject-matter experts included this statement where relevant.

API-36 The Supplemental EIS states that underwater currents make it unlikely that oil would be distributed in all directions around the well, but it makes no reference to the uniformity of oil around the well site. A statement has been added to clarify that oil would not likely be uniformly distributed around the well site.

API-37 The subject-matter experts conducted a critical analysis of all reports, studies, and research to determine their suitability for use in this Supplemental EIS. The subject-matter experts, after reviewing the Oxford Economics Report, did come to the conclusion that the data were relevant to an analysis of the alternatives and their impacts, including a post-DWH environment. References are provided to allow the reader to review the cited document to answer specific questions about the data.

API-38 The BOEMRE feels that the statement is accurate and validated and an additional reference on this issue has been included.

API-39 The statement is accurate in that public perception of the DWH event did impact tourism, at least in the short term. The immediate impacts of the DWH event and subsequent cleanup activities upon tourism have been well documented in this Supplemental EIS. The duration of these impacts will be determined by the actual recovery of physical impacts and the public perception of the recovery efforts. As such, BOEMRE feels that the statements in this Supplemental EIS remain accurate.

API-40 It would be premature to rule out the effects of dispersants on the potential contribution of oil degradation by bacteria to subsurface anoxic conditions until more research is completed. The BOEMRE is using a conservative approach by considering the worst possible impacts, including the potential for anoxic conditions after a spill. This conservative approach allows BOEMRE to proceed with a choice among alternatives.

API-41 There is no evidence at this time to support the statement that impacts from catastrophic subsurface blowouts would be localized and limited in duration.

API-42 The full impact upon recreational fisheries in the CPA in respect to closures has not been fully determined since it will take several seasons to assess overall impacts to recreational take of those species targeted by recreational fishermen. However, there is sufficient data referenced in this Supplemental EIS to determine that recreational fishing in the WPA was not significantly impacted by the spill.

API-43 Although fish might be expected to avoid oil, in the case of three whale sharks observed in the Gulf during the DWH event, this was not the case. The whale sharks were swimming at, or near, the water surface in areas where there was visible surface oil, although the NOAA scientist that observed them indicated that they were not visibly oiled. The inclusion of this information indicates the potential for whale sharks to be directly exposed to oil during spill events. This information in the Supplemental EIS has been updated to include the reference that reported these observations. Further scientific study may be needed to determine whether, and to what degree, individual whale sharks and/or populations might be affected. In regards to possible informational gaps, BOEMRE has identified where relevant information on reasonably foreseeable significant adverse impacts is incomplete or unavailable and has evaluated the need for the information to determine if it was essential to a reasoned choice among the alternatives, and if it was, either acquired the information or, in the event it was impossible or exorbitant to acquire the information, accepted scientific methodologies were applied in its place. The BOEMRE has the scientifically credible information necessary to make a reasoned choice among the alternatives and to evaluate the effects of the proposed action and its alternatives.

API-44 The fact that mobile fish populations could move to other areas in the event of a spill is already adequately acknowledged in this Supplemental EIS.

API-45 Although BOEMRE feels there is sufficient evidence currently available, BOEMRE acknowledges that it is not uniform geographically, and therefore, the “will be” affected has been changed to “could be” affected.

API-46 There were no fishery closures in the WPA; however, as of the publication of the Draft Supplemental EIS, all fisheries closed after the DWH event have all been reopened.

API-47 **Chapter 4.2.2.3** and **Appendix B** have been updated to reflect the most recent report, which was published April 20, 2011.

API-48 The BOEMRE agrees that the Consolidated Fish and Wildlife Collection Report may include individuals that were not necessarily affected by the DWH oil spill. However, it would be unduly speculative to assume that a certain percentage of the carcasses were related to the DWH oil spill. Absolute numbers of marine mammals affected by the DWH oil spill are unknown. While it is likely that not all animals on the Consolidated Fish and Wildlife Collection Report were affected by the spill, it is also likely that not all individuals were found; therefore, the overall number of deaths may be underestimated. Therefore, the Supplemental EIS has been clarified at **Chapters 4.1.1.10.1 and 4.2.2.3**.

API-49 The results of the reports are not reported in the document because the relationship of raw data to impacts cannot be determined geographically. This information is provided annually to NMFS’s Southeast Regional Office. The BOEMRE only reports shut-downs to NMFS and does not report whether an animal is a “take.” The NMFS is the regulatory agency that would make that distinction.

API-50 Comment noted. Language in the Supplemental EIS has been updated where appropriate.

API-51 See response to API-50.

API-52 See response to API-50.

API-53 Very little is known about the affects of the DWH event specifically on *Sargassum*, although it is important to note that the DWH spill did not reach WPA waters or sediments. The text has been changed to more conservatively allow for the possibility of impact rather than a presumption of impact. In regards to possible informational gaps, BOEMRE has identified where relevant information on reasonably foreseeable significant adverse impacts is incomplete or unavailable and has evaluated the need for the information to determine if it was essential to a reasoned choice among the alternatives, and if it was, either acquired the information or, in the event it was impossible or exorbitant to acquire the information, accepted scientific methodologies were applied in its place. The BOEMRE has the scientifically credible information necessary to make a reasoned choice among the alternatives and to evaluate the effects of the proposed action and its alternatives.

API-54 The referenced language was streamlined by the subject-matter experts to remove information not relevant to the WPA as appropriate.

API-55 Comment noted.

API-56 Subject-matter experts determined the information that was relevant for the individual resource analyses. New information that was available and that was determined relevant has been used to finalize this Supplemental EIS.

API-57 The Supplemental EIS has been updated to reflect this updated report.

API-58 The analysis in the Supplemental EIS has been clarified to indicate that the cause of death for most of the recovered carcasses has not yet been determined.

API-59 The Supplemental EIS has been updated to reflect this updated report..

API-60 The statement was updated to reflect that data are becoming available regarding the concentrations of hydrocarbons in sediments or on benthic community structure on the seafloor of the Gulf of Mexico after the DWH event. Note however, that the DWH spill did not reach WPA waters or sediments. New information, including those referenced by API, is reviewed by the subject-matter experts as it becomes available, in the context of the source of the data, research methodology, and data quality. This process is ongoing, and new information that was available and that was determined relevant or complete has been used to update this Supplemental EIS.

API-61 See the response to Comment API-50.

API-62 The OSAT-2 report does not change the statement that a fair amount of oil may be buried below the beach surface in the CPA and, therefore, the statement remains accurate.

API-63 The oil budget cited in **Appendix B** has been updated.

API-64 See the response to Comment API-63.

API-65 The supporting reference has been added to **Appendix B**.

API-66 As stated in the Supplemental EIS, the DWH spill did not reach WPA waters and sediments. In any event, BOEMRE feels that this statement is sufficiently clear that the severity of oiling may alter the resulting impacts.

API-67 It has not been definitively determined that the third reptile was a misreport; therefore, the text remains unchanged to reflect the currently reported data.

API-68 It still remains that few reports have been published regarding topographic features. New information, as it becomes available, is reviewed by subject-matter experts in context of the source of the data, research methodology, and data quality. This process is ongoing, and new information that was available and that was determined relevant or complete has been used to update this Supplemental EIS. In regards to possible informational gaps, BOEMRE has identified where relevant information on reasonably foreseeable significant adverse impacts is incomplete or unavailable and has evaluated the need for the information to determine if it was essential to a reasoned choice among the alternatives, and if it was, either acquired the information or, in the event it was impossible or exorbitant to acquire the information, accepted scientific methodologies were applied in its place. The BOEMRE has the scientifically credible information necessary to make a reasoned choice among the alternatives and to evaluate the effects of the proposed action and its alternatives.

API-69 The conclusions regarding the amount of oil remaining are not altered by the OSAT-1 and OSAT-2 findings. As such, the statements referenced by API remain accurate.

API-70 The information referenced by API remains accurate. Any future information that becomes available will be used to update future NEPA documents.

API-71 The OSAT-1 does not contradict the fact that hydrocarbons were detected at the wellhead, only that they are not currently being detected. The text has been changed to reflect that the subsea plumes were detected rather than are currently being detected. The fact that they were detected would constitute a potential impact so that statement should remain. It would be speculative at this time to debate if PAH's in the water column were in dissolved rather than droplet form. But please note that this information was provided in the analysis of accidental events that may occur in the future. As identified in the Supplemental EIS, the DWH spill did not reach WPA waters or sediments.

API-72 The experiment was on the behavior of oil released during a deepwater blowout and not on the use of dispersants. This Supplemental EIS has been clarified to reflect the limiting factors of the experiment.

API-73 The discussion states that a 200-m (656-ft) thick subsea plume remained at a water depth of between 1,100 and 1,300 m (3,609 and 4,265 ft). It does not state that there were two plumes. The statement has been clarified to prevent this mistaken conclusion.

API-74 It is expected that additional research currently being conducted and to be conducted may better describe the relationship of dispersants and behavior of dispersed oil in the future. However, based on information available, this analysis remains accurate. In regards to possible informational gaps, BOEMRE has identified where relevant information on reasonably foreseeable significant adverse impacts is incomplete or unavailable and has evaluated the need for the information to determine if it was essential to a reasoned choice among the alternatives, and if it was, either acquired the information or, in the event it was impossible or exorbitant to acquire the information, accepted scientific methodologies were applied in its place. The BOEMRE has the scientifically credible information necessary to make a reasoned choice among the alternatives and to evaluate the effects of the proposed action and its alternatives.

Center for Biological Diversity * Defenders of Wildlife * Earthjustice

June 6, 2011

Regional Supervisor, Leasing and Environment (MS 5410)
Bureau of Ocean Energy Management, Regulation and Enforcement
Gulf of Mexico OCS Region
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RE: Comments on the WPA Lease Sale 218 Draft Supplemental EIS

Dear Regional Supervisor:

On behalf of the undersigned groups, we submit this comment letter in response to the Notice of Availability and call for comments on the Draft Supplemental Environmental Impact Statement (DSEIS) for WPA Lease Sale 218. 76 Fed. Reg. 22,139 (April 20, 2011). We appreciate the opportunity to provide you with our concerns and recommendations.

Our organizations seek effective protection of the Gulf of Mexico environment and the fish and wildlife resources of the area. We are deeply concerned about the ongoing impacts to wildlife, the environment, and communities from the disaster last year when the *Deepwater Horizon* exploded resulting in oil gushing into the Gulf unchecked for months. Until the Bureau of Ocean Energy Management, Regulation, and Enforcement (BEOMRE) completes the collection and analysis of information on the impacts of the *Deepwater Horizon* disaster on the Gulf, incorporates this information into its analysis pursuant to the National Environmental Policy Act (NEPA) and enacts appropriate safeguards to ensure that oil activities do not risk undue harm to the marine environment future lease sales should not take place.

CBD-1

We are disappointed that the DSEIS fails to provide the hard look promised by NEPA. BOEMRE now has an opportunity to take a fundamentally new approach to its analysis of oil spills. Previous NEPA analyses consistently downplayed the risks of spills and overstated the efficacy of cleanup technology. Now that the *Deepwater Horizon* incident has shown those previous analyses to be wrong, BOEMRE has a duty to reexamine these issues thoroughly based on the best new information. Instead of doing this, the DSEIS largely reiterates and reaffirms the conclusions of the original Multisale EIS. Appendix B, which is the only real attempt at providing a new analysis of catastrophic oil spill informed by last year's disaster contains woefully inadequate analysis and instead provides only vague information and general statements.

BACKGROUND

On April 20, 2010, the *Deepwater Horizon* offshore drilling rig exploded and caught fire, killing 11 workers and resulting in an oil geyser that spilled millions of gallons of oil into the Gulf of Mexico. The *Deepwater Horizon* sank two days after the explosion, and the well it was drilling spewed oil without abatement for months. Approximately 25 percent of the oil was recovered, leaving the vast majority of oil in the sea. In addition to the oil, nearly 2 million gallons of toxic dispersants were discharged into the Gulf's waters.

The spill has resulted in roughly 580 miles of oiled shoreline. *See* Campbell Robertson & John Collins Rudolf, *Spill Cleanup Proceeds Amid Mistrust*, N.Y. Times, Nov. 3, 2010, at A14. Scientists have also reported large plumes of oil below the sea's surface which have been confirmed to have originated from the *Deepwater Horizon* well. Researchers from the National Institute for Undersea Science and Technology discovered oil plumes as big as ten miles long, three miles wide, and 300 feet thick. *See* Justin Gillis, *Giant Plumes of Oil Forming Under the Gulf*, N.Y. Times, May 16, 2010, at A1. Scientists from Woods Hole Oceanographic Institution documented an undersea oil plume 22 miles long and 700 feet thick. *See* Woods Hole Oceanographic Inst., WHOI Scientists Map and Confirm Origin of Large, Underwater Hydrocarbon Plume in Gulf, Aug. 19, 2010, http://www.whoi.edu/dwhresponse/page.do?pid=43720&tid=282&cid=79926. Scientists have confirmed that the undersea oil plumes originated from the *Deepwater Horizon* well. *Id.*

It has been over a year since the oil spill began, but still there is pervasive uncertainty concerning its root causes. As noted by BOEMRE Director Michael R. Bromwich in a report to the Secretary of Interior on October 1, 2010,

> Several environmental reviews and investigations seeking to identify the root causes of the Deepwater Horizon accident are ongoing and have not yet issued findings . . . . Substantial investigative work remains to be done and, therefore, significant factual information and insights relating to the Macondo blowout and Deepwater Horizon explosion will be available in the future.

Memorandum from Michael R. Bromwich to Secretary of the Interior Kenneth Salazar, Report regarding the current suspension of certain offshore permitting and drilling activities on the Outer Continental Shelf (Oct. 1, 2010), at 7, *available at* http://www.doi.gov/news/pressreleases/loader.cfm?csModule=security/getfile&PageID=64703.

On May 22, 2010, President Obama established the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling (hereafter "the Commission") as an independent, nonpartisan entity charged with providing a thorough analysis of the causes of the disaster, an assessment of the oil industry's ability to respond to spills, and recommended reforms for making offshore drilling safer. *See* Weekly Address: President Obama Establishes Bipartisan National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, May 22, 2010, http://www.whitehouse.gov/the-press-office/weekly-address-president-obama-establishes-bipartisan-national-commission-bp-deepwa. The Commission issued its final report on January 11, 2011, in which it reached numerous conclusions and offered several recommendations regarding offshore oil activities in the Gulf of Mexico. *See* Nat'l Comm'n on the BP Deepwater Horizon Oil Spill & Offshore Drilling, *Deepwater: The Gulf Oil Disaster and* *the Future of Offshore Drilling: Report to the President, available at* http://www.oilspillcommission.gov/sites/default/files/documents/DEEPWATER_ReporttothePresident_FINAL.pdf.

In its final report, the Commission found that, in order to ensure the safety of offshore energy exploration and production, regulatory oversight of offshore drilling activities would require reforms beyond those already initiated since the *Deepwater Horizon* oil spill. The report noted that the breakdown of the government's environmental review process for OCS activities was "systemic," requiring significant revision. *Id.* at 260. The Commission made the following recommendations, among others:

- To assure human safety and environmental protection, regulatory oversight of leasing, energy exploration, and production requires reform in both the structure of regulatory oversight and related internal decisionmaking processes to ensure political autonomy, technical expertise, and full consideration of environmental protection concerns.
- Because regulatory oversight alone will not be sufficient to ensure adequate safety, the oil and gas industry will need to take its own, unilateral steps to increase safety throughout the industry, including self-policing mechanisms that support governmental enforcement.
- The technology, laws and regulations, and practices for containing, responding to, and cleaning up spills lag behind the real world risks associated with deepwater drilling into large, high-pressure reservoirs of oil and gas located far offshore and thousands of feet below the ocean's surface. Government must close the existing gap and industry must support rather than resist that effort.
- Scientific understanding of environmental conditions in sensitive environments in deep Gulf waters, along the region's coastal habitats, and in other areas proposed for drilling, such as the Arctic, is inadequate. The same is true of the human and natural impacts of oil spills.
- The government must revise and strengthen NEPA policies to improve environmental analyses, transparency and consistency and create a new oil spill analysis and planning process.
- In addition, a fundamental reorganization of the former Minerals Management Service is needed. Congress should create an independent agency within the Department of Interior with enforcement authority to oversee offshore drilling safety.

See generally id. Neither these recommendations, nor any of the Commission's other findings, have been adopted by BOEMRE or the Department of the Interior.

As BOEMRE recognizes, the *Deepwater Horizon* disaster represents new information making supplemental analysis necessary pursuant to the National Environmental Policy Act (NEPA). 75 Fed. Reg. 69,122 (Nov. 10, 2010). A change that produces a seriously different picture of the environmental landscape requires BOEMRE to take another hard look at the environmental impacts. *See Louisiana Wildlife Federation, Inc. v. York*, 761 F.2d 1044, 1051-53 (5th Cir. 1985) (requiring supplemental environmental review where there are concerns of sufficient gravity presenting a seriously different picture of the environmental landscape such that another hard look is necessary). The present draft, however, does not represent a hard look at the impacts of the *Deepwater Horizon* disaster and a realistic analysis of potential future spills sufficient to satisfy NEPA.

SPECIFIC CONCERNS

A. <u>A Site-Specific Environmental Assessment Cannot Tier to Prior EISs or EAs Which Have Been Rendered Obsolete by the Deepwater Horizon Disaster.</u>

CBD-2

In its DSEIS, BOEMRE continues to tier to prior EISs to find no new significant impact will occur as the result of the lease sale. *See* DSEIS at 2-3 ("This Supplemental EIS tiers from the Multisale EIS and the 2009-12 Supplemental EIS. Its purpose is to determine if new information is substantial enough to alter the conclusions state in [those EISs]."). However, tiering to prior EISs which have been rendered obsolete as a result of significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts is improper. 40 C.F.R. § 1502.9(c)(1)(ii).

CBD-3

For example, in the 2007 Multi-Sale EIS upon which BOEMRE relies, MMS assumed the probable large spill would only be 4,600 barrels, would only last one day, would occur 200 miles from shore, would produce an oil slick with a maximum size of 350 acres, that the oil would weather (naturally disperse) long before reaching shore, and that only 19-31 miles of shoreline would be affected. Multisale EIS at IV-232 to 235. Within a week of the Deepwater Horizon disaster, these assumptions had been proven conclusively wrong:

April 20: The Deepwater Horizon mobile drilling unit located 42 miles off the coast of Louisiana, catches fire, explodes, and burns.[1]

April 22: The drilling rig has settled below the surface of the ocean and the fire is out. The search for 11 missing crewmen is continuing.[2]

April 25: The sunken oil rig had been located capsized on the sea floor and oil is leaking from a broken pipe approximately 5000 feet below the surface at an estimated rate of 1000 barrels per day. The posted information includes underwater photographs of the sunken rig and oil billowing from two breaks in the riser which lies crumpled on the ocean floor.[3]

April 25: The oil slick measures approximately 20 miles by 20 miles and is approximately 40 miles offshore;[4]

[1] UPDATE 8 - Unified Command Continues to Respond to Deepwater Horizon http://www.restorethegulf.gov/release/2010/04/25/update-8-unified-command-continues-respond-deepwater-horizon
[2] Exhibit 42.
[3] CORRECTION - Coast Guard to Conduct Joint Press Conference Regarding Oil Drilling Platform Fire http://www.restorethegulf.gov/release/2010/04/22/correction-coast-guard-conduct-joint-press-conference-regarding-oil-drilling-plat
[4] *Id.*

April 25: The blowout preventer is inoperable and BP is mobilizing a drilling rig to prepare for relief well-drilling operations;[5]

April 26: The oil slick measures approximately 80 miles by 42 miles and is located 36 miles from shore.[6]

April 30: The first oiled bird has been recovered.[7]

May 4: The first fisheries closure which is largely between Louisiana state waters at the mouth of the Mississippi River to waters off Florida's Pensacola Bay.[8]

May 7: The U.S. Fish and Wildlife Service closes the Breton National Wildlife Refuge to public entry. The first shoreline impact of oil from the spill was confirmed late Wednesday afternoon at Breton.[9]

May 7: NOAA modifies and expands the boundaries of the closed fishing area to better reflect the current location of the BP oil spill, and is extending the fishing restriction until May 17.[10]

May 9: Shoreline assessment teams recovered tar balls Saturday from the beach on Dauphin Island, Alabama.[11]

May 14: Adm. Landry discloses that "the rate of oil flow is an ongoing topic of discussion and analysis.[12]

May 15: The U.S. Coast Guard and USEPA announced they have authorized BP to use dispersants underwater, at the source of the Deepwater Horizon leak. The use of the dispersant at the source of the leak represents a novel approach to addressing the significant environmental threat posed by the spill.[13]

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[5] PHOTO RELEASE - Unified Command Graphic Shows Current Location for Sheen http://www.restorethegulf.gov/release/2010/04/27/photo-release-unified-command-graphic-shows-current-location-sheen

[6] First Oiled Bird is Recovered http://www.restorethegulf.gov/release/2010/04/30/first-oiled-bird-recovered

[7] *Id.*

[8] NOAA Closes Commercial and Recreational Fishing in Oil-Affected Portion of Gulf of Mexico http://www.restorethegulf.gov/release/2010/05/04/noaa-closes-commercial-and-recreational-fishing-oil-affected-portion-gulf-mexico

[9] Breton National Wildlife Refuge Closed to Public Entry http://www.restorethegulf.gov/release/2010/05/07/breton-national-wildlife-refuge-closed-public-entry Appendix 8.

[10] NOAA Expands Commercial and Recreational Fishing Closure in Oil-Affected Portion of Gulf of Mexico http://www.restorethegulf.gov/release/2010/05/07/noaa-expands-commercial-and-recreational-fishing-closure-oil-affected-portion-gul

[11] Tarballs Recovered From Dauphin Island, AL http://www.restorethegulf.gov/release/2010/05/08/tarballs-recovered-dauphin-island-ala Appendix 10.

[12] Transcript Press Briefing May 14, 2010 http://www.restorethegulf.gov/release/2010/05/19/transcript-press-briefing-may-14-2010

[13] Coast Guard and EPS Approve Use of Dispersant Subsea in Further Effort to Prevent Oil from Reaching U.S. Shoreline

May 17: We have also - we know there are concerns with our use of dispersants. And certainly we talked in previous days about the threshold we crossed when we decided to use subsea dispersant.[14]

May 19: SECRETARY KEN SALAZAR: I am here in Robert, Louisiana, today because I wanted to make a statement that the president has directed me to make to everybody who is involved in this effort and that is that we shall not rest. We shall not take a day off until we get this problem resolved. We have been on this problem now going on 25 days. There are many different fronts on this battle. We are fighting them on all fronts and we are resolute in our effort to do everything we can to bring this problem under control. Tomorrow in the afternoon at the – with Secretary Chu, we will essentially be pulling together the best of scientists once again to take a look at the different options that are on the table to kill this well. Today I was in Louisiana at the Fort Jackson Wildlife Rehabilitation Center. I was there because I wanted to see what is happening with respect to wildlife resources. We will continue to do everything that we can, throwing every ounce of effort that we have at the Department of the Interior to deal with this issue. So many in the federal family have come together to deal with this disaster, which is creating huge problems for everybody who lives here in the Gulf Coast. We feel the pain. We are frustrated and we want to make sure that at the end of the day that no stone is left unturned relative to the effort that is concentrated on this matter.[15]

CBD-4

The full extent of currently-known impacts of the Deepwater Horizon spill is chronicled in the National Commission's Report. Commission Report, Chapter 6. Given what is now known, it is untenable for BOEMRE to continue, as it does in the DSEIS, to rely upon the Multisale EIS's analysis of the impacts of accidental events on the resources of the gulf. *See, e.g.,* DSEIS at 4-122 (stating for impacts of accidental events on chemosynthetic benthic communities "a detailed impact analysis . . . can be found in the Mutisale EIS."), 4-129 (same for non-chemosynthetic deepwater benthic communities), 4-137 (same for marine mammals), 4-147 (same for sea turtles), 4-159 (same for coastal and marine birds).

B. ALTERNATIVES

CBD-5

BOEMRE should have analyzed additional alternatives to consider measures that could further mitigate the impacts of oil exploration and development and improve safety. Instead, BOEMRE adopts the same alternative MMS analyzed in the previous Multisale EISs. *See* DSEIS at 2-3. BOEMRE should analyze an alternative that incorporates stringent mitigation measures into any future leases as lease stipulations.

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http://www.restorethegulf.gov/release/2010/05/15/coast-guard-and-eps-approve-use-dispersant-subsea-further-effort-prevent-oil-reac

[14] Transcript Press Briefing May 17, 2010 http://www.restorethegulf.gov/release/2010/05/19/transcript-press-briefing-may-17

[15] Transcript Press Briefing May 15, 2010 http://www.restorethegulf.gov/release/2010/05/19/transcript-press-briefing-may-15

CBD-6

In addition BOEMRE should consider an alternative that implements the draft staff finding, announced on December 3, 2010 by the *National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling*, that recommends: "Long-term monitoring of potential harm to Gulf seafloor habitats, the water column, and valued species—bluefin tuna, shrimp, and many others—is critical to successful restoration. . . . . Marine Protected Areas should be considered as possible "mitigation banks" to help offset harm to the marine environment; should be aggressively vetted in public. Also: National Marine Sanctuaries pass through a rigorous public process and provide protection across a number of metrics." (*National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, December 3, 2010*).

One of NEPA's fundamental requirements is that the agency "study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources." 42 U.S.C. § 4332(2)(E) (2000). NEPA does not require the agency to adopt any particular alternative, but it does require the agency fully to consider alternatives. The discussion of alternatives "is the heart of the [EIS]," 40 C.F.R. § 1502.14, and it "guarantee[s] that agency decisionmakers have before them and take into proper account all possible approaches to a particular project (including total abandonment of the project) which would alter the environmental impact and the cost-benefit balance." *Alaska Wilderness Recreation & Tourism Ass'n v. Morrison*, 67 F.3d 723, 729 (9th Cir. 1995) (quoting *Bob Marshall Alliance v. Hodel*, 852 F.2d 1223, 1228 (9th Cir. 1988)); *see also California v. Block*, 690 F.2d 753, 767 (9th Cir. 1982).

C. <u>MISSING INFORMATION</u>

CBD-7

We are aware that the impacts of the spill are still being assessed, yet this can serve as no excuse for lack of searching review. CEQ regulation specifically directs how agencies are to deal with incomplete and unavailable information:

> If the incomplete information relevant to reasonably foreseeable significant adverse impacts is essential to a reasoned choice among alternatives and the overall costs of obtaining it are not exorbitant, the agency shall include the information in the environmental impact statement.

40 C.F.R. § 1502.22(a).

Pursuant to this command, BOEMRE should have evaluated ongoing research related to the impacts of the spill, as well as research that has yet to be undertaken, to determine whether the information can be obtained without exorbitant cost. Even if the cost of obtaining the information is found to be exorbitant, BOEMRE still must disclose that the information is missing, include a "statement of the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment," summarize existing scientific evidence relevant to evaluating reasonably foreseeable significant adverse impacts, and evaluate such impacts based upon generally accepted scientific methods. *Id.* at § 1502.22(b). Importantly for inherently risky activities such as offshore oil drilling, "'reasonably foreseeable' includes impacts which have catastrophic consequences, even if their probability of occurrence is low, provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason." *Id.* A federal district court in Alaska recently found BOEMRE to be in violation of this requirement regarding the sale of OCS leases in Alaska's Chukchi Sea. *Native Vill. of Point Hope v. Salazar*, 730 F. Supp. 2d 1009 (D. Alaska, July 21, 2010).

CBD-8

In addition to baseline conditions that were previously analyzed but now have changed due to the *Deepwater Horizon* disaster, the agency also must closely examine the types of basic information about the Gulf marine environment that were not analyzed prior to the spill. Numerous early reports from spill response efforts alerted that it would be difficult to judge the full impact of the spill because significant baseline information had not been gathered or regularly updated prior to the spill. This concern about missing information highlights both the importance of a robust baseline condition assessment as part of the NEPA process, as well as BOEMRE's previous failure to take seriously the command of 40 C.F.R. § 1502.22. The agency must not move forward with further leasing and related activities in the Gulf until it has fully complied with this requirement, including reassessing previously analyzed conditions and including for the first time assessment of conditions previously disregarded.

CBD-9

Here, BOEMRE purports to go through the analysis required by 40 C.F.R. § 1502.22 concluding, "there is no incomplete or unavailable information that is deemed relevant to making a determination regarding reasonably foreseeable significant adverse impacts or that is essential to a reasoned choice among alternatives . . ." DSEIS at 4-6. At the same time, BOEMRE acknowledges "available information does not provide a complete understanding of the effects of the spilled oil and active response/cleanup activities on the affected marine mammal environment." DSEIS at 4-139. *See also* DSEIS at 4-146 (available information does not provide a complete understanding of the effects of the spilled oil and active response/cleanup activities on sea turtles and their environment."). BOEMRE does not explain how understanding the full effect of a spill on marine mammals and endangered sea turtles is not relevant to making a decision on further leasing. Similarly, the DSEIS admits

> the extent of recovery of individual species that were potentially adversely affected by the spill and likely to be present in the WPA when exploration activities first occur as a result of this lease sale is uncertain . . . . For those individuals and subpopulations, consensus information is still merging on the magnitudes of these impacts and the length of time for baseline conditions to return to pre-spill conditions. . . . The Programmatic EIS being prepared by the Natural Resources Trustees aims to answer some of these lingering questions, but that information will not be available until after this proposed lease sale."

Id. at 4-5 to 4-6. Again, BOEMRE does not explain how this information could conceivably be irrelevant to the decision at hand.

D. ENDANGERED SPECIES

CBD-10

The DSEIS fails to take into account the significant impact on endangered species from the DWH spill and clean up efforts. BOEMRE's conclusions are contradicted by the available evidence and represent the same head-in-the-sand approach MMS has followed in previous NEPA documents. In general, BOEMRE concludes that the "environmental baseline in [the WPA] area is essentially unchanged . . . ." DSEIS 4-5. This conclusion fails to take into account that listed species present in the WPA were seriously impacted by the *Deepwater Horizon* spill.

CBD-10 (continued)

For example, BOEMRE finds "no substantial new information that would alter the impact conclusion for sea turtles presented in the Multisale EIS and the 2009-2012 Supplemental EIS." DSEIS at 4-140. This conclusion is impossible to reconcile with the fact that dozens of endangered turtles were killed by the *Deepwater Horizon* spill. *See* Deepwater Horizon Response Consolidated Fish and Wildlife Collection Report (Nov. 2, 2010). The take of turtles from the spill almost certainly exceeds the incidental take authorized by NMFS for the entire 40-year lifetime of the 2007 to 2012 lease sales. *See* DSEIS at 4-146 (quoting NMFS incidental take authorizations). Because this additional mortality likely does change the baseline, BOEMRE has reinitiated ESA consultation with NMFS and USFW. *See* Reinitiation Letters of July 30, 2010. In this context, contrary to what BOEMRE is now concluding in its DSEIS, BOEMRE explicitly stated that

> the DWH incident and the resulting oil spill necessitate this reinitiation action. . . . [W]e acknowledge that the spill volumes and scenarios used in the analysis for the existing NMFS BO need to be readdressed given the "rare event" of a spill exceeding 420,000 gallons as referenced in the current NMFS BO has occurred and that affects [sic] to and the status of some listed species or designated critical habitats may have been altered as a result of the DWH incident and therefore require further consideration.

Id. NMFS responded to this letter on September 24, 2010, agreeing that reinitiation was warranted. In this response, NMFS explicitly noted that

> As our response and impact analysis . . . [regarding the spill] continues, it is a good time for [BOEMRE] to evaluate the impacts to endangered and threatened species, and designated critical habitat from the oil, as well as for any potential future spills. We have begun synthesizing data from the spill, and it is clear that we have underestimated the size, frequency, and impacts associated with a catastrophic spill under the 2007-2012 lease sale program.

E. OIL SPILL ANALYSIS

CBD-11

The draft SEIS fails to remedy BOEMRE's previously inadequate analysis of the likely impact of oil spills. In the initial Multisale EIS, MMS downplayed all of the impacts from offshore drilling. Among the Multisale EIS's conclusions are the following:

- An oil spill would only "result in sublethal impacts (e.g., decreased health, reproductive fitness, and longevity; and increased vulnerability to disease) to marine mammals." Multisale EIS at 2-37 to 2-38 (2007).
- "In most foreseeable cases, exposure to hydrocarbons persisting in the sea following the dispersal of an oil slick will result in sublethal impacts (e.g., decreased health, reproductive fitness, and longevity; and increased vulnerability to disease) to sea turtles." *Id.* at 2-38.
- "The majority of effects … on endangered/threatened and nonendangered/nonthreatened coastal and marine birds are expected to be sublethal." *Id.* at 2-39.
- "The likelihood of spill occurrence and subsequent contact with, or impact to, Gulf sturgeon and/or designated critical habitat is extremely low." *Id.* at 2-40.

- The effects of an oil spill on fish populations and the commercial fishing industry would be "negligible and indistinguishable from variations due to natural causes" and "any affected commercial fishing activity would recover within 6 months." *Id.*

MMS estimated that over the 40-year life span of the eleven proposed lease sales, the total amount of oil spilled in the offshore waters of the Central Planning area, which includes the Deepwater Horizon site, would be 5,500 to 26,500 barrels of oil. *Id.* at 4-241. The maximum amount estimated – 26,500 barrels – is slightly over 1 million gallons, about 0.5% of the current estimate of oil spilled at the Deepwater Horizon site.

CBD-12

The *Deepwater Horizon* incident has illustrated, among other problems with current OCS operations, how difficult it is to control a blowout in very deep water and how difficult it is to marshal and put to use cleanup equipment. These factors added not only to the risk of the spill, but to the overall impact of the spill once it occurred and must be fully analyzed in the SEIS. BOEMRE also must include in its assessment of future oil spill impacts, both the impacts of the release of crude oil and the impacts of cleanup technologies, such as in situ burning and application of dispersants. Scientists continue to debate the fate of the oil released from the *Deepwater Horizon* spill, especially the impact of chemical dispersants applied in unprecedented amounts near the seafloor. Again, this analysis requires a clear-eyed assessment regarding the capacity of both the government and the industry to control and mitigate the impacts of any future oil spills.

CBD-13

In the DSEIS, it is clear that BOEMRE continues to underestimate the impacts of oil spills on the environment and overestimate the ability of industry to prevent and respond to spills. Particularly troubling is the agency's use of recovered animals as an approximation of the number taken by the spill. Given the difficulty of recovering the corpses of marine animals, these numbers dramatically underestimate the actual impact. *See* Williams et al., *Underestimating the Damage: interpreting cetacean carcass recoveries in the context of the Deepwater Horizon/BP incident*, Conservation Letters 2011, 1-6. Williams *et al.* report that under normal circumstances, "the overall pooled rate of carcass recovery for cetaceans in the Gulf of Mexico is approximately 0.4% of the total estimated mortality." *Id.* at 3. Based on known recovery rates, Williams *et al.* found that it is possible up to 5,050 cetaceans were killed by the *Deepwater Horizon* spill. *Id.* at 4.

The Center for Biological Diversity reviewed scientific articles and government figures to assess the likely impacts of the spill.

> In total, we found that the oil spill has likely harmed or killed approximately 82,000 birds of 102 species, approximately 6,165 sea turtles, and up to 25,900 marine mammals, including bottlenose dolphins, spinner dolphins, melon-headed whales and sperm whales. The spill also harmed an unknown number of fish — including bluefin tuna and substantial habitat for our nation's smallest seahorse — and an unknown but likely catastrophic number of crabs, oysters, corals and other sea life. The spill also oiled more than a thousand miles of shoreline, including beaches and marshes, which took a substantial toll on the animals and plants found at the shoreline, including seagrass, beach mice, shorebirds and others.

Center for Biological Diversity, *A Deadly Toll: The Gulf oil spill and the unfolding wildlife disaster*.

1. The Bureau's Accidental Oil Spill Analysis is Fundamentally Flawed

CBD-14

Deepwater wells in the Gulf of Mexico may be high pressure/high temperature wells which were not considered economically viable until the mid-1990s.[16] "HP/HT conditions are extremely dangerous and add exorbitant risk to drilling, completion and workover operations. The most extreme risk, HP/HT conditions can cause blowouts."[17] A survey of HP/HT professionals taken post-*Deepwater Horizon* disaster describes the hazards and the major challenges facing operators drilling such wells such as the fact that "BOP control is not proven."[18] The risks peculiarly associated with ultra-deepwater drilling in the Gulf of Mexico are well known:

> Many of the prospects in the ultra deepwater GoM have what can only be described as having a unique combination of challenges. The combination of deepwater (Up to 10,000 ft [3048m] water depth), high-pressure (Over 10,000 psi [690 bar] shut in pressures), high temperatures (Over 350oF [195oC] bottom hole temperature), problematic formations (Salt zones, tar zones, etc.), deep reservoirs (Over 30,000 ft [9145m] true vertical depth), tight sandstone reservoirs (< 10mD) and fluids with extreme flow assurance issues separate many GoM deepwater and ultra deepwater wells from deepwater and ultra deepwater wells in other parts of the world.
>
> Much of the prospective GoM deepwater exploration areas are in 4,000 ft [1220m] to 10,000 ft [3048m] of water. Most of this area is in a sub-salt environment; with salt canopies ranging from 7,000 ft [2134m] to 20,000 ft [6096m] thick, and have target depth ranges from 25,000 ft [7620m] to 35,000 ft [10668m] true vertical depth.[19]

In the Draft SEIS, BOEMRE states: "Industry challenges remain as operators move into ultra-deepwater areas and seek deeper geologic prospects with little knowledge of its subsurface environment and with the use of new technologies in both familiar and unfamiliar environments." DSEIS at 3-46. It is unreasonable for BOEMRE not to discuss areas where deepwater drilling could occur, the riskiness of those areas, and the unique risks associated with drilling in those areas in conducting its oil spill risk analysis for the SEIS.[20]

CBD-15

2. The Bureau's Reliance on Blowout Preventers to Minimize the Risk of an Accidental Spill and Consequential Environmental Harm is Unreasonable

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[16] Rigzone: How Are HP/HT Reservoirs Developed; Exhibit 73: Transocean News Press Release; Exhibit 74: Chevron Powerpoint; Exhibit 75: Challenges for very deep oil and gas drilling - will there ever be a depth limit? 2009

[17] *Id.*

[18]: Major Challenges in HPHT Operations, Survey results of a survey sent to HPHT Professionals 16 November 2010, HPHT Wells Summit 2010.

[19] Deepwater Gulf of Mexico Development Challenges Overview.

[20] Over-Pressured Wells a Risk for E&P Operators in Deep-Water Gulf of Mexico, Says Joint IHS/GPT Report

CBD-15 (continued)

A recently issued report by a government consultant concluded that the BOP's blind shear rams, designed to cut the well's drill pipe in an emergency so that the well can be sealed, could not operate as intended because the pipe had buckled which constituted a design flaw of the system.[21] In response, the head of BOEMRE informed the House Committee on Natural Resources on March 30, that blowout preventers need further examination and should no longer be treated as certain to work.[22] He has also stated that additional rules need to be put in place to govern their use.[23] Industry experts, including those who have assisted BOEMRE and the oil spill commission have stated that "blowout preventers are not reliable enough" and that ultra deep water drilling shouldn't be conducted until the operators conduct validation projects to prove they can drill safely.[24] It was well known in the industry that operation of subsea blowout preventers in the hostile deepwater environment presented risks not existing on surface mounted BOPs:

> From the 1st BOP design to the present designs, the basic mechanisms have remained constant: A BOP body is sandwiched between 2 operating systems. The rams are opened and closed mechanically either by manual intervention or by hydraulically operated pistons. What has changed, however, and is in a constant state of flux are the operating parameters and the manner in which BOPs are used in today's drilling activities. Today, a subsea BOP can be required to operate in water depths of greater than 10,000 f t, at pressures of up to 15,000 psi and even 5,000 psi, with internal wellbore fluid temperatures up to 400° F and external immersed temperatures coming close to freezing (34° F).[25]

CBD-16

It is unreasonable for BOEMRE to analyze environmental risk and anticipate mitigation of that risk through blowout preventers in the face of this newly acquired knowledge and its own acknowledgement that new BOP rules are needed to reduce the risk of a major blowout.[26]

> First, we will be launching in the very near future a major rulemaking designed to further enhance offshore drilling safety. This process will be broad, inclusive and ambitious. Our goal will be nothing less than a further set of enhancements that will increase drilling safety and diminish the risks of a major blowout. It will address weaknesses and necessary improvements to blowout preventers, as well as many other issues. We genuinely hope that the broad efforts undertaken by the industry in the wake of Deepwater Horizon, through its joint industry task forces, recently-announced Center for Offshore Safety, and other vehicles, will provide the basis for solid recommendations of best practices, including those that should be included within prescriptive or performance-based regulations.

[21] Report on Blowout Preventer Failure, March 2011.
[22] A webcast of Mr. Bromwich's testimony is available at http://naturalresources.house.gov/Calendar/EventSingle.aspx?EventID=227642 and incorporated by reference.
[23] Blowout Preventer Rules Unfinished as Deep-Water Rigs Return, April 8, 2011; Exhibit 78: Inter Interior Department will seek continual improvements in blowout preventers, April 5, 2011; Exhibit 79: Deep Water May Be Too Much For BOPs, April 3, 2011; Exhibit 87: Offshore Safety Updates in Works
[24]
[25] Design evolution of a subsea BOP; Exhibit 88: National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling The History of Offshore Oil and Gas in the United States, Staff Working Paper No. 22.
[26] Analysis: A year after BP spill, drilling risks linger.

http://csis.org/files/attachments/110419_EnergyBromwichRemarks.pdf (BOEMRE Director Discusses Future of Offshore Oil and Gas Development in the U.S. at Gulf Oil Spill Series)

CBD-17

3. The Bureau's Reliance on the Marine Well Containment Company to Minimize the Risk of an Accidental Spill and Consequential Environmental Harm is Unreasonable

Similarly, BOEMRE relies upon newly required "containment systems" which are being developed by the industry as a backup in the event the blowout preventer fails.

The Commission has strongly stated that oil spill response plans should not be approved unless there is proof the containment technology is "immediately deployable and effective." Commission Report at 33. The National Commission has also strongly recommended that source control and well-containment capabilities not be left in the hands of the industry which would appear to be the case here. *Id.* at 32. The Bureau should not be assessing environmental risk based upon an assumption of mitigation when the system it is relying upon for mitigation is has not been tested to the satisfaction of independent experts.

Additionally, a key component to the containment system devised by the Marine Well Containment Company, floating risers, recently failed for unknown reasons in connection with the Petrobas floating development and production system recently permitted by BOEMRE.[27] As stated by an oil industry expert: "The failure of a key component in freestanding riser technology raises the question about the reliability of the free standing risers in the well containment systems that are staged for rapid deployment in the event of another subsea well blowout."[28] Reliance on an unproven system of unknown reliability for the purpose of finding that an accidental spill will not occur is unreasonable.

4. The Bureau's Reliance on the Oil Spill Risk Analysis Model is Arbitrary and Capricious.

CBD-18

The Bureau continues to rely upon its oil spill risk analysis model ("OSRA") which serves as a proxy for a trajectory analysis. The problems with the use of this model to accurately determine environmental risk are self-evident. The model does not predict the fate of a release greater than one day; it does not evaluate the fate of the single release for longer than 30 days; and it does not assume a particular spill size but only evaluates contact probabilities for spill's greater than 1000 barrels. The analysis also does not consider marine fishery resources and habitats; offshore marine mammal habitats and resources; and offshore sea turtle resources and habitats. Staff Report on Environmental Review at 26.[29] As Commission staff points out – overall, it fails to consider most of the offshore environmental resources that are located outside

[27] Exhibit 80: Articles on Petrobras Floating Riser Failure; Exhibit 81: MWCC Description of Expanded Containment System (showing floating risers).
[28] *Id.*
[29] National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling: Federal Environmental Review Of Oil And Gas Activities In The Gulf Of Mexico: Environmental Consultations, Permits, And Authorizations, Staff Working Paper No. 21, January 12, 2011.

of the coastal zone and are managed by NOAA. *Id.* at 26. Use of this model by the Bureau during its NEPA analyses, "resulted in significant underestimations of oil-spill impacts compared to the actual BP oil spill." *Id.* at 27. Given these facts, BOEMRE's use of the OSRA to model environmental risk is arbitrary and capricious.

Instead, BOEMRE should be using the OSRA Catastrophic Run (Appendix C) to analyze the environmental risk of deepwater drilling.

CBD-19

5. BOEMRE's Failure to Use the Catastrophic Blowout for its Oil Spill Risk Analysis is Arbitrary and Capricious

The Commission found that the Deepwater Horizon disaster and its adverse impacts cannot be severed from other proposed Gulf drilling operations because the root causes of the blowout are endemic to the industry as a whole. If allowed to proceed apace without redress, these flaws might well result in another disaster:

> The blowout was not the product of a series of aberrational decisions made by rogue industry or government officials that could not have been anticipated or expected to occur again. Rather, the root causes are systemic and, absent significant reform in both industry practices and government policies, might well recur.

Commission Report at 122.[30] The Commission has determined that a combination of missteps, poor training, lack of communication, and lack of regulatory oversight, all contributed to the blowout, but went unnoticed as common industry practices. *Id.* at 125-26. The Commission further suggests that this haphazard decision-making is part of a corporate culture shared by other companies in the industry. *Id.* In its Recommendations, the Commission suggested that what is needed is "fundamental reform" that goes beyond those reforms already initiated since the disaster. Recommendations at vii. Because BOEMRE has made no attempt to carry out the Commission's recommendation prior to moving forward with deepwater exploration in the Gulf of Mexico, the risk of another uncontrolled blowout and its associated environmental risk is a potential outcome. As the Commission explained:

> [I]in the aftermath of the BP Deepwater Horizon spill, it is difficult to argue that deepwater drilling is an activity that does not present at least some potentially significant risk of harm to the environment of the Gulf.

Id. at 18. It is arbitrary and capricious for BOEMRE to conduct its environmental analysis of anything other than the catastrophic blowout described in Appendix C. We now know that a catastrophic spill is not inconceivable, that blowout preventers are known to fail, and containment systems are unproven and indeed, BOEMRE concedes, may not work at all.

CBD-20

6. The Agency Must Withdraw the Draft EIS Until Its OSRP/Certification Process Has Been Made the Subject of Public Notice and Comment.

[30] Final Report: National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, January, 2011.

CBD-20 (cont)

At this time, operators in the Gulf do not have approved regional oil spill response plans ("OSRPs"). Instead, they are being allowed to go forward with drilling if they have "certified" they can respond to the maximum extent possible to a worst case discharge in the region. Despite the National Commission's strong recommendation that oil spill response plans should be the subject of extensive interagency consultation and a transparent process including notice and comment, Recommendations at 26,[31] OSRPs and certifications and the process by which those certifications have been approved have never been disclosed to the public.

OSRPs provide the "mitigation" BOEMRE uses to claim that the environmental risk of a blowout resulting in a large oil spill has been reduced to an insignificant level. The public cannot meaningfully participate in an environmental review of a lease sale where the basis for the minimization of risk associated with the activities to be conducted pursuant to that plan has not been exposed to public scrutiny and comment.

7. Appendix B Does Not Provide an Adequate Analysis of Oil Spill Impacts.

CBD-21

The only section of the DSEIS that represents a new analysis is Appendix B. This appendix, however, contains very little new information and is replete with cursory analyses and vague conclusions. BOEMRE acknowledges that NEPA requires analysis of catastrophic low-probability impacts such as very large oil spills. DSEIS at B-1; *see also San Luis Obispo Mothers for Peace v. Nuclear Regulatory Comm'n*, 449 F.3d 1016, 1030-31 (9th Cir. 2006); *Limerick Ecology Action, Inc. v. Nuclear Regulatory Comm'n*, 869 F.2d 719, 740 (3d Cir. 1989); *Found. on Econ Trends v. Heckler*, 756 F.2d 143, 153-54 (D.C. Cir. 1985). BOEMRE's analysis here, however, falls far short of the hard look NEPA requires.

CBD-22

Appendix B contains some admissions of potentially dire consequences, yet contains scant analysis of the ramifications of these impacts and no consideration of whether and how these impacts can be mitigated. For instance, BOEMRE states that "a high volume oil spill lasting 120 days could impact greater than 1,000 sea turtles, and the majority could be Kemp's ridley turtles, which are listed as endangered under the ESA." DSEIS at B-19. NMFS 2007 biological opinion premised its no jeopardy finding on an authorization of 13 lethal takes and 26 nonlethal takes over the 40-year lifetime of the leases. Despite this potentially catastrophic impact on endangered sea turtles, the entire analysis of the impact of a large offshore oil spill on the five potentially impacted species of sea turtles consists of fewer than 250 words. *Id.* The two paragraphs devoted to sea turtles contain no attempt to consider what this would mean to the continued existence of the species. Similarly, the analysis of impacts to marine mammals acknowledges potentially devastating impacts to cetaceans, but is shocking in its lack of detail. BOEMRE concludes "it is reasonable to assume that a catastrophic oil spill lasting up to 120 days could have population-level effects on many species of marine mammals (e.g., sperm whales, Byrde's whales, etc.)." DSEIS B-19.

CBD-23

Throughout this section, despite acknowledging that counts of dead animals do not represent accurate indicators of impacts, BOEMRE continues to use numbers of animals actually recovered in the wake of the *Deepwater Horizon* accident in its analysis. For instance,

[31] "Specifically, oil spill response plans, including source-control measures, should be subject to interagency review. . . . Plans should also be made available for a public comment period prior to final approval. . . .

CBD -23(cont)

BOEMRE notes "103 marine mammals have been collected (9 alive and 94 deceased as of September 22, 2010). Thus, a high-volume spill lasting 120 days could directly impact as many individuals or more." Similarly, for birds BOEMRE indicates "a spill lasting 120 days could result in direct mortality of over 7,000 birds." DSEIS at B-31. BOEMRE then admits that "this number represents a small fraction of total bird mortality." *Id.* Given this acknowledgement, BOEMRE should not present these number as though they were a basis for predicting the impacts of future oil spills, but instead should extrapolate from these numbers a reasonable range of potential impacts. *See* Williams et al. (2011).

CONCLUSION

We appreciate BOEMRE's recognition of the need for further NEPA analysis of issues surrounding the impacts of oil activities in the Gulf of Mexico in light of the *Deepwater Horizon* disaster. We request BOEMRE publish a new DSEIS for the WPA that considers a more robust range of alternative, further develops the analysis of oil spill impacts, and more fully integrates new information into the analysis.

Sincerely,

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CBD-1 Comment noted. The BOEMRE disagrees with the Center for Biological Diversity's assessment of this NEPA process and Supplemental EIS. The BOEMRE did take the requisite "hard look" mandated by NEPA, as evidenced by the fact that this supplemental analysis used the scientifically credible information available to evaluate significant new circumstances and information since the publication of the Multisale EIS and the 2009-2012 Supplemental EIS.

CBD-2 This Supplemental EIS for WPA Lease Sale 218 is not an environmental assessment. This Supplemental EIS is necessary because significant impacts may result from the proposed action or the alternatives. In any event, BOEMRE disagrees that the analyses and conclusions in the Multisale EIS and the 2009-2012 Supplemental EIS are rendered obsolete due to the DWH event. The proposed action (i.e., the lease sale) remains the same, and much of the analysis in the Multisale EIS and the 2009-2012 Supplemental EIS on the affected environment and impacts from routine events, accidental events that do not rise to the level of a catastrophic event similar to the DWH event, and cumulative impacts remain just as relevant today. The oil spill resulting from the DWH event was an accidental event, not part of the proposed action. Nonetheless, new significant information available since the Multisale EIS and the 2009-2012 Supplemental EIS, as well as the changes in baseline conditions as a result of the DWH oil spill, are adequately considered in this Supplemental EIS.

CBD-3 A spill of the magnitude of the DWH spill was certainly not expected and would not have been a valid assumption prior to the event, nor is it a valid assumption for WPA Lease Sale 218 in light of the exceedingly low probability for such an event, particularly in light of recent regulatory and technological changes. Although the DWH event remains an exceedingly low-probability accidental event, there are far more likely accidental scenarios whose impacts should and must be evaluated under NEPA. For the most part, these scenarios remain valid and were only somewhat impacted by information available since the DWH event. Therefore, the bulk of the analyses in the Multisale EIS and the 2009-2012 Supplemental EIS remain valid, and the purpose of this Supplemental EIS was to update and clarify those analyses that were changed.

In any event, in light of the DWH event and oil spill, BOEMRE ran OSRA with additional parameters and summarized the effort in **Appendix C** of this Supplemental EIS. Using new information available since the Multisale EIS and the 2009-2012 Supplemental EIS, the subject-matter experts analyzed the potential impacts to resources in the context of these updated scenarios.

CBD-4 See the response to Comment CBD-2.

CBD-5 The BOEMRE's consideration of appropriate mitigations and stipulations are already included for each alternative as part of the OCSLA lease sale process. An EIS is a disclosure document and, based upon its findings, is often used in the development of mitigations and stipulations to reduce or eliminate impacts of the chosen action alternative. Consistent with this principle, BOEMRE considers mitigations and stipulations to minimize the impacts of oil and gas exploration and development and to improve safety throughout the leasing process. The BOEMRE applies a number of lease sale mitigations and stipulations. **Chapter 2.2.2.1** of this Supplemental EIS discusses these, including the Topographic Features Stipulation, Military Areas Stipulation, Protected Species Stipulation, and Law of the Sea Convention Royalty Payment Stipulation. Additionally, a number of site-specific mitigations for environmental protection and safety are routinely applied at the post-lease stage. All exploration plans, development plans, and pipeline applications are thoroughly reviewed to determine what protective measure(s) should to be included as a condition of plan or permit approval. Mitigations and stipulations are developed as conditions warrant and are subject to a review and approval process.

CBD-6 Long-term monitoring is not an alternative to the proposed action, nor is it a method for mitigating impacts of the proposed action or alternatives. Monitoring requirements are a result of consultations conducted with other Federal agencies as well as BOEMRE's long-term monitoring of OCS-related activities. The analyses in the Multisale EIS, the 2009-2012 Supplemental EIS, and this Supplemental EIS are based upon the best available information known to date. Where relevant information on reasonably foreseeable significant adverse impacts is incomplete or unavailable, the need for the information was evaluated to determine if it was essential to a reasoned choice among the alternatives and, if so, was either acquired or in the event it was impossible or exorbitant to acquire the information, accepted scientific methodologies were applied in its place. The BOEMRE has done so here, and, in light of the above, long term monitoring is not an appropriate alternative for this Supplemental EIS.

This Supplemental EIS meets the requirements of NEPA in the development and consideration of alternatives.

CBD-7 **Chapter 4.1**, "Incomplete or Unavailable Information," has been updated on these issues and, where appropriate, has been described in the individual resource analyses.

CBD-8 See the response to Comment CBD-7. The Gulf of Mexico, including the WPA, is a dynamic environment that will be studied far into the future. There will never be a "final" assessment of baseline conditions in such an environment; any baseline would be constantly evolving. Nevertheless, BOEMRE has extensive experience in this environment, holding over 90 lease sales in the Gulf of Mexico, preparing over 50 lease sale EIS's, and continuing to study this ever-changing environment. The types of basic information included in the "Description of the Affected Environment" for each resource has been developed over many years and new information is added on a regular basis. In this Supplemental EIS, the subject-matter experts described new information on changes in baseline conditions as a result of the DWH spill, and this information was taken into account in analyzing the impacts of the proposed action on the various resources. In addition, three new resources were added to this Supplemental EIS in consideration of the DWH spill. These included soft bottoms, *Sargassum*, and diamondback terrapins. It is BOEMRE's opinion that the discussion of baseline conditions in this Supplemental EIS is robust and is, in fact, much more lengthy than recommended by NEPA guidelines.

CBD-9 See the response to Comment CBD-7. The CEQ regulation cited by the Center for Biological Diversity, namely 40 CFR 1502.22, acknowledges that information may be unavailable or incomplete and sets forth the analysis the agency must make prior to continuing without the incomplete or unavailable information. In this case, BOEMRE has identified where relevant information on reasonably foreseeable significant adverse impacts is incomplete or unavailable and has evaluated the need for the information to determine if it was essential to a reasoned choice among the alternatives, and if it was, either acquired the information or, in the event it was impossible or exorbitant to acquire the information, accepted scientific methodologies were applied in its place. The BOEMRE has the relevant information necessary to make a reasoned choice among the alternatives and to evaluate the effects of the proposed action and its alternatives.

CBD-10 See the response to Comment CBD-7. The BOEMRE acknowledges that consultation reinitiated in light of the DWH event is still underway and may not be concluded prior to the printing of the Final Supplemental EIS. Because this is a lease sale that does not in and of itself make any irreversible or irretrievable commitment of resources that would foreclose the development or implementation of any reasonable and prudent alternative measures to comply with the Endangered Species Act (ESA), BOEMRE may proceed with publication of this Supplemental EIS and finalize a decision among the alternatives even if consultation is not complete, consistent with Section 7(d) of the ESA. While consultation is ongoing, BOEMRE is developing an interim coordination program with NMFS and FWS.

CBD-11 This Supplemental EIS supplements and updates information made available since the Multisale EIS and the 2009-2012 Supplemental EIS. At the time of these prior NEPA documents, a spill of the magnitude of the DWH event was not a reasonably foreseeable occurrence. And, indeed, the likelihood of another event on this scale is exceedingly low, made even more so by BOEMRE's promulgation of new drilling and safety regulations and the ongoing endeavors to advance containment technologies. Information that is currently available indicates that the resources in the WPA were not significantly affected or, in most cases, not affected at all by the DWH event. Two new appendices, however, were added to this Supplemental EIS to provide more information about general impacts of a catastrophic spill – **Appendix B**, "Catastrophic Spill Event Analysis," and **Appendix C**, "BOEMRE-OSRA Catastrophic Run."

CBD-12 Comment noted. Where information is available on the impacts of deploying oil-spill response technologies (including from the Federal and State agencies with direct oversight of cleanup activities), the subject-matter experts included this information in their analyses of the resources. Where information is incomplete or unavailable, BOEMRE evaluated whether the information was relevant to reasonably foreseeable significant impacts, and if so, was it essential to a reasoned choice among alternatives (**Chapter 4.1**, "Incomplete or Unavailable Information"). The capacity of both government and industry to respond to oil spills, both from a regulatory and technological perspective, is continually being updated and improved. Many of these changes are outside of BOEMRE's authority (e.g., USCG), and for the purposes of this NEPA analysis, BOEMRE has taken a conservative approach, assumed for purposes of impact analysis that a catastrophic spill may occur, and has not relied on untested technological advances in oil-spill response in our analysis of impacts.

CBD-13 The BOEMRE has relied on publicly available information on actual carcasses recovered, but has clarified in the Supplemental EIS that these numbers may underestimate the total number of individuals affected. As noted in the Supplemental EIS, extrapolation from this raw data is not reliable at this point in time. In this case, BOEMRE has identified where relevant information on reasonably foreseeable significant adverse impacts is incomplete or unavailable and has evaluated the need for the information to determine if it was essential to a reasoned choice among the alternatives, and if it was, either acquired the information or, in the event it was impossible or exorbitant to acquire the information, accepted scientific methodologies were applied in its place.

CBD-14 The BOEMRE uses data on past OCS production and spills, along with estimates of future production, to evaluate the risk of future spills (Chapter 4.3.1.2 of the Multisale EIS). Data on the numbers, types, sizes, and other information on past spills, including those that are relevant to ultra deepwater wells, were reviewed to develop the spill scenario for analysis in this Supplemental EIS. Past spill data used in the model indicate that there is no trend of increased number of spills based on exploration in deeper water prior to Macondo. The spill scenario provides the set of reasonable assumptions and estimates of future spills; the type, frequency, quantity, and fate of the spilled oil for specific scenarios; and the rationale for the scenario assumptions or estimates. Neither high-temperature/high-pressure conditions nor water depth are used to calculate the risk of future spills because these are post-lease operational issues that cannot be reasonably predicted at the lease stage without site-specific information. In the post-lease stage, applicants submit site-specific data on conditions and BOEMRE technical staff reviews this data to determine whether conditions on approval, based on well data, are appropriate. The BOEMRE believes that the NEPA analysis in this Supplemental EIS is conservative, in that even with the oil-spill risk analysis showing that the risk of a spill remains low (whether in deep water or shallow water), for the purposes of impacts analysis, a potential spill was assumed and evaluated.

CBD-15 The statement regarding BOEMRE's reliance on BOP's is not an accurate assessment. The BOEMRE views the entire drilling process as a whole in the prevention of losses of well control and well blowouts, and no one component could reasonably be expected to be a 100 percent fail safe in all scenarios. The BOP's should not be viewed in isolation, when they are one of only a number of technological devices and regulatory initiatives to prevent and, if necessary, contain and kill blowouts. The BOEMRE also directed significant energies on improving the way wells are designed and drilled to prevent the occurrence of a well control incident that would require the use of the BOP (**Chapter 1.3.1**). Even with all of these improvements on well design and drilling practices and the changes to increase the reliability of the BOP stacks, BOEMRE did not stop there. In addition to prevention, BOEMRE focused resources on improvements to containment capabilities as well. Therefore, BOEMRE is not putting an unreasonable amount of reliance on the BOP's, viewed in the context of a number of overlapping and complementary initiatives to prevent and, in the unlikely event a loss of well control results in a spill, contain and kill the spill. The BOEMRE has addressed this problem from every possible angle with the intent of reducing the overall risk.

CBD-16 See the response to Comment CBD-15.

CBD-17 Although this Supplemental EIS introduces and evaluates new information on containment systems as it is relevant to the proposed action and alternatives and in light of the DWH event, containment is being reviewed in more detail on a per application for permit to drill (APD) basis. An APD is not approved unless the operator has demonstrated a capability to contain a subsea blowout. To date, containment has been successfully demonstrated by several operators through the post-lease process. Currently, containment is being provided by Marine Well Containment Corporation (MWCC) and the Helix Well Containment Group. All equipment and containment strategies utilized by these organizations are inspected and reviewed by experts at BOEMRE. At this time, MWCC is not utilizing floating risers similar to Petrobras. While BP did utilize this technology during the DWH event without incident, MWCC has decided to utilize proven riser systems deployed from mobile offshore drilling units. Free-standing risers systems similar to Petrobras will not be utilized for containment until such a time that MWCC and BOEMRE can fully evaluate the technology. Although independent experts are free to opine on equipment and containment strategies, BOEMRE remains the Federal agency with oversight authority for oil and gas development on the OCS, including requirements for the drilling, safety, and oil-spill response, and it must make its own informed decision on whether an operator is complying with BOEMRE's containment requirements. In any event, this issue is outside of the purview of this document or NEPA generally.

CBD-18 See the response to Comment CBD-11. The OSRA model is a trajectory analysis, combined with the probability of spill occurrence. Past spill data used in the OSRA models, both for accidental spills and catastrophic runs, indicate that there is no trend of increased number of spills based on exploration in deeper water prior to Macondo. For purposes of this Supplemental EIS, BOEMRE believes that it is appropriate to run the OSRA model for both low-probability catastrophic spills (**Appendix C**) and for other types of accidental events (**Table 3-5**) to frame the impacts analysis and better inform the decisionmaker.

CBD-19 See the responses to Comments CBD-11 and CBD-18.

CBD-20 The CBD's request that this Supplemental EIS be withdrawn until the OSRP review and/or certification processes have been made subject to public notice and comment has no precedence under NEPA. The regulations implementing the OSRP/certification requirements were the subject of notice and comment. Public notice and comment on individual OSRP submissions and certifications is not provided for in the statutes or regulations and raises a number of complicating factors (such as proprietary and personal contact information that must be included). Even if BOEMRE were allowed to subject the OSRP and certification processes to public notice and comment in the future, that is not a basis for withdrawing this Supplemental EIS now. Public notice and comment on the OSRP and certification process would be unlikely to result in information relevant to the reasonably foreseeable significant adverse impacts of the proposed action or the alternatives. If anything, public notice and comment would only be expected to further reduce the potential for impacts during the post-lease process rather than increase the potential for heightened or new impacts. Thus, the Supplemental EIS remains conservative in its evaluation of potential impacts from oil spills and the potential for OSRP's to reduce or minimize this potential.

CBD-21 The BOEMRE has reviewed the "Catastrophic Spill Event Analysis" (**Appendix B**) to correct or update it where necessary. However, it should be noted that the analysis in **Appendix B** was intended to be a general overview of potential effects of a catastrophic spill and to complement the substantive analyses in the main body of the Supplemental EIS itself. It was never envisioned to replace such analyses for individual resources in the main Supplemental EIS. As such, the Catastrophic Spill Event Analysis should be read with the understanding that further detail about oil impacts on a particular resource can be found in the main Supplemental EIS or previous relevant NEPA documents.

CBD-22 See the response to Comment CBD-21. The intent of this analysis was not how to mitigate for a catastrophic spill event but to estimate the potential effects if such a catastrophic spill event occurred. Potential mitigation measures are discussed in the main body of the Supplemental EIS, where appropriate. The 2007 NMFS Biological Opinion does not authorize lethal takes of any species from an oil spill, including sea turtles, and indeed it is not within NMFS's or FWS's power to "authorize" takes for some future accidental event. The Catastrophic Spill Event Analysis is meant to provide an overview of the potential effects of a catastrophic spill, and when read in conjunction with the main body of the Supplemental EIS, to inform the decisionmaker and public on potential impacts of the proposed action if a catastrophic spill does occur. Therefore, the information on sea turtles and marine mammals should be read in context of the information presented in the Supplemental EIS itself. The Catastrophic Spill Event Analysis recognized the potential for adverse population level effects of sea turtles and marine mammals as a result of a catastrophic spill event. The Catastrophic Spill Event Analysis does not assign detailed mortality rates, and it was never intended to do so.

CBD-23 See the response to Comment CBD-13.

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The Center for Regulatory Effectiveness ("CRE") appreciates this opportunity to comment on the WPA Draft SEIS. [1]

CRE's comments address BOEMRE's review and regulation of noise, in particular oil and gas seismic operations in the Gulf of Mexico ("GoM"). As discussed in detail below:

- Long-standing BOEMRE regulation in the GoM adequately protects marine mammals and other species from seismic and other noise;
- Regulation of noise in the GoM at the 120 db level, as suggested in NMFS' earlier comments, is both unnecessary and infeasible; and
- BOEMRE's consultations with NMFS on noise should be transparent and open to public comment. BOEMRE and NMFS should, for example, allow public comment on significant documents such as draft biological opinions or revised BOEMRE requests for NMFS rules under the MMPA. Public comment is necessary to ensure the agencies are using the best available data.

I. Background

The WPA Draft SEIS states that NOAA/NMFS submitted scoping comments which included the following:

> "The NMFS recommends that BOEMRE conduct a study to better understand the cumulative effects of noise from oil and gas construction and development

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[1] BOEMRE's Federal Register notice soliciting comment is available at 76 FR 22139 (April 20, 2011), and online at http://edocket.access.gpo.gov/2011/2011-9701.htm . The WPA Draft SEIS is available online at http://www.gomr.boemre.gov/PDFs/2011/2011-018.pdf .

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> activities on the OCS. This recommendation includes characterizing all aspects of noise producing construction and operation activities such as pile driving during well construction and platform installation, and other common OCS activities. Major noise-producing activities (>120 dB re 1 μParms) should be identified, and measurements of noise from these activities should be reported in appropriate units of measurement to estimate the acoustic footprint on the environment, duration, frequency, and relative contribution to ambient noise levels in the Gulf of Mexico."

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> "The Supplemental EIS should characterize all noise sources with source levels above 120 dB re 1 μParms as the potential to affect marine mammals and other listed species".[2]

Offshore noise concerns usually focus on marine mammal effects. The WPA Draft SEIS states that

> "In this Supplemental EIS, BOEMRE has reexamined the analysis for marine mammals presented in the Multisale EIS and the 2009-2012 Supplemental EIS, and has considered the recent reports cited in the analysis and other new information. Following the DWH event, BOEMRE requested reinitiation of ESA consultation with both NMFS and FWS (July 30, 2010). The NMFS responded with a letter to BOEMRE on September 24, 2010. The FWS responded with a letter to BOEMRE on September 27, 2010. The reinitiated consultations are not complete at this time, although BOEMRE is in discussions with both agencies. The existing consultations remain in effect until the reinitiated consultations are completed. The existing consultation recognizes that BOEMRE- required mitigations and other reasonable and prudent measures should reduce the likelihood of impacts from BOEMRE-authorized activities.
>
> Because of the mitigations described in the analysis, routine activities (e.g., operational discharges, noise, vessel traffic, and marine debris) related to the proposed WPA lease sale are not expected to have long-term adverse effects on the size and productivity of any marine mammal species or population in the northern GOM. Lethal effects are most likely to be from chance collisions with OCS service vessels or ingestion of any accidentally-released plastic materials. Most routine OCS activities are expected to have sublethal effects."[3]

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[2] WPA Draft SEIS at pages A-99 and A-100, available online at http://www.gomr.boemre.gov/PDFs/2011/2011-018.pdf (BOEMRE's summary of NMFS' scoping comments).

[3] *Id.* at page 2-14.

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With regard to seismic and consultation with NOAA/NMFS, the WPA Draft SEIS further states that:

> "On December 26, 2002, this Agency petitioned NMFS for rulemaking under the MMPA for the taking, by harassment, of sperm whales incidental to the oil and gas industry's seismic surveys to discover oil and gas deposits offshore in the GOM. The NMFS published a notice of receipt of the application on March 3, 2003 (68 FR 9991). This Agency then submitted a revised petition on September 26, 2004, to include the incidental take of other species of marine mammals. On July 30, 2004, this Agency completed its final programmatic environmental assessment on the action. On November 18, 2004, NMFS published a Notice of Intent to Prepare an EIS, a notice of public meetings, and a request for scoping comments. The BOEMRE and NMFS are working together as co-lead agencies on the EIS and, due to lengthy delays in the MMPA process, BOEMRE is currently updating and revising its previously submitted petition for MMPA rulemaking. Following issuance of such regulations under the MMPA, NMFS will amend their opinion to include any authorized incidental take of sperm whales, as may be appropriate at that time."[4]

II. A 120 dB Isopleth Is Unnecessary

CRE-1

NMFS is incorrect when it comments that "120 dB re 1 μParms [has] the potential to affect marine mammals and other listed species".[5]

The National Research Council has concluded that

> "there have been no known instances of injury, mortality, or population level effects on marine mammals from seismic exposure but that the potential for these types of impacts may exist without appropriate mitigation measures. The MMS-approved seismic surveys include mitigation measures designed to reduce the potential for effects to occur." [6]

The MMS/BOEMRE mitigation measures referenced above include a 500 meter exclusion zone based on a 180 dB isopleth. They do not include any measures based on a 120 dB isopleths.

NMFS itself correctly explained that

[4] *Id.* at page 4-138.

[5] WPA Draft SEIS at pages A-99 and A-100, available online at http://www.gomr.boemre.gov/PDFs/2011/2011-018.pdf (BOEMRE's summary of NMFS's scoping comments)

[6] See, *e.g.*, Outer Continental Shelf Oil & Gas Leasing Program,2007-2012 Final Environmental Impact Statement, page V-64 (MMS April 2007), *available online at* http://www.boemre.gov/5-year/2007-2012DEIS/VolumeII/5and6-ConsultationPreparers.pdf

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> "To date, there is no evidence that serious injury, death, or stranding by marine mammals can occur from exposure to airgun pulses, even in the case of large airgun arrays."[7]

NMFS recently pointed out that whale populations have thrived and increased during years of seismic and other noise-producing activities:

> "gray whales have continued to migrate annually along the west coast of North America with substantial increases in the population over recent years, despite intermittent seismic exploration (and much ship traffic) in that area for decades (Appendix A in Malme et al., 1984; Richardson et al., 1995; Allen and Angliss, 2010). The western Pacific gray whale population did not seem affected by a seismic survey in its feeding ground during a previous year (Johnson et al., 2007). Similarly, bowhead whales have continued to travel to the eastern Beaufort Sea each summer, and their numbers have increased notably, despite seismic exploration in their summer and autumn range for many years (Richardson et al., 1987; Allen and Angliss, 2010)."[8]

Similarly, the best abundance estimate available for northern Gulf of Mexico sperm whales is set forth in the following NMFS table:

"Table 1. Summary of abundance estimates for northern Gulf of Mexico sperm whales. Month, year and area covered during each abundance survey, and resulting abundance estimate (Nbest) and coefficient of variation (CV).

Month/Year	Area	Nbest	CV
Apr-Jun 1991-1994	Oceanic waters	530	0.31
Apr-Jun 1996-2001 (excluding 1998)	Oceanic waters	1,349	0.23
Jun-Aug 2003, Apr-Jun 2004	Oceanic waters	1,665	0.20" [9]

[7] 75 FR 49795-96 (Aug. 13, 2010), *available online at* http://edocket.access.gpo.gov/2010/2010-19962.htm .

[8] NMFS' proposed issuance of a an IHA for seismic under the Marine Mammal Protection Act, 76 FR 26255 (May 6, 2011), *available online at* http://www.gpo.gov/fdsys/pkg/FR-2011-05-06/html/2011-11152.htm

[9] SPERM WHALE (*Physeter macrocephalus*): Northern Gulf of Mexico Stock, http://www.nmfs.noaa.gov/pr/pdfs/sars/ao2009whsp-gmxn.pdf

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According to NMFS, the number of sperm whales has increased despite abundant seismic and other noise-producing oil and gas activities in the GoM, and without a 120 dB regulatory standard.

The only court to review NMFS' attempt to impose a 120 db limit on oil and gas seismic activities stayed that attempt because

> "While it appears that all parties are well intended, CPAI [the plaintiff oil company] has raised a 'serious question' regarding the propriety of these additional testing requirements, which is sufficient to justify the interim relief requested. As thoroughly discussed by CPAI, the 'best science' currently available seems to support CPAI's argument with regard to the impact on the bowhead whale. Moreover, a 'balancing of the hardships,' including the danger associated with additional monitoring requirements, tips clearly in CPAI's favor."[10]

The stay was based in part on the plaintiff oil companies' brief which demonstrated that

> "MMS and NMFS have been authorizing seismic exploration and other oil and gas development activities within the BCB [Beaufort/Chukchi bowhead whale stock's habitat for more than 30 years, imposing, at most, a 180 dB exclusion zone requirement. Brueggeman Decl. ¶¶ 21, 26, 39. During that time, the population has more than doubled, reproductive rates have been robust, and harvested whales have been found to be in excellent physical and reproductive condition. *Id.* ¶¶ 14, 25." [11]

CRE-2

In sum, despite years of offshore seismic operations under a 180 dB standard, there is no evidence that seismic has jeopardized or threatened the existence of any species, diminished the population of any marine mammal, or seriously injured any individual mammal or any other species. Any contrary claim or conclusion would violate BOEMRE and NMFS' Information Quality Act ("IQA") Guidelines because it would be inaccurate. [12]

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[10] ConocoPhillips Alaska, Inc. v. NMFS, Case 3:06-cv-00198-RRB (U.S. Dist. Alaska), Order Granting Motion to Stay, dated September 18, 2006. The court eventually dismissed this case as moot because the 2006 IHA expired on December 31, 2006; and CPAI withdrew its application for a 2007 IHA. Order Re Pending Motions on Appeal and Vacating Oral argument, Case 3:06-cv-00198-RRB, Document 116 Filed 04/17/07 (U.S. Dist. Alaska).

[11] ConocoPhillips Alaska, Inc. v. NMFS, Case 3:06-cv-00198-RRB, Document 6 Filed 08/25/06, Page 17 of 34

[12] BOEMRE's IQA guidelines are available online at http://www.boemre.gov/qualityinfo/ . NMFS IQA Guidelines are available online at http://www.nmfs.noaa.gov/quality.htm .

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III. A 120 dB Isopleth is Infeasible

In addition to being unnecessary, regulation on a 120 dB isopleth is infeasible. According to NMFS:

> "Projection of sound propagation from measurements of sound around drilling operations and seismic operations and modeled sound propagation (Hall et al., 1994) yielded estimations of the 120-dB isopleth well beyond the 20 km (12.4 mi) distance. For example, Hall et al. (1994) estimated the 120-dB isopleth for combined drilling/ice management operations to be in excess of 100 km (62 mi) from the source(s)."[13]

CRE-3

We do not know of any effective way of monitoring whether a whale enters a safety radius of 62 miles. Requiring safety radii that are impossible to monitor would violate the Marine Mammal Protection Act, which only authorizes NMFS to impose feasible mitigation measures. 16 U.S.C. § 1371(a)(5)(D)(ii)(1).

An external peer review panel of experts reviewed Shell's proposed noise monitoring plan for the Arctic. The panel's report emphasized the limits on monitoring effectiveness:

> "Shell will use vessel-based MMOs and either bottom-founded hydrophones or a system of radio spar buoys to monitor near the drill site. The utility of MMOs depends largely on visibility, and all the standard concerns apply with regard to periods of low visibility (e.g., darkness, rough sea state, inclement weather). The use of the acoustic monitoring will help compensate for poor visibility, but the accuracy of acoustic data for the purpose of localizing animals declines beyond approximately 10 km from the hydrophone array, and passive acoustic methods cannot be used to monitor individuals that do not vocalize. If the drilling and support activities cause disturbance beyond this limit, or if vocalization rates are unknown or variable, then the monitoring plan will not be adequate. As a consequence, the company's ability to estimate take also will be compromised." [14]

CRE-4

Finally, it would be arbitrary to regulate all sound sources at the 120 db level regardless of whether a particular sound source is hazardous at that level. For example, NMFS generally regulates oil and gas seismic on a 180 dB isopleth. NMFS originally wanted to impose a 120 dB isopleth for seismic in the Alaska out of concern for bowhead whales and for the native peoples who kill and

[13] 72 FR 17864 (April 10, 2007), available online at http://edocket.access.gpo.gov/2007/E7-6753.htm

[14] Peer review panel report for Shell., page 16, available online at http://www.nmfs.noaa.gov/pr/pdfs/permits/openwater_peer_review2010.pdf .

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eat them. [15] There are no bowheads in the GoM. Nor is there anyone who (legally) kills and eats whales in the GoM .

IV. BOEMRE and NOAA/NMFS Should Be Transparent in Regulating Sound in the GoM

CRE-5

As quoted above in the Background section of our comments, BOEMRE is consulting with NMFS on the regulation of seismic and perhaps other sound sources in the GoM. These consultations would benefit by public review and comment on significant documents such as draft biological opinions or revised BOEMRE requests for NOAA/NMFS rules under the MMPA. The agencies need public review and comment in order to be sure they are working on the best available information.

This transparency also seems mandated by President Obama's Transparency and Open Government Memorandum, and by OMB's implementation of the President's Memorandum. [16]

We commend BOEMRE for its transparency so far in this process. We also note that NMFS has not always been transparent in its consultations with other agencies. [17]

We once again thank you for this opportunity to comment and for BOEMRE's continuing efforts to maintain a transparent regulatory process.

Jim J. Tozzi
Member, CRE Board of Advisors

[15] See, *e.g.*, *id.*

[16] The President's Transparency memorandum is available online at http://www.whitehouse.gov/the_press_office/TransparencyandOpenGovernment/ OMB's Implementing actions are available online at http://www.whitehouse.gov/sites/default/files/omb/assets/memoranda_2010/m10-06.pdf

[17] For an example involving EPA, see page 5 of the letter available online at http://www.epa.gov/espp/litstatus/nmfs-3-11-11-draft-biop.pdf , where EPA explains that it has to take public comment on draft BiOps because NMFS does not allow public comment.

CRE-1 The NMFS is only issuing Marine Mammal Protection Act authorizations using the current Level A (180 dB) and Level B (160 dB) criteria.

CRE-2 Comment noted. Please note that this Supplemental EIS uses the current Level A (180 dB) and Level B (160 dB) criteria to evaluate potential impacts on marine mammals.

CRE-3 Comment noted. The BOEMRE notes, however, that for compliance with the Marine Mammal Protection Act for these purposes, NMFS would be the agency responsible for imposing feasible mitigation measures.

CRE-4 Comment noted.

CRE-5 The NOAA and FWS would be the agencies that could provide draft Biological Opinions for public review since they are the agencies that issue them. The recently revised MMPA petition package for seismic sources in the Gulf of Mexico will be announced by NMFS in the *Federal Register*, and interested parties can receive a copy at that time.

International Association IAGC of Geophysical Contractors

Via Electronic Mail

June 6, 2011

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Subject: Draft Supplemental Environmental Impact Statement for the Gulf of Mexico OCS, Western Planning Area, Oil and Gas Lease Sale for the 2007-2012 5-Year OCS Program

Dear Mr. Christopher,

The International Association of Geophysical Contractors (IAGC) is pleased to provide the following comments to the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) in response to its 20 April 2011 Federal Register Notice of Availability (NOA) of a Draft Supplemental Environmental Impact Statement (SEIS) for the Gulf of Mexico (GOM) Western Planning Area (WPA), Oil and Gas Lease Sale for the 2007–2012 5–Year Outer Continental Shelf (OCS) Program.

IAGC is the international trade association representing the industry that provides geophysical services (geophysical data acquisition, processing and interpretation, geophysical information ownership and licensing, associated services and product providers) to the oil and natural gas industry. In the last ten years IAGC member companies have invested over $3 billion in acquiring and processing multi-client geophysical data in the GOM OCS. Geophysical data plays an integral role in the successful exploration and development of offshore hydrocarbon resources.

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6 June 2011
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General Comments

The Gulf of Mexico is one of the most productive oil and gas provinces in the world. Its prospectivity attracts investments from around the world. One of the more attractive aspects of the GOM OCS has always been the consistency that acreage has been made available for leasing through regularly scheduled lease sales. IAGC and the geophysical industry are supportive of the actions of BOEMRE to move forward with the completion of the SEIS for the Western Planning Area that will allow for a lease sale to be held in that Planning Area later this year. Furthermore, IAGC supports BOEMRE's conclusion that their analysis of information made available since the completion of the Multisale EIS and the 2009-2012 Supplemental EIS and the consideration of the Deep Water Horizon event has not resulted in any substantial differences that would alter the impact conclusions as presented in the Multisale EIS and the 2009-2012 Supplemental EIS for a Western Planning Area (WPA) lease sale.

Specific Comment

IAGC-1

In Section 3.1.1.1.1 of the draft SEIS (and possibly other areas), seismic operations are generally described as "towed streamer" operations. While towed streamer operations are a significant part of the seismic operations occurring in the Western Planning Area – as well as the other planning areas of the Gulf of Mexico – there are other types of technologies used to acquire seismic data. Specifically, ocean bottom systems are used in shallow water, areas where towed streamer operations are impractical because of existing structures or in acquiring 4D seismic to aid in reservoir management.

Accordingly, IAGC recommends that BOEMRE incorporate the following text in the draft SEIS, Section 3.1.1.1.1, second paragraph, after the third sentence:

> In shallow water, areas of dense infrastructure or in 4D seismic to aid in reservoir management, ocean bottom systems (OBS) may be deployed instead of streamers. This methodology utilizes hydrophones placed statically on the seafloor. The energy source (airgun arrays) remains the same as streamer methods, and is towed behind a source vessel.

Summary

IAGC-2

IAGC supports the conclusions presented in the draft SEIS and urges BOEMRE to devote all of the necessary resources (time and personnel) to complete the SEIS for the Western Planning Area in the most expeditious time possible – without compromising the integrity of the process – and to hold a Western Gulf of Mexico lease sale later this year.

On behalf of IAGC and the geophysical industry, thank you for the opportunity to provide you with these comments.

Sincerely,

WRRosenbusch

Walt Rosenbusch, Vice President – Projects & Issues

cc: Chip Gill, IAGC President
Sarah Tsoflias, Vice President – Marine Environment
IAGC Americas Offshore Committee Chairman
IAGC Americas Offshore Committee Members

IAGC-1 A paragraph was added to **Chapter 3.1.1.1.1** to describe the use of ocean bottom systems to acquire seismic data.

IAGC-2 Comment noted. The decision on which alternative will be selected will be made after this Supplemental EIS is finalized and, if the decision is to hold a lease sale under either Alternative A or B, it will be announced in the Final Notice of Sale.

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June 3, 2011

Via Email

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Dear Mr. Goeke:

Oceana respectfully submits the following comments on the Draft Supplement Environmental Impact Statement ("SEIS") for the Western Gulf of Mexico Planning Area Lease Sale 218, prepared by the Bureau of Ocean Energy Management, Regulation, and Enforcement's ("BOEMRE"). Oceana has a number of concerns pertaining to the lack of sufficient consideration of a number of issues in the Draft SEIS that prevents the SEIS from fulfilling the requirements of the National Environmental Policy Act ("NEPA"). All of these concerns must be addressed by BOEMRE in the Final SEIS for Lease Sale 218 in order to meet NEPA requirements. The following list summarizes the problems (each of which is discussed at length below) with the Draft SEIS that must be addressed by BOEMRE in the Final SEIS. Each of these shortcomings, if not addressed, would prevent the SEIS from fulfilling NEPA requirements and thus violate those requirements.

Summary of Problems

I. Overarching problems with the Draft SEIS
   a. The SEIS does not fulfill the stated purposed and need of the proposed action, specifically reducing the nation's dependence on foreign oil and gas.
   b. The SEIS does not consider two alternatives that would fulfill the stated purpose and need of the proposed action and that are necessary to provide a clear basis for a choice.
   c. The SEIS is woefully inadequate in providing information regarding the impacts of the Deepwater Horizon oil spill on Gulf of Mexico resources, which is necessary to accurately determine baseline conditions in the Gulf of Mexico and to consider the impacts of another catastrophic oil spill.
   d. The SEIS fails to adequately consider issues related to climate change throughout the document. In particular, the SEIS fails to adequately address:
      i. greenhouse gas emissions resulting from the proposed action,

ii. environmental impacts of the proposed action in light of ongoing climate change,
iii. ocean acidification,
iv. exacerbation of the Gulf hypoxic zone vis-à-vis climate change, and
v. other environmental impacts of climate change.

e. The SEIS relies upon an insufficiently-detailed and outdated oil spill risk analysis that underestimates the risks of oil spills of all sizes, and particularly those of catastrophic sizes. Consequently, the SEIS underestimates potential environmental impacts from oil spills and, by extension, the proposed action.

f. The SEIS fails to account for significant shortcomings in the oil industry's spill cleanup and response capabilities that were previously unknown but amply demonstrated during the Deepwater Horizon spill.

II. Problems in the catastrophic spill impact analysis on biological resources (Appendix B)

a. The SEIS's discussions (in Appendix B) of potential impacts that catastrophic oil spills would have on specific groups of species are insufficient in many ways. Broadly, the SEIS:

i. contains multiple knowledge gaps, some of which have already been filled by published research pertaining to the impacts of the DWH spill, that limit a complete analysis of environmental impacts from another catastrophic spill;
ii. fails to consider many potential effects of catastrophic oil spills, like those on behavior, reproduction, growth, and development, that are necessary for a comprehensive analysis of risk to biological systems;
iii. fails to consider all life stages of affected species;
iv. fails to consider population level effects of sublethal impacts such as malnourishment, particularly in the context of already-weakened populations from the DWH spill; and
v. fails to consider potential impacts of a catastrophic oil spill on critical habitats in the Western Gulf of Mexico, such as turtle nesting sites, coral reefs, the Flower Garden Banks National Marine Sanctuary, and Padre Island National Seashore.

The SEIS also contains multiple shortcomings in each of its impact analyses for groupings of species, e.g. sea turtles. All of these issues violate NEPA by preventing the SEIS from providing a full and fair discussion of the proposed action's potential environmental impacts.

Detailed Description of Problems

I. OVERARCHING PROBLEMS WITH THE DRAFT EIS

A. Purpose and Need

OCE-1

The purpose and need section of an EIS should determine the universe of alternatives an agency must consider. In this section, an agency must "specify the underlying purpose and need to which the agency is responding" (40 C.F.R. § 1502.13). BOEMRE states that "[t]he need for the proposed action is to further the orderly development of OCS resources" (SEIS 1-3), partly fulfilling the mandate set forth by the Outer Continental Shelf Lands Act ("OCSLA") that states: "the outer Continental Shelf is a vital national resource reserve … which should be made available for expeditious and orderly development … in a manner which is consistent with the maintenance of competition and other national needs" (43 U.S.C. § 1331(3)).

While the SEIS's proposed action, namely Lease Sale 218, would arguably promote expeditious and orderly development of the nation's offshore resources, it fails to do so in a manner that maintains competition and achieves other important national needs. Specifically, BOEMRE suggests that the underlying need Lease Sale 218 is meant to address is reducing our dependence on foreign oil and gas (SEIS 1-3), which may be considered a national need. However, as discussed below, Lease Sale 218 would not appreciably reduce the nation's long-term dependence on foreign oil or gas.

1. Crude Oil

BOEMRE implies that the need for the orderly development of Outer Continental Shelf ("OCS") oil resources is to "reduce the Nation's need for oil imports and lessen a growing dependence on foreign oil" (SEIS 1-3). However, increasing domestic drilling will have no substantive impact on the nation's dependence on foreign oil and the SEIS gives no evidence that it would. Rather, the only way to significantly decrease our nation's dependence on foreign oil is to fundamentally alter our relationship with oil. Such a fundamental shift requires the phase-out of oil-derived products, like gasoline and diesel, and replacement with alternative sources of energy, like non-oil-dependent electricity and advanced biofuels, as discussed below.

By contextualizing the total amount of oil projected to be produced as a result of Lease Sale 218 within overall U.S. oil demand, which the SEIS does not do, it becomes apparent that Lease Sale 218 will not appreciably diminish oil imports. BOEMRE estimates between 0.222 and 0.423 billion barrels of oil ("BBO") will be developed due to Lease Sale 218 (SEIS 1-4). At a nationwide consumption rate of 19.5 million barrels of oil per day ("bpd"), as was the case in 2008 (*id.* 1-3), the oil developed as a result of Lease Sale 218 would satisfy the nation's oil demand for only 11 to 22 days, or between 3% and 6% of *one year's* oil consumption. Worse, the nation's oil consumption will only continue to grow,[1] meaning years from now when the oil is brought to market, it will satisfy even less of the nation's demand. Thus, this lease sale will have a negligible impact on our nation's dependence on foreign oil.

[1] "Annual Energy Outlook 2011: Table 11 – Liquid Fuels Supply and Disposition." *EIA*. 26 Apr 2011.

OCE-1 (continued)

Considering Lease Sale 218 as one part in the broader development of all oil resources in the Gulf of Mexico still does not appreciably "reduce the Nation's need for oil imports and lessen a growing dependence on foreign oil" (SEIS 1-3). The EIA's most recent estimate in 2009 stated that proved oil reserves in the Gulf of Mexico amount to 4 billion barrels.[2] Assuming all of this oil is developed in 2025 (a reasonable timeline given the long lag between leasing and production), when U.S. oil consumption is projected by the EIA to reach 21 million bpd,[3] it would satisfy U.S. demand for only half a year. In other words, even if all the proven oil reserves in the Gulf of Mexico were developed, they would provide only a drop in the bucket of long-term U.S. oil demand. Only by shrinking the size of the bucket, i.e. U.S. oil demand, can oil imports truly be decreased.

The inability of offshore oil to appreciably change our dependence on foreign oil imports is the result of the small fraction of global oil reserves held by the United States. The U.S. possesses less than 2% of the world's oil reserves[4] yet it accounts for roughly 22% of world oil demand.[5] Clearly, a sizable gap exists between the nation's consumption and maximum possible production of oil. Increasing the nation's production, therefore, will have an extremely limited effect on oil imports, which fill the gap. In fact, the EIA has previously examined the impact increased domestic access to oil reserves would have on domestic oil production. Specifically, the agency examined the effect that opening the Pacific, Atlantic, and Eastern Gulf of Mexico regions to oil and gas development would have on domestic production. According to the EIA, these three regions hold roughly 20% of the nation's technically recoverable oil. Even so, developing these resources was found to increase domestic oil production by only 0.54 million bpd in 2030[6] – less than 3% of that year's projected oil consumption.[7] Imports would be offset by a similarly negligible amount. Therefore, rather than increasing production, policies and actions must decrease consumption in order to significantly close the gap and thereby decrease imports.

2. Natural Gas

With respect to natural gas, Lease Sale 218 is not necessary to decrease our nation's imports of natural gas, which are currently only 12% of total consumption (SEIS 1-3). It is estimated that Lease Sale 218 will lead to the development of 1.495 to 2.647 Tcf of natural gas (*id.* 1-4). Total offshore federal Gulf of Mexico dry gas reserves were estimated by the EIA at 12.6 Tcf in 2009.[8] This is compared to total U.S. dry natural gas reserves of 272.5 Tcf,[9] which does not even include shale gas, a

[2] "Gulf of Mexico Proved Reserves and Production by Water Depth." *EIA*. 30 Nov. 2010. http://www.eia.doe.gov/oil_gas/natural_gas/data_publications/crude_oil_natural_gas_reserves/cr.html.
[3] "Annual Energy Outlook 2011: Table 11 – Liquid Fuels Supply and Disposition." *EIA*. 26 Apr 2011.
[4] U.S. proved oil reserves: 20.682 billion bbl ("Table 7: Total U.S. Proved Reserves of Crude Oil." *EIA*. 30 Nov 2010. http://www.eia.doe.gov/pub/oil_gas/natural_gas/data_publications/crude_oil_natural_gas_reserves/current/pdf/table07.pdf). World proved oil reserves: 1,353.7 billion bbl ("International Energy Outlook 2010." *EIA*. July 2010. Table 5, Page 37).
[5] In 2009, U.S. and world oil demand was 18.771 and 84.337 million bpd, respectively ("December 2010 International Petroleum Monthly: Table 1.7." *EIA*. Jan 2011).
[6] "Impact of Limitations on Access to Oil and Natural Gas Resources in the Federal Outer Continental Shelf." *EIA*. Mar 2009. http://www.eia.doe.gov/oiaf/aeo/otheranalysis/aeo_2009analysispapers/aongr.html.
[7] Total oil consumption in 2030 is projected by the EIA under business as usual to be 21.36 million bpd. Source: "Annual Energy Outlook 2011: Table 11 – Liquid Fuels Supply and Disposition." *EIA*. 26 Apr 2011.
[8] "Dry Natural Gas Proved Reserves, Reserves Changes, and Production, 2009." *EIA*. 30 Nov. 2010. http://www.eia.doe.gov/pub/oil_gas/natural_gas/data_publications/crude_oil_natural_gas_reserves/current/pdf/table09.pdf.
[9] *Id.*

rapidly-growing reserve of natural gas currently estimated at 60 Tcf. Thus, federal offshore natural gas resources currently represent only a tiny fraction of the nation's total reserves. With respect to production, statistics from February 2010 to 2011 show that average natural gas production from federal offshore Gulf of Mexico was only 8% of total U.S. gas production.[10] This figure will likely decrease as shale gas resources are further explored and developed, and this amount of natural gas production could furthermore be replaced in its entirety without increasing imports by already-accelerating shale gas development or, better yet, through adoption of renewable energy, like wind turbines or solar panels. Consequently, no need exists to exploit the natural gas resources targeted by Lease Sale 218.

B. Alternatives Analysis

OCE-2

The purpose of an EIS is to "rigorously explore and objectively evaluate all reasonable alternatives" to the proposed action (40 C.F.R. § 1502.14(a)). That discussion of alternatives "is at the heart of the [EIS]" and should provide "a clear basis for choice among options by the decisionmaker and the public" (*id.* § 1502.14). As discussed below, the SEIS fails to provide such a clear basis for decision making because it does not consider two reasonable alternatives, specifically increasing renewable energy and conservation or delaying the lease sale until impacts of the Deepwater Horizon oil spill are completed. An increase in renewable energy and conservation would fulfill the proposed action's need and reduce oil and gas imports more effectively and efficiently than the proposed action. A delay of the lease sale would have no appreciable effect on its ability to achieve the stated need of the proposed action and allow for a

1. Renewable Energy and Conservation Alternative

As previously discussed, while the stated need for the proposed action is to decrease the nation's reliance on foreign oil and gas, the proposed action is not necessary to eliminate gas imports and would have a negligible long-term impact on foreign oil dependence. Indeed, our dependence on foreign oil will persist as long as the nation's transportation fleet, which accounts for the majority of oil consumption,[11] relies almost exclusively on gasoline and diesel. Thus, to reduce our imports on foreign oil, the nation's transportation fleet must shift away from gasoline and diesel. Yet no such alternative is considered in the SEIS, a significant oversight. Such an alternative, which could include expedited adoption of electric vehicles, expansion of public transit, and research, development, and deployment of alternative fuels, must be considered in order for the SEIS to provide "a clear basis for choice among options by the decisionmaker and the public" (40 C.F.R. § 1502.14). Until this alternative is included, the SEIS cannot be viewed as complete.

2. Delay the Lease Sale until Adequate Impact Assessments of the Deepwater Horizon Oil Spill are Completed and Can be Fully Considered

OCE-3

According to BOEMRE, the SEIS "is being prepared because of the potential changes to baseline conditions of the environmental, socioeconomic, and cultural resources that may have

[10] "Gross Withdrawals of Natural Gas." *EIA*. 29 Apr. 2011. http://www.eia.gov/oil_gas/natural_gas/data_publications/eia914/eia914.html.
[11] "Annual Energy Outlook 2011: Table 11 – Liquid Fuels Supply and Disposition." *EIA*. 26 Apr 2011.

OCE-3 (continued)

occurred as a result of (1) the *Deepwater Horizon* (DWH) event … [and] (2) the acute impacts that have been reported or surveyed since that time" (SEIS 1-3). However, as stated multiple times throughout the SEIS itself, insufficient information currently exists to determine the extent to which the Deepwater Horizon ("DWH") spill altered baseline conditions in the Gulf (e.g., "[t]he best available information does not provide a complete understanding of the effects of the spilled [DWH] oil and active response/cleanup activities on the affected marine mammal environment" (SEIS 4-139), "[t]he actual effects of the DWH event on fish populations are unknown at this time" (*id.* 2-16), "[t]here is a great deal of uncertainty regarding the long-term impacts of a catastrophic spill [like the DWH] in the Gulf of Mexico" (*id.* B-40)).

An EIS must "provide full and fair discussion of significant environmental impacts" (40 C.F.R. §1502.1). The lack of available data on the environmental impacts of the Deepwater Horizon spill prohibits a full and fair discussion of significant environmental impacts, invalidating the SEIS. Delaying the completion of the SEIS until adequate data pertaining to the impacts of the DWH spill has been gathered and fully considered in the context of this lease sale is necessary to rectify this problem as it is the only way to allow the full and complete analysis of environmental impacts from Lease Sale 218.

Delaying Lease Sale 218 by a year or more would have no impact on short-term domestic oil production given the long time lag between leasing and production. It would also have no appreciable impact on the nation's long-term dependence on foreign oil for two reasons. As discussed above, any increase in domestic oil production will have a negligible impact on the quantity of foreign oil imports, so delaying increased oil production would similarly have a negligible impact. Additionally, in March 2011 the Department of the Interior found that 70% of the Undiscovered Technically Recoverable Resources leased in the Gulf of Mexico were not being explored or developed.[12] This demonstrates that even if the sale proceeds, it could be many years before exploration and development begins on auctioned blocks. Without necessarily affecting the delivery time of any potential product, a delay of Lease Sale 218 would allow for adequate analysis of environmental impacts, while exploration and development of idle leases could still proceed.

C. Incomplete Information

OCE-4

According to BOEMRE, the SEIS "is being prepared because of the potential changes to baseline conditions of the environmental, socioeconomic, and cultural resources that may have occurred as a result of (1) the *Deepwater Horizon* (DWH) event … [and] (2) the acute impacts that have been reported or surveyed since that time" (SEIS 1-3). However, as stated multiple times throughout the SEIS, insufficient information exists to determine the extent to which the Deepwater Horizon ("DWH") spill affected Gulf resources. Consequently, the SEIS fails its mandate to "provide full and fair discussion of significant environmental impacts" (40 C.F.R. § 1502.1).

The lack of necessary information to gauge the impact of the DWH spill on Gulf resources is a systemic problem in the SEIS. The following list of direct quotes from the SEIS highlights just some of the places in the SEIS where it acknowledges insufficient information exists.

[12] "Oil and Gas Lease Utilization – Onshore and Offshore." *U.S. Department of the Interior*. Mar 2011.

- The actual effects of the DWH event on fish populations are unknown at this time, and the total impacts are likely to be unknown for several years (2-16, 4-181).
- Many of the long-term impacts of the DWH event to low-income and minority communities are unknown (2-23).
- A survey of major oil-spill events in the past indicates that the long-term effects of an oil spill on human health and the environment, are still unknown (4-16).
- How assemblages of fish have changed or will change as a result of the DWH event is unknown at this time (4-174).
- The effects of the DWH event on the population levels of each of these species [of fish] are unknown at this time (4-185).
- Longitudinal epidemiological studies of possible long-term health effects from exposure to either the DWH event's oil or dispersants, such as the possible bioaccumulation of toxins in tissues and organs, are lacking and the potential for the long-term human health effects are largely unknown (although the National Institutes of Health has proposed such a study) (4-256).
- The best available information does not provide a complete understanding of the effects of the spilled oil and active response/cleanup activities on marine mammals [and their environment] (4-134, 139, 140, 292, 293).
- The best available information does not provide a complete understanding of the effects of the spilled oil and active response/cleanup activities on sea turtles and their environment (4-146, 147, 149).
- The best available information does not provide a complete understanding of the effects of the spilled oil and active response/cleanup activities on the affected coastal and marine bird environment (4-164, 172).

By not including this vital information, the SEIS violates 40 C.F.R. § 1502.22, which states that "[i]f the incomplete information … is essential to a reasoned choice among alternatives and the overall costs of obtaining it are not exorbitant, the agency shall include the information in the environmental impact statement." As discussed below, complete information pertaining to the impacts of the DWH spill is essential to adequately establish two crucial aspects of the SEIS: baseline conditions of Gulf resources and potential environmental impacts of another catastrophic oil spill. Baseline conditions of Gulf resources must be established in order to assess what damage environmental impacts resulting from Lease Sale 218 will have. Similarly, understanding the environmental effects of the DWH spill would greatly improve the SEIS's impact assessment of another catastrophic spill, a discussion currently so riddled with knowledge gaps as to render it largely meaningless. Both pieces of information, i.e. baseline conditions and impacts of future catastrophic spills, would greatly inform decision-making by illuminating otherwise-unknown environmental impacts of the proposed action, which are necessary to "provide full and fair discussion of environmental impacts" (40 C.F.R. § 1502.1).

Notably, collecting the missing data would not impose exorbitant costs on the government. Many studies are ongoing, including a formal natural resource damage assessment, and funding has been made available by BP and other institutions for scientific analysis of the spill's impacts. Indeed, many effects, such as the widespread loss of eggs or juveniles of a given species from hydrocarbon exposure, may not manifest themselves for months or years but, when they do, must be measured and considered. Thus, since the information necessary to gauge the impact of the DWH spill "is essential to a reasoned choice among alternatives and the overall costs of obtaining it are not exorbitant" (40 C.F.R. § 1502.22), BOEMRE must include the information in its SEIS. Because BOEMRE currently fails to do so, the SEIS cannot be deemed complete, and must include such information in order to fully comply with NEPA.

1. Baseline Conditions

OCE-5

Without understanding how Gulf resources were affected by the DWH spill, it is impossible to determine their baseline conditions, which are necessary to judge what effect future impacts could have. Because of their significance, without establishing baseline conditions, a "full and fair discussion of significant environmental impacts" (*id.*) cannot be had.

The discussion within the SEIS of bluefin tuna provides an excellent example of the gaps in knowledge of the DWH spill's impacts exhibited throughout the SEIS, as well as the import of these gaps. Bluefin tuna populations, as noted in the SEIS, have declined significantly in the western Atlantic, and attempts to rebuild the populations have heretofore failed. As a result, the Atlantic bluefin tuna has been classified as a "species of concern" under the Endangered Species Act by NOAA.[13] Given the imperiled nature of this species, it is possible even small impacts from the DWH spill had/will have great population-level effects. Any such effects would make Atlantic bluefin tuna populations more susceptible than is currently thought to environmental impacts from Lease Sale 218. Determining the status of bluefin tuna is therefore extremely important in ensuring the continued viability of the population and understanding the potential effects of the sale.

While efforts are ongoing to this end, no definitive conclusions have been reached. The SEIS notes in regard to the Gulf stock of Atlantic bluefin tuna, "[t]he effects [of the DWH spill] at this time are, however, unknown" (4-175). This lack of information is particularly alarming considering that, as stated in the SEIS, "[b]ecause of their decline in stock, the timing of their spawn in the Gulf, their buoyant eggs, and the timing of the DWH event, there is concern about further decline in the Gulf stock of bluefin tuna" (*id.*). In other words, there is every reason to believe that the already-imperiled Gulf bluefin tuna stock was significantly impacted by the DWH spill, placing it in even greater danger of extinction. But how and to what extent the population was impacted is unknown. Consequently, it is impossible to determine the current state of the bluefin tuna population to a high degree of confidence. It will not be possible to judge the effects of Lease Sale 218 on the population until additional studies are completed.

This situation, while particularly alarming, is by no means unique to bluefin tuna. As previously listed, numerous deficiencies in the understanding of the DWH spill's impacts on various resources exist throughout the SEIS. Until such deficiencies are addressed, the SEIS cannot be deemed complete.

2. Catastrophic Oil Spill Impacts

OCE-6

The environmental impacts of a future catastrophic oil spill and, by extension, Lease Sale 218 have not been fully considered in the SEIS. The DWH spill was the largest offshore oil spill in the

[13] "Endangered Species Listing for Atlantic Bluefin Tuna Not Warranted." *NOAA*. 27 May 2011. http://www.noaanews.noaa.gov/stories2011/20110527_bluefintuna.html.

OCE-6 (continued)

United States. As a result, it provided a unique opportunity to collect data on the environmental impacts of catastrophic oil spills, but those data are still being collected and analyzed. Because data collection and analysis is ongoing, it is too soon to fully assess the impacts of a catastrophic spill. Therefore, any SEIS purporting to do so is necessarily insufficient.

BOEMRE attempts to assess the environmental impacts of catastrophic oil spills in Appendix B of the SEIS. However, because of the significant shortcomings in the understanding of the environmental impacts of the DWH spill (as described above and acknowledged in the document itself), the analysis in Appendix B is inadequate and riddled with knowledge gaps. For instance, Appendix B states that "[t]he best available information does not provide a complete understanding of the effects of the spilled oil and active response/cleanup activities on marine mammals" (SEIS B-19), and that "[l]ongitudinal epidemiological studies of possible long-term health effects from exposure to either the DWH event's oil or dispersants, such as the possible bioaccumulation of toxins in tissues and organs, are lacking and the potential for the long-term human health effects are largely unknown (although the National Institutes of Health has proposed such a study)" (*id.* B-47).

Because Lease Sale 218 has the potential to cause catastrophic oil spills, any full and fair discussion of the environmental impacts of Lease Sale 218 must contain a full and fair discussion of the environmental impacts of catastrophic oil spills. Such a discussion is not yet possible due to insufficient data, as frequently stated within Appendix B. Until additional data are collected concerning the environmental impact of the DWH spill, which will strengthen the understanding of the environmental impacts of catastrophic oil spills, the SEIS cannot be deemed adequate, and Lease Sale 218 cannot take place.

D. Climate Change

OCE-7

Climate change is a global phenomenon that will have significant environmental and economic impacts around the world, including in the Gulf of Mexico.[14] Given the magnitude and diversity of impacts posed by climate change, the SEIS's discussion of it falls woefully short. Specifically, the SEIS's discussion of climate change violates NEPA because the SEIS fails to (1) inventory greenhouse gas ("GHG") emissions resulting from the proposed action, Lease Sale 218, (2) take a "hard look" at the environmental impacts of the proposed action in the context of ongoing climate change, (3) consider the potential contribution of Lease Sale 218 to and the environmental impacts of ocean acidification, (4) consider the exacerbation of the Gulf hypoxic zone vis-à-vis climate change by Lease Sale 218, and (5) adequately consider the remaining potential environmental impacts of climate change.

[14] E.g., (1) M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (eds). *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007.* Cambridge University Press, New York, NY, USA.
(2) "Building a Resilient Energy Gulf Coast." *Entergy Corporation.* 20 Oct 2010. http://www.swissre.com/rethinking/climate/Building_a_resilient_Energy_Gulf_Coast.html.

1. Inventory of Greenhouse Gas ("GHG") Emissions

The SEIS violates NEPA by failing to quantify GHG emissions that would result from Lease Sale 218. Lease Sale 218 leads to the generation of GHG emissions directly, via activities related to exploration, development, transportation of product and product processing, as well as indirectly, via the combustion of the oil and gas extracted as a result of the lease sale. In neither case does the SEIS quantify emitted GHGs, which contribute to climate change.[15]

The omission of GHG accounting prohibits the SEIS from "providing a full and fair discussion of environmental impacts" (40 C.F.R. § 1502.1) because climate change could have significant impacts on the Gulf of Mexico. The SEIS itself notes that "[g]lobal climate change can increase surface temperature, increase sea levels, and increase storm events" (4-77), all of which could have profound impacts on resources in the Gulf. For instance, the SEIS states that "[s]everal studies highlight the potentially disastrous effects of future hurricane storm-surge enhanced by sea-level rise on coastal communities" (4-262). It also finds that "a rise in sea level [as expected to occur by 2100 by recent climate change projections] would cause unprotected shorelines to migrate inland" (*id.*). According to the SEIS, climate change would also affect foraging areas and nesting beaches of hawksbills (4-142) and Kemp's ridleys (4-143), and threaten sperm whale populations via loss of prey base (4-135).

The above list of environmental impacts from climate change is not intended to be exhaustive (and indeed is not nearly so), but to merely point out that BOEMRE itself recognizes climate change may significantly impact the Gulf. Yet, the SEIS fails to connect these and other climate change-induced threats to GHGs, which have a cumulative impact on climate change. An EIS must "consider the cumulative impact of the proposed action" (*Kern v. US Bureau of Land Management*, 284 F.3d 1062,1076 (9th Cir. 2002)). GHGs accumulate in the atmosphere and ultimately cause climate change. As "individually minor but collectively significant actions taking place over a period of time" (40 C.F.R. §1508.7), GHGs definitively qualify as cumulative impacts, and so "[t]he impact of greenhouse gas emissions on climate change is precisely the kind of cumulative impacts analysis that NEPA requires agencies to conduct" (*Center for Biological Diversity v. NHTSA*, 538 F.3d 1172,1217 (9th Cir. 2008)). Thus, the SEIS's failure to account for and consider the cumulative impacts of GHGs is a violation of NEPA.

Furthermore, the calculation of GHG emissions as a result of the lease sale is not a difficult task. Emissions factors are readily available from the U.S. Environmental Protection Agency and Energy Information Administration for the combustion of crude oil and natural gas in various applications, including transportation and electricity generation. The ready availability of these emissions factors in conjunction with the SEIS's estimates of oil and gas resources that would be developed as a result of Lease Sale 218 make the calculation of GHG emissions from combustion relatively straightforward. The following calculation done by Oceana is only meant to illustrate the ready availability of the necessary data, and by no means should be considered a sufficiently detailed analysis for inclusion in the SEIS. A sufficiently detailed analysis would take into account all GHGs and black carbon, not just CO_2, and divide the developed resources by their intended use, e.g. for transportation versus electricity.

[15] Core Writing Team, Pauchauri, R.K., and A. Reisinger (eds.). *Contribution of Working Groups I, II, and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007.* IPCC, Geneva, Switzerland.

Table 1: Projected emissions of CO_2 from the combustion of oil and gas resources that would be developed as a result of Lease Sale 218.

Resource	**CO_2 Emissions Factor[a]**	**Reserves Estimate[b]**	**CO_2 Emissions Estimate (million metric tons CO_2)**
Crude Oil	0.43 metric tons CO_2 per barrel oil	0.222 billion barrels	95.46
		0.423 billion barrels	181.89
Natural Gas	120,000 lb CO_2 per 10^6 scf gas	1.495×10^{12} scf	81.4
		2.647×10^{12} scf	144.12
		Total CO_2 Emissions (Low):	**176.86**
		Total CO_2 Emissions (High):	**326.01**

[a] Emissions factors estimated by the EPA.[16]
[b] See SEIS 1-4.

Routine activities would also emit significant amounts of GHGs that must be quantified. Some routine activities, e.g. service vessels trips and helicopter operations, have already been projected by BOEMRE in Table 3-2 of the SEIS (A-25). However, when calculating emissions from routine activities, a "cradle-to-grave" approach must be taken in determining what qualifies as a routine activity. In other words, routine activities at all stages of oil and gas production, from exploration to development to transportation to refining, must be quantified and the resulting GHG emissions calculated because activities at all stages would be the result of Lease Sale 218 and have potentially significant environmental impacts. Only by summing these emissions with those resulting indirectly from Lease Sale 218 (i.e., from combustion of developed oil and gas) can the SEIS fully account for the potential environmental impacts of Lease Sale 218 and therefore comply with NEPA.

2. Environmental Impacts in the Context of Ongoing Climate Change

As previously documented, climate change is projected to have significant environmental impacts on the Gulf of Mexico. These impacts stem from a variety of consequences of climate change, including ocean acidification, rising sea levels, and increased water temperature. While the most severe impacts from climate change are projected to occur mid to late century, some impacts are already occurring today.[17] As they worsen, these impacts will increasingly alter the environment of the Gulf of Mexico, which could stress biological populations. Further stress, in turn, could weaken the resilience of populations, which would make them more susceptible to the environmental impacts from

[16] Crude oil emissions factor: "Green Power Equivalency Calculator Methodologies." *EPA*. Apr 2011. http://www.epa.gov/greenpower/pubs/calcmeth.htm.
Natural gas emissions factor: "AP-42, Vol. 1, CH1.4: Natural Gas Combustion." *EPA*. July 1998. Page 1.4-6, Table 1.4-2. http://www.epa.gov/ttn/chief/ap42/ch01/final/c01s04.pdf.
[17] M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (eds). *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007.* Cambridge University Press, New York, NY, USA.

Lease Sale 218. The SEIS, however, neglects to consider such changes to baseline conditions of biological resources. Consequently, it also fails to consider the impacts of Lease Sale 218 on biological populations in the context of altered, i.e. worsened, baseline conditions. Such an analysis must be conducted for the SEIS to truly take a "hard look" at the environmental impacts of the proposed action and thereby comply with NEPA.

3. Environmental Impacts of Ocean Acidification

The SEIS fails to mention or discuss ocean acidification despite the significant threat it poses to Gulf of Mexico resources. Ocean acidification is driven by the dissolution of atmospheric CO_2 into seawater; approximately one third of anthropogenic CO_2 emissions are projected to be stored in the oceans.[18] As atmospheric CO_2 concentrations increase, more CO_2 dissolves into the oceans, lowering its pH. Detrimental effects of decreased pH include lower fertilization rates, respiratory stress, behavioral shifts, and inhibited calcification.[19] Consequently, activities that generate carbon dioxide exacerbate ocean acidification and so qualify as cumulative impacts, since they are "individually minor but collectively significant actions taking place over a period of time" (40 C.F.R. §1508.7). As previously discussed, NEPA demands cumulative impacts be analyzed. Since Lease Sale 218 would lead to the emission of CO_2 but does not analyze the cumulative impacts of these emissions via ocean acidification, the SEIS violates NEPA and will continue to until such an analysis is conducted.

4. Exacerbation of Gulf of Mexico Dead Zone by Climate Change

The Gulf of Mexico dead zone, estimated to have been the size of New Jersey at 7,722 square miles in 2010,[20] is one of the largest in the world. Dead zones are areas of hypoxic water, where insufficient oxygen exists to sustain most life. Hypoxic conditions are caused by an influx of excess nutrients, which typically originate from runoff containing nitrogen and phosphorus from agricultural fertilizers. Excess nutrients lead to phytoplankton blooms that die and are decomposed by bacteria in a process that consumes oxygen. When blooms are especially large, as when in the presence of excess nutrients, oxygen becomes so depleted that its aqueous concentration decreases below life-sustaining levels, killing and altering the distribution of fish, benthic marine species, and other marine life.

Climate change is expected to exacerbate the dead zone in the Gulf of Mexico through various mechanisms. Increased precipitation due to climate change in the Mississippi River watershed is expected to increase the river's discharge to the Gulf of Mexico, which would increase nutrient influxes to the region and exacerbate the dead zone.[21] Increased surface water temperatures due to atmospheric warming are enhancing stratification of ocean layers, which decreases mixing between layers and could also strengthen and/or expand dead zones.[22] Finally, increased aqueous CO_2 concentrations due to fossil fuel emissions are expected to increase acidity, which will in turn increase

[18] Sabine, C., *et al.* 2004. The oceanic sink for anthropogenic CO_2. *Science*, **305**(5682):367-371.
[19] Harrould-Kolieb, E., and J. Savitz. "Acid Test." *Oceana*. June 2009.
[20] "NOAA-Supported Scientists Find Changes to Gulf of Mexico Dead Zone." *NOAA*. 9 Aug 2010. http://www.noaanews.noaa.gov/stories2010/20100809_deadzone.html.
[21] Justic, D., Rabalais, R. Turner, R.E. 1997. Impacts of climate change in net productivity of coastal waters: implications for carbon budgets and hypoxia. *Climate Research*, **8**:225-237.
[22] Diaz, R. J. and Rosenberg, R. 2008. Spreading dead zones and consequences for marine ecosystems. *Science*, **321**: 926-929.

baseline respiratory stress on organisms, lowering their tolerance to depleted oxygen concentrations and increasing the threat such low-concentration regions like dead zones pose.[23]

5. Other Environmental Impacts of Climate Change

The SEIS does not sufficiently consider environmental impacts of climate change beyond those listed above. These additional environmental impacts include, but are not limited to, sea level rise, more severe and frequent storms, and increased water and atmospheric temperatures. Because Lease Sale 218 would contribute to climate change via direct and indirect GHG emissions (see above), the SEIS must consider the impacts climate change-related impacts would have on Gulf resources, but it only minimally engages in this discussion. For instance, it states simply that global climate change poses a threat to the future of Kemp's ridley sea turtles (SEIS 4-143); affects hawkbills in foraging areas and on nesting beaches (*id.* 4-142); decreases the prey base of sperm whales (*id.* 4-135); and affects seagrass beds by adding stress vis-à-vis increased surface temperature, sea levels, and storm events (*id.* 4-77). These considerations are very simplistic and do not consider in sufficient detail (e.g., by implementing regional climate forecast models) or breadth (e.g., by accounting for climate impacts at all life stages of development) the diverse array of potential impacts from climate change. In order to comply with NEPA by "provid[ing] full and fair discussion of significant environmental impacts" (40 C.F.R. §1502.1), the SEIS must fully consider the potential breadth and severity of climate change-related impacts.

E. Oil Spill Risk Analysis

OCE-8

The oil spill risk analysis of the SEIS, summarized in Table 3-5, fails to take into account that spill rates differ across drilling depths. Ultimately, this leads to an underestimation of the risk of large spills, i.e. greater than 1,000 barrels, and of the environmental impacts such spills would have.

The oil spill risk analysis used in the SEIS hinges on spill rates classified by spill size. The spill rates "were calculated based on the assumption that spills occur in direct proportion to the volume of oil handled" (SEIS 3-33). In other words, spill rates were calculated as the number of spills of a certain size that occur per billion barrels of oil handled/produced, pooling data across all other variables, e.g. drilling depth. For instance, Table 3-5 of the SEIS shows that the estimated spill rate for spills of size less than one barrel is roughly 3,400 spills per billion barrels of oil handled. Setting aside the fact that these spill rates have not been updated since 2000, an egregious oversight in and of itself, the methodology for calculating these spill rates is fundamentally flawed. As a result of the flaw, the SEIS underestimates the risk and corresponding environmental impacts of all spills, but particularly of large spills of greater than 1,000 barrels.

By categorizing spill rates by spill size only and not other variables, the SEIS and its spill risk analysis implicitly assumes that all produced oil has an equal spill risk. However, this is not true. Deepwater and ultra-deepwater wells pose significantly greater risks than shallow wells due to increased complexity and harsher environments, making deepwater operations inherently riskier

[23] Brewer, P.G., and Peltzer, E.T. 2009. Limits to marine life. *Science,* **324**: 347-348.

OCE-8 (continued)

operations.[24] As a result, one barrel of oil produced in deep water has a greater spill risk than one barrel of oil produced in shallow waters, in direct contradiction to the method employed by BOEMRE. Furthermore, the spill rate factors used in the SEIS's spill risk analysis are taken from a paper written in 2000,[25] when most historic oil and gas production had occurred in relatively shallow waters. In the years since, oil production has shifted to increasingly deeper waters, as shown in Table 2. Indeed, the SEIS projects that over half of all wells drilled as a result of Lease Sale 218 will be in waters deeper than 200 meters (SEIS Table 3-2). Thus, it is likely that spill rates for spills of all sizes, and consequently overall spill risk, for Lease Sale 218 are higher than for the 2000 values. Given the significant environmental impacts spilled oil poses, a recalculation of spill risks must be done in order to fully comply with NEPA.

Table 2: Crude oil production categorized by drilling water depth from 1992 to 2007, the most recent year data for which data is available. Source: EIA.[26]

Years	Crude Oil Production from Less than 200 Meters Deep (million bbl)	Crude Oil Production from Greater than 200 Meters Deep (million bbl)	Ratio of Crude Oil Production from Less than 200 Meters Deep to Greater than 200 Meters Deep
1992-1999	1694	834	2.03
2000-2007	1119	2390	0.47

In addition to an erroneously low overall spill risk, the SEIS significantly underestimates the risk of large oil spills, i.e. greater than 1,000 barrels. Given that Lease Sale 218 will lead to the drilling of many wells (see SEIS Table 3-5), well blowouts are a particularly relevant potential cause of spills that should be considered in a spill risk analysis. When analyzing spills from well blowouts using the SEIS's spill risk analysis methodology, though, two problems arise. First, because deepwater wells are located in harsher environments, controlling and stopping well blowouts can be more difficult. This fact was amply demonstrated during the DWH spill, when numerous techniques applicable in shallow waters failed to stop the flow of oil from the Macondo well due to unique deepwater conditions. Because blowouts in deep water tend to be harder to control or stop, once a blowout occurs oil will likely flow for a longer period of time than in shallow water. Consequently, the risk of a catastrophic oil spill is greater with deepwater drilling. Second, more oil is being produced in deep versus shallow water (see above) and drilling is occurring in increasingly deeper environments (for instance, average crude oil exploratory well depth was 1,899 meters between 1964 and 1999, the timeframe examined by Anderson and LaBelle, and 2,276 meters between 2000 and 2008[27]). As a result, the total potential for well blowouts and other events that could lead to a spill is greater. These two issues (i.e. spills from deepwater operations have a greater chance of being catastrophic and deepwater production is increasing in volume and depth) combine to substantially increase the risk of a catastrophic oil spill.

[24] E.g., "Deep Water: The Gulf Oil Disaster and the Future of Offshore Drilling." *National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling*. Jan 2011. Page vii.
[25] Anderson, C.M., and R.P. LaBelle. 2000. "Update of Comparative Occurrence Rates for Offshore Oil Spills." *Spill Science and Technology Bulletin*, **6**: 303-321.
[26] "Gulf of Mexico Federal Offshore Production." *EIA*. 30 Dec 2010. http://tonto.eia.gov/dnav/pet/pet_crd_gom_s1_a.htm.
[27] "Annual U.S. Average Depth of Crude Oil Exploratory Wells Drilled." *EIA*. 5 May 2011. http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=E_ERTWO_XWDE_NUS_FW&f=A.

Yet the SEIS's risk analysis methodology does not detect this rise in risk because it pools data across depths, obscuring the additional risks brought on by the increased prevalence of deepwater drilling. This is a significant shortcoming.

Not only are well blowouts likely to be more difficult to control in deepwater environments, a recent investigation commissioned by the Department of the Interior and conducted by Det Norske Veritas ("DNV") suggests blowout prevention capabilities may be much weaker than previously thought.[28] DNV conducted a forensic examination of the Deepwater Horizon's blowout preventer ("BOP"), which infamously did not prevent the Macondo well from blowing out. DNV found that the BOP failed to seal the well because the blind shear rams ("BSRs") failed to fully close. The failure of the BSRs, in turn, was attributed by DNV in part to the drill pipe elastically buckling within the wellbore "due to forces induced on the drill pipe during loss of well control" ("Report No. EP030842" 5). In other words, as stated by DNV, "[t]he elastic buckling of the drill pipe was a direct factor that prevented the BSRs from closing and sealing the well" (*id.* 6).

The disturbing conclusions of DNV show that all BOPs, not just the Deepwater Horizon's, may be flawed by design and therefore cannot be relied upon as a viable last line of defense in blowout prevention. Indeed, the high-pressure surge of oil and gas that accompanies loss of well control - exactly the type of event BOPs are supposed to defend against – can render BOPs ineffective. While DNV only investigated the BOP used by Deepwater Horizon, it is a standard design used widely in the deepwater drilling industry, and DNV concludes that the findings of its study should "be considered and addressed in the design of future Blowout Preventers and the need for modifying current Blowout Preventers" (*id.* 177). At this time, no extensive examinations have been conducted to verify the functionality of BOPs in operation across the Gulf of Mexico, meaning the actual chances of a well blowout and an ensuing large or catastrophic oil spill are much greater than is currently perceived. Despite this possible significantly increased risk of large and catastrophic oil spills, Lease Sale 218 gives no consideration to the findings of the DNV study nor to its ramifications. Given the significant environmental impacts of large and catastrophic oil spills (see Ch. II below), the SEIS must take into account the DNV study's findings in its spill risk analysis.

F. Spill Cleanup and Response Capabilities

OCE-9

If nothing else, the DWH spill clearly demonstrated how ill prepared the oil industry was – and still is - to respond to a well blowout and subsequent massive oil spill. At the time the 5-year 2007 Multisale EIS was drafted, MMS was ignorant of these shortcomings. Now, the industry-wide deficiencies in spill response and cleanup have been recognized, yet the SEIS finds that "no substantial new information… was found that would alter the impact conclusions as presented in the Multisale EIS and the 2009-2012 Supplemental EIS for a WPA lease sale" (SEIS x). The validity of this conclusion, though, is highly questionable given the significant cleanup capability shortcomings uncovered by the DWH spill.

The DWH event demonstrated numerous severe deficiencies in oil spill cleanup capabilities. Importantly, cleanup techniques employed during the DWH spill are employed industry-wide and

[28] "Report No. EP030842, Forensic Examination of Deepwater Horizon Blowout Preventer." *Det Norske Veritas*. 20 Mar 2011.

OCE-9 (continued)

would be the same techniques used in response to any other future spill in the Gulf. These methods include chemical dispersants, burning, boom, and skimming. Each technique suffered from significant problems: weather conditions prohibited burning on many days, boom was largely ineffective, chemical dispersants have still not been proven to be benign, and skimming vessels collected far less oil than they were rated for. These and other problems resulted in an anemic oil recovery rate; the federal oil budget calculator estimates only 24% of the spilled oil, or 1.2 million barrels, was either chemically dispersed, burned, or skimmed, while 23% of the oil was unaccounted for and between 52% and 75% of the oil remained in Gulf waters.[29] While the 2007 Multisale EIS estimates a similar amount of oil, 27%, would be cleaned up following a small spill resulting from a pipeline rupture in the Western Planning Area, it also estimates roughly 42% of this oil would be "naturally dispersed" (Vol. II Table 4-37). In other words, per the Multisale EIS's own estimate, 42% of the oil in a spill would have the potential to impact Gulf resources by, for instance, oiling beaches or coastal wetlands or dispersing into the water column. In the case of a large or catastrophic spill, this amount of oil would have a devastating effect on the local environment.

Failing to discuss the environmental implications of significantly-worse-than-expected cleanup capabilities, particularly in the event of another catastrophic spill, betrays the requirement that the SEIS "provide full and fair discussion of significant environmental impacts" (40 C.F.R. §1502.1). The SEIS must therefore reexamine environmental impacts from spills, both small and large, in light of deficient spill cleanup capabilities.

II. PROBLEMS IN THE CATASTROPHIC SPILL IMPACT ANALYSIS ON BIOLOGICAL RESOURCES (APPENDIX B)

A. Relevance of DWH Spill to SEIS

OCE-10

The Catastrophic Spill Event Analysis of the Western Planning Area Supplemental EIS, located at Appendix B, excludes credible scientific analysis on the impacts to marine life that occurred from the recent DWH spill. The SEIS ignores scientific studies produced after the DWH spill and, by not taking their findings into account, does not incorporate many foreseeable impacts of another catastrophic oil spill. The western region of the Gulf of Mexico being proposed for leasing and drilling has very similar levels of marine biodiversity and parallel characteristics to the area affected by the DWH spill. Given the relevance of the DWH disaster to this leasing process, it is necessary to consider all evidence pertaining to catastrophic oil spills to adequately understand the potential environmental impacts associated with offshore oil drilling in the Gulf of Mexico. Such evidence includes, but is not limited to, comprehensive ecosystem perspectives of spill impacts, current and ongoing research on the DWH spill, and longitudinal studies of previous catastrophic spills like the Exxon Valdez, much of which the SEIS ignores. The failure of the SEIS to consider the issues described below makes it highly deficient in "providing a full and fair discussion of environmental impacts" (40 C.F.R. § 1502.1), violating NEPA. In order to comply with NEPA, the final SEIS must therefore include the considerations detailed below.

[29] "Oil Budget Calculator: Deepwater Horizon." *The Federal Interagency Solution Group*. Nov 2010. Pages 39-40.

B. Section-Specific Problems of Appendix B, Section 3 ("Offshore Spill (Phase 2)")

The following list details the numerous shortcomings contained in Appendix B of the SEIS section-by-section, with particular emphasis placed on Section 3 of Appendix B, "Offshore Spill (Phase 2)" (SEIS B-11). Section headings below (e.g. "3.2.2.1 Marine and Migratory Birds") mirror those employed within Appendix B for ease of reference and comparison.

3.2.2.1 Marine and Migratory Birds

OCE-11

i) After the DWH spill there were graphic images of oil soaked pelicans, cormorants, and other seabirds washed up in the surf. These images were direct observations of the biological impacts of a catastrophic oil spill. As of November 2010, there have been over 8,000 birds collected near the DWH spill, many of which were oiled.

OCE-12

ii) The number of birds found dead near a catastrophic spill is likely a small subset of the total number killed by direct contact with oil. After the Exxon Valdez, 30,000 dead oiled seabirds were found on the beaches, but aerial surveys and population assessments estimated that 250,000 seabirds were killed by the oil, nearly ten times more.[30] Several populations of seabirds have not recovered more than 20 years since that catastrophic spill event.[31]

OCE-13

iii) Some larger birds, such as pelicans, can depart the affected area while partially covered in oil, leading to the underestimation of total bird fatalities due to the disaster. After the Exxon Valdez spill, about 88% of the total birds found dead were outside of Prince William Sound, where the spill was located.[32]

OCE-14

iv) While the short term impacts to bird deaths from direct contact with oil is easier to evaluate, the long-term impacts to bird populations can take years to decades to fully evaluate. Birds are top predators in the Gulf of Mexico and require a healthy supply of prey species to sustain their populations. The long term impacts of potential food stress for bird species throughout the Gulf of Mexico from an altered ecosystem are yet to be seen. Disturbances to the ecosystem can cause long-term sublethal impacts in birds such as malnourishment and decreased reproductive success, which can have severe impacts to bird populations as seen after the Exxon Valdez.[33]

3.2.2.2 Fish, Fisheries, and Essential Fish Habitat

OCE-15

i) Fish species are most vulnerable to an oil spill early in their life history at the egg and larval stages. The onset of the DWH disaster coincided with the spawning period (April and May) of one of the world's most valuable commercial fish species, which is also

[30] Piatt, J and P. Anderson. 1996. Response of Common Murres to the Exxon Valdez oil spill and long-term changes in the Gulf of Alaska marine ecosystem. *American Fisheries Society Symposium*, **18**: 720-737.
[31] *Id.*
[32] Piatt, J. Lnesink, L., Butler, W., Kendziorek, M., and D. Nysewander. 1996. Immediate impact of the Exxon Valdez oil spill on marine birds. *The Auk*, **107**: 387-397.
[33] Piatt, J and P. Anderson. 1996. Response of Common Murres to the Exxon Valdez oil spill and long-term changes in the Gulf of Alaska marine ecosystem. *American Fisheries Society Symposium*, **18**: 720-737.

OCE-15 (cont)

already threatened, the North Atlantic bluefin tuna. As seen in Figure 1, some of the highest quality habitat of North Atlantic bluefin tuna larvae was in the vicinity of the DWH oil spill and part of the 2010 year class was immediately lost by contacting the oil.[34] NOAA is continuing with research surveys of the area to determine the extent to which larvae were impacted by the oil and the dispersant used in response, and how this may affect recruitment for the already threatened North Atlantic bluefin tuna. The map on the left hand side of Figure 1 demonstrates the importance of the western Gulf of Mexico as critical habitat for North Atlantic bluefin tuna larvae.

OCE-16

ii) At the height of the DWH spill, 36% of federal waters in the Gulf of Mexico were closed to fishing, an area of 86,985 square miles (225,290 km²).[35] Figure 2 shows the area that was closed to fishing. Similar fisheries closures would be expected in a catastrophic spill in the western Gulf of Mexico, with deleterious economic impacts to Texas coast fisheries worth an estimated $117 million annually (SEIS 4-185).

3.2.2.3 Marine Mammals

OCEA-17

i) NOAA is currently investigating the cause of an Unusual Mortality Event (UME) for dolphins and whales in the northern Gulf of Mexico. While there were some dolphin mortalities just before the DWH spill in February 2010, the number has spiked post-spill, especially since November 2010.[36] A UME is defined under the Marine Mammal Protection Act as "a stranding that is unexpected; involves a significant die-off of any marine mammal population; and demands immediate response" (16 U.S.C. § 1421(h)(6)). According to NOAA's data on the UME in the Northern Gulf of Mexico from 2010 to 2011, there were 350 cetacean strandings (96 percent of which were dead upon stranding) from the beginning of the DWH spill on April 30, 2010, to May 15, 2011. Furthermore, a recent increase in strandings has occurred that has been particularly alarming due to the abnormally high number of premature, stillborn or neonatal dolphin carcasses (74 such carcasses were found between January and April 17, 2011).[37] These young dolphins were developing in their mother's wombs as the oil spill spread, and the timing of their appearance coincides with the expected time of birth of individuals conceived around the time of the spill. Whether the high number of dead young dolphins can be tied to the DWH spill and/or the dispersants used during spill response is still being investigated.

OCE-18

ii) The number of carcasses found is likely only a small fraction of the actual number of cetaceans killed from the DWH spill. Based on historical carcass detection rates in the

[34] "Bluefin Tuna Hit Hard by 'Deepwater Horizon' Disaster." *European Space Agency*. 26 Oct 2010. http://due.esrin.esa.int/news/news210.php.
[35] "FB10-055. BP Oil Spill: NOAA Modifies Commercial and Recreational Fishing Closure in the Oil-Affected Portions of the Gulf of Mexico." *NOAA*. 21 June 2010. http://sero.nmfs.noaa.gov/bulletins/pdfs/2010/FB10-055_BP_Oil_Spill_Closure_062110.pdf.
[36] "2010-2011 Cetacean Unusual Mortality Event in the Northern Gulf of Mexico." *NOAA Fisheries Office of Protected Resources*. 2011. http://www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico2010.htm.
[37] *Id.*

northern Gulf of Mexico for 14 cetacean species, the number of marine mammal deaths from the DWH spill may be 50 times higher than the number of located carcasses.[38]

3.2.2.4 Sea Turtles

OCE-19

i) The SEIS does not consider the full life history, habitats, range or sublethal impacts to which sea turtles are susceptible in a catastrophic spill. Sea turtles require sandy beaches as nesting spots. A catastrophic oil spill in the western Gulf of Mexico could threaten at least 17 known sea turtle nesting beaches and hundreds of clutches along the Texas coastline, including important nesting sites at Padre Island National Seashore, the longest stretch of undeveloped barrier island in the world,[39] for three of the six species of sea turtles in U.S. waters, namely the endangered Kemp's ridley and threatened populations of loggerhead and green sea turtles.[40]

OCE-20

ii) Along with nesting beaches, oil spills can be harmful to sea turtles by destroying important sea turtle habitat areas and reducing available prey.[41] Some important sea turtle habitats that can be impacted by oil include sargassum seaweed mats, sea grass beds and coral reefs. Declines in sea grass, as well as invertebrates and sponge populations, as a result of oil exposure reduce the available food supply to sea turtles.[42]

OCE-21

iii) An independent review by retired Coast Guard flag officers and government officials noted that the Coast Guard was unprepared to protect Environmentally Sensitive Areas ("ESAs") along the coasts from another spill of a similar magnitude as the DWH.[43] No laws have been passed to improve the response of the Coast Guard to protect ESAs, such as sea turtle nesting sites, in the case of another catastrophic oil spill. After the DWH spill, NOAA had to transfer 274 sea turtle nests to the eastern side of Florida to prevent the hatchlings from encountering oil.[44] Whether this was successful remains to be seen.

OCE-22

iv) The SEIS inaccurately depicts the range of sea turtles and claims the impacts to turtles would occur mostly in shallow water, minimizing the threats in the open ocean. Adult females will migrate from foraging areas to mainland or island nesting beaches and may

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[38] Williams, R., Gero, S., Bejder, L., Calambokidis, J., Kraus, S., Lusseau, D., Read, A., and J. Robbins. 2011. Underestimating the damage: interpreting cetacean carcass recoveries in the context of the Deepwater Horizon/BP incident. *Conservation Letters*, DOI:10.1111/j.1755-263x2011.00168x.
[39] "Sea Turtle Nesting Sites: OBIS-SEAMAP." *State of World's Sea Turtles (SWOT).* 2009. http://seamap.env.duke.edu/swot.
"Padre Island National Seashore." *National Park Service, U.S. Department of Interior*. 31 Mar 2011. http://www.nps.gov/pais/index.htm.
[40] "Sea Turtle Nesting Sites: OBIS-SEAMAP." *State of World's Sea Turtles (SWOT).* 2009. http://seamap.env.duke.edu/swot.
[41] Shigenaka, G. et al. "Oil and Sea Turtles, Biology, Planning and Response." *NOAA*. 2003. http://response.restoration.noaa.gov/book_shelf/35_turtle_complete.pdf.
[42] *Id.*
[43] "Final Action Memorandum: Incident Specific Preparedness Review (ISPR) of Deepwater Horizon Spill." *U.S. Department of Homeland Security, U.S. Coast Guard.* 18 Mar 2011. Page 20.
[44] "Number of Turtle Nests Translocated and Hatchlings Released in the Atlantic Ocean." *NOAA Fisheries Office of Protected Resources*. 19 Apr 2010. http://www.nmfs.noaa.gov/pr/health/oilspill/turtles.htm.

OCE-22 (cont)

travel hundreds or thousands of kilometers each way through the open ocean.[45] After emerging from the nest, hatchlings swim to offshore areas, where they are believed to live for several years, feeding close to the surface on a variety of pelagic plants and animals.[46] The SEIS downplays the impacts of an offshore catastrophic spill on essential habitat for turtles in the open ocean convergence zones.

OCE-23

v) The SEIS also excludes many internal and external injuries that can occur when sea turtles contact oil or chemical dispersants. Sea turtles are vulnerable to the direct effects of oil at all life stages—eggs, post-hatchlings, juveniles, and adults.[47] They are especially at risk because they do not avoid oiled waters according to studies.[48] Depending on the circumstances of the oil spill, sea turtles could become coated in oil or inhale volatile chemicals when they surface to breathe, swallow oil or contaminated prey, swim through oil, or come in contact with it on their nesting beaches. A catastrophic oil spill is dangerous to sea turtles in a variety of ways that are not covered by the SEIS:

1) Oil or dispersants on the sea turtle's skin and body can cause skin irritation, chemical burns, and infections.[49] Oil exposure for just 4 days can cause sea turtles' skin to continually fall off in sheets. This condition persists even after they are removed and treated from the exposure.[50]
2) Inhalation of volatile petroleum compounds or dispersants can damage the respiratory tract and lead to diseases such as pneumonia.[51]
3) Ingesting oil or dispersants may cause injury to the gastrointestinal tract, which may affect the animals' ability to absorb or digest foods.[52] Turtles of all life stages exposed to tarballs have been found with tar blocking their digestive systems leading to toxic exposure and "floating syndrome" where gas prevents the turtle from diving and therefore feeding. This can lead to starvation.[53]
4) Chemicals that are inhaled or ingested may damage liver, kidney, and brain function, cause anemia and immune suppression, or lead to reproductive failure or death.[54]

OCE-24

vi) The SEIS fails to detail the threats of a catastrophic oil spill to important nesting sites, the full life history of sea turtles, crucial foraging and offshore habitats, and sublethal long-term impacts to prey species for sea turtles in the western Gulf of Mexico. The inadequacy of the SEIS to present the full range of threats to these already endangered species shows the document's glaring insufficiencies.

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[45] "NOAA's Oil Spill Response: Effects of Oil on Marine Mammals and Sea Turtles." *NOAA*. 12 May 2010. http://response.restoration.noaa.gov/book_shelf/1887_Marine-Mammals-Sea-Turtles-fact-sheet.pdf.
[46] *Id.*
[47] Shigenaka, G. et al. "Oil and Sea Turtles, Biology, Planning and Response." *NOAA*. 2003. http://response.restoration.noaa.gov/book_shelf/35_turtle_complete.pdf.
[48] *Id.*
[49] "NOAA's Oil Spill Response: Effects of Oil on Marine Mammals and Sea Turtles." *NOAA*. 12 May 2010. http://response.restoration.noaa.gov/book_shelf/1887_Marine-Mammals-Sea-Turtles-fact-sheet.pdf.
[50] Shigenaka, G. et al. "Oil and Sea Turtles, Biology, Planning and Response." *NOAA*. 2003. http://response.restoration.noaa.gov/book_shelf/35_turtle_complete.pdf.
[51] "NOAA's Oil Spill Response: Effects of Oil on Marine Mammals and Sea Turtles." *NOAA*. 12 May 2010. http://response.restoration.noaa.gov/book_shelf/1887_Marine-Mammals-Sea-Turtles-fact-sheet.pdf.
[52] *Id.*
[53] *Id.*
[54] *Id.*

3.2.2.5 Offshore Habitats

OCE-25

i) Offshore habitat impacts are some of the most overlooked when it comes to the impacts of an oil spill. The open waters of the Gulf of Mexico are not devoid of life, but home to many forms of plankton and zooplankton that are essential producers. Not only is plankton important in regulating climate, but they also contribute to marine snow, which serves as an important source of nutrients for mesopelagic and benthic habitats.[55] Plankton also include the larval forms of many ecologically and commercially important fish and shellfish, including blue crabs, oysters, and shrimp. A spill in offshore waters would not just impact free-floating sargassum mats and the hundreds of species that depend on these mats as spawning sites, but it could also damage many offshore plankton populations and the species that depend on them as well as fishery-dependent economies.

3.2.2.6 Continental Shelf Benthic Resources

OCE-26

i) Seafloor communities along the continental shelf that are directly covered with oil will be adversely impacted, and additional secondary effects could occur related to a large oil spill like the buildup of microbial mats on the seafloor and the potential toxicity of dispersants like COREXIT® EC9500A. The consumption of oil by microbes seems like a good thing, but in large quantities the enhanced bacterial respiration can impact oxygen levels and contribute to hypoxic conditions that already harm Gulf of Mexico ecosystems. Large amounts of microbes can sink to the seafloor and form a thick microbial mat that snuffs out other forms of life.[56] The long term biological impacts of the large quantities (over 1 million gallons) of COREXIT® EC9500A used during the DWH spill needs better understanding. There is little information about how dispersant has been biodegraded after the DWH spill and whether it or any of its breakdown products are bioaccumulating in the food chain or remaining in coastal sediments.[57]

3.2.2.7 Deepwater Benthic Communities

OCE-27

i) Soft Bottom: Based on the susceptibility of foraminifera to chemical pollution,[58] their populations were likely adversely impacted by the DWH spill. Oil-affected foraminifera exhibit deformed shells, but the shells do not totally dissolve in the presence of oil. Their malformed shells are useful in assessing the status of recovery after oil spills.[59] NOAA scientists and researchers at Auburn University and the University of South Florida have taken samples of benthic foraminifera from the DWH spill area, and they will be

[55] Green, E., and M. Dagg. 1996. Mesozooplankton associations with medium to large marine snow aggregates in the northern Gulf of Mexico. *Journal of Plankton Research*, **19**(4): 435-447.
[56] Duran, R., and M. Goni-Urriza. (2010) Impact of pollution on microbial mats. *Handbook of Hydrocarbon and Lipid Microbiology*, **22**:2339-2348.
[57] Place, B., et al. (2010) A role for analytical chemistry in advancing our understanding of the occurrence, fate, and effects of Corexit oil dispersants. *Environ. Sc. Technol.,* **44**(16):6016-6018.
[58] Ernst, S.R. et al. 2006. Benthic foraminiferal response to experimentally induced Erika oil pollution. Marine Micropaleontology, **61**: 76-93.
[59] Sabean, J., Scott, D., Lee, K., and A. Venosa. (2009) Monitoring oil spill bioremediation using marsh foraminifera as indicators. *Mar Pollut Bull*, **59**(8-12): 352-61.

conducting further analysis and sampling in 2011.[60] Understanding the status of benthic foraminifera will be a significant and important indicator of the health of the Gulf of Mexico after the DWH spill and will help to determine how much the deepwater communities have been impacted.

OCE-28

ii) Deep Sea Impacts from Methane Release: Along with the 200 million gallons of oil that were spilled during the DWH blowout, it also released 500,000 tons of gaseous hydrocarbons into the deep-sea, which accounted for 40% of the total amount of hydrocarbons discharged.[61] There could be extensive and long term impacts to oxygen levels from microbial consumption of these hydrocarbons.[62]

OCE-29

iii) Deepwater Coral Benthic Communities: The SEIS makes faulty claims about the resilience of corals to oil pollution, e.g. "[e]xperiments with shallow tropical corals indicate that corals have a high tolerance to oil exposure. The mucus layers on coral resist penetration of oil and slough off the contaminant" (SEIS B-24). Real-world examples of coral responses to oil spills have demonstrated the opposite.[63] Increased levels of oil significantly decreased the number of corals, total coral cover, and species diversity on a coral reef after a major spill in Bahia Las Minas, Panama.[64] Deepwater corals may experience similar responses as shallow water corals to oil pollution. Such responses could include reductions in colony viability, decreases in the number of ovaria per polyp, lower life expectancy of gametes and abnormal behavioral responses of gametes, direct damage to tissues, thinning of cell layers, disruption of cell structure and damage to normal feeding mechanisms, as well as excessive mucus secretion leading to enhanced bacterial growth and eventual coral destruction.[65] The SEIS also makes an unreasonable claim that it is not likely that a sensitive deepwater coral habitat would be impacted by a deepwater plume of oil from a catastrophic spill, which defies recent observations in the post-DWH spill Gulf. A discovery from a community of deepwater corals (gorgonian and *Madrepora*) located seven miles from the DWH spill have shown that those corals were in fact exposed and that the result is decreased coral health such as decaying tissue or no tissue visible.[66] The team that discovered the unhealthy corals will be returning to the Gulf of Mexico at least four times in 2011 to search for more coral communities and assess the extent and persistence of damage caused by the oil spill on the marine ecosystem near these deep sea coral sites.[67] Clearly, the likelihood of a coral habitat being impacted by an oil plume depends primarily on the presence of such a habitat within

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[60] Preliminary Research: Lewis, R. Using mid-outer shelf foraminifera to assess benthic community damage and recovery following the deepwater horizon oil spill, Gulf of Mexico. *Dept. of Geology and Geography Auburn University.*
[61] Joye, S. B., MacDonald, I.R., Leifer, I., and V. Asper. 2011. Magnitude and oxidation potential of hydrocarbon gases released from the BP oil well blowout. *Nature Geoscience*, **4**, 160-164.
[62] *Id.*
[63] Loya, Y., and B. Rinkevich. 1980. Effects of oil pollution on coral reef communities. *Mar. Ecol. Prog. Ser.*, **3**: 167-180. Guzman, H., Jackson, J., and E. Weil. 1991. Short-term ecological consequences of a major oil spill on Panamanian subtidal reef corals. *Coral Reefs*, **10**: 1-12.
[64] Guzman, H., Jackson, J., and E. Weil. 1991. Short-term ecological consequences of a major oil spill on Panamanian subtidal reef corals. *Coral Reefs*, **10**: 1-12.
[65] Loya, Y., and B. Rinkevich. 1980. Effects of oil pollution on coral reef communities. *Mar. Ecol. Prog. Ser.*, **3**: 167-180.
[66] "Life and Death in the Deep Sea: Does the Gulf Oil Spill Threaten Vital Seafloor Communities." *Oceanus Magazine*. 5 May 2011.
[67] *Id.*

a reasonable distance from a spill site, which is not the least bit unlikely in the Gulf of Mexico.

C. Missing Species and Additional Considerations

OCE-30

i) Census of Marine Life Data: Scientists have collected spill impact data on very few species that live in the vicinity of the DWH spill, and are just beginning to assess the broader impacts to the health of the Gulf of Mexico system, including the WPA. The Census of Marine Life states that there is a baseline of 8,332 species in the area affected by the DWH spill.[68] The following are some examples of the number of species that are located near the DWH spill area: 1,461 mollusk species, 604 polychaete species,1,503 crustacean species,1,270 fish species, 4 sea turtle species, 218 bird species, and 29 marine mammal species.[69] In fact, according to the Census of Marine Life, the entire Gulf of Mexico ecosystem is ranked as the fifth most biologically diverse region of the world in terms of sea life.[70] The SEIS's catastrophic spill analysis does not refer to the significant threats to the overall biodiversity of the Gulf of Mexico.

OCE-31

ii) Impacts to Microbes and Phytoplankton: Oil had a strong influence on microbial population dynamics that are now becoming evident on beaches near the DWH spill. There have been sharp spikes in the frequency of human pathogens such as Vibrio cholera and an increase in Rickettsiales sp.[71] These changes in microbial and phytoplankton communities has significant impacts on marine ecosystems and are threatening human health. Vibrio cholera causes the illness called cholera in humans, and exposure to Rickettsiales sp. can also lead to a variety of harmful infections. Changes to microbial communities can also transform the functionality of marine ecosystems, and the SEIS lacks appropriate acknowledgment of these important changes that have occurred after the DWH spill.

OCE-32

iii) Flower Garden Banks National Marine Sanctuary ("FGBNMS"): The SEIS lacks any information on the potential impacts of a catastrophic oil spill event on the Flower Garden Banks National Marine Sanctuary. The FGBNMS is one of only 14 federally designated underwater areas protected by NOAA's Office of National Marine Sanctuaries, and the only site located in the Gulf of Mexico. The sanctuary contains biologically diverse coral reef ecosystems set atop geological formations called salt domes. It is situated 70 to 115 miles off the coasts of Texas and Louisiana in the heart of the WPA. The FGBNMS, because it hosts large schools of hammerhead sharks and other species that have become uncommon through the Caribbean like grouper, jacks, snapper and whale sharks, supports many local jobs in SCUBA diving, research, and tourism. The lack of consideration for the potential impacts of an oil spill to the FGBNMS and liabilities of an oil spill under the National Marine Sanctuaries Act shows the inadequacy of the SEIS.

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[68] Ausube, J.H., Crist, D.T., and Waggoner, P.E., eds. *First Census of Marine Life: Highlights of a Decade of Discovery.* New York: Census of Marine Life, 2010. Page 20.
[69] *Id.*
[70] *Id.*
[71] Widger, W., et al. (2011) Longitudinal metagenomic analysis of the water and soil from Gulf of Mexico beaches affected by the Deep Water Horizon oil spill. *Nature Precedings,* hdl:10101/npre.2011.5733.1.

OCE-33

iv) Lack of Accurate Maps for Oil Spill Trajectory Analysis: The SEIS includes figures of the square miles that could be impacted by a catastrophic spill but excludes good spatial depictions of what is truly at risk from a catastrophic oil spill in the WPA. The high fraction of northward currents in the western portion of the Gulf Loop Current puts large amounts of the Texas and Louisiana coastlines at risk, as well as the Flower Garden Banks National Marine Sanctuary and other essential marine habitats. The SEIS undermines its own analysis of the potential impacts of a catastrophic oil spill by excluding a map that incorporates the potential shapes of oil slicks and methane releases overlapping topographic features, the Flower Garden National Marine Sanctuary, important fisheries, marine habitats, and levels of primary productivity or biological diversity.

OCE-34

v) Lack of Acknowledgment of the Natural Resources Damage Assessment (NRDA) from the DWH spill: The SEIS's claim that there is incomplete or unavailable information about the impacts of the DWH spill ignores the massive amount of information collected during and after the spill. NOAA's "Natural Resources Damage Assessment (NRDA) by the Numbers" report stated that by December 1, 2010, the following actions had been taken: 29,599 environmental samples collected; 37,183 NRDA laboratory analyses conducted; almost 30,000 other samples collected by 83 offshore research cruises, including 17,026 water samples, 3,806 sediment samples, 5,007 tissue samples, and 1,917 tarball samples; 34,768 images taken; and over 4,000 linear miles of shoreline surveyed.[72] Reviewing this information from the DWH spill is imperative for any EIS about offshore drilling in the Gulf of Mexico. Furthermore, BOEMRE needs to conduct a comprehensive long term analysis of the threats, or wait for a full review of the impacts from the NRDA process so that it can be included and thus help to make the SEIS more complete.

OCE-35

vi) While BOEMRE pays particular attention to federally-protected wildlife, such as those listed under the Endangered Species Act, Marine Mammal Protection Act, and/or Migratory Bird Treaty Act, many additional species have no federal protection yet are threatened on a global scale. A recent paper by Campagna et al.[73] estimates that in the Gulf of Mexico, 14 marine species are federally protected, whereas 40 species are not despite being listed as threatened on the International Union for Conservation of Nature's ("IUCN") Red List. The IUCN's Red List is a widely-recognized indicator of species health that is based on a broad range of scientific data, and should therefore not be taken lightly. Indeed, these 40 threatened but federally-unprotected species are not specifically considered in the SEIS despite their globally-threatened status, which makes them particularly susceptible to local disruptions as occurred during the DWH spill.

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[72] "Gulf Spill Restoration." *NOAA*. 23 Dec 2010. http://www.gulfspillrestoration.noaa.gov/.

[73] Campagna, C., Short, F.T., Polidoro, B.A., McManus, R., Collette, B.B., Pilcher, N.J., de Mitcheson, Y.S., Stuart, S.N., and K.E. Carpenter. 2011. Gulf of Mexico oil blowout increases risks to globally threatened species. *Bioscience* **61**: 393.

OCE-36

For the above reasons, the Draft SEIS for Lease Sale 218 fails to fully comply with NEPA. Oceana strongly urges BOEMRE to include the considerations discussed above in its Final SEIS; only by doing so can the Final SEIS fully comply with existing regulations. Each of these shortcomings, if not addressed, would prevent the SEIS from fulfilling NEPA requirements and thus violate those requirements. If any further clarification or explanation is required, you may contact me at 202-467-1953 or jsavitz@oceana.org. We appreciate the opportunity to comment on this Draft SEIS.

Sincerely,

Jacqueline Savitz
Senior Scientist, Senior Campaign Director
Oceana

FIGURES

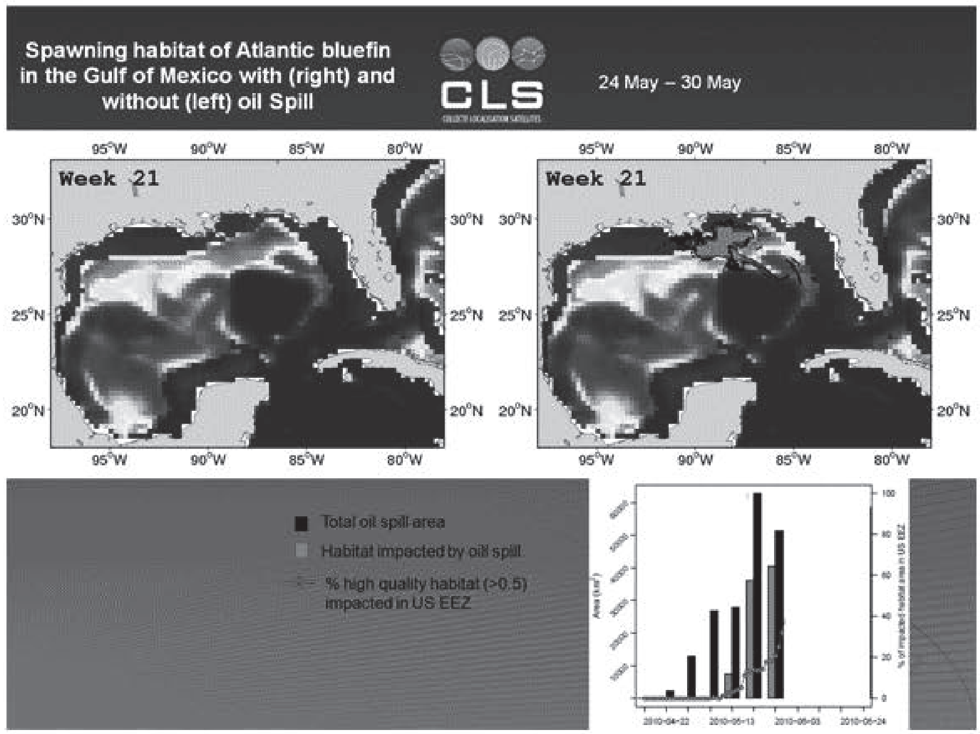

Figure 1: Map of the overlap between critical spawning habitat of North Atlantic bluefin tuna and the DWH oil spill extent. Credit: CLS.[74]

[74] "Bluefin Tuna Hit Hard by 'Deepwater Horizon' Disaster." *European Space Agency*. 26 Oct 2010. http://due.esrin.esa.int/news/news210.php.

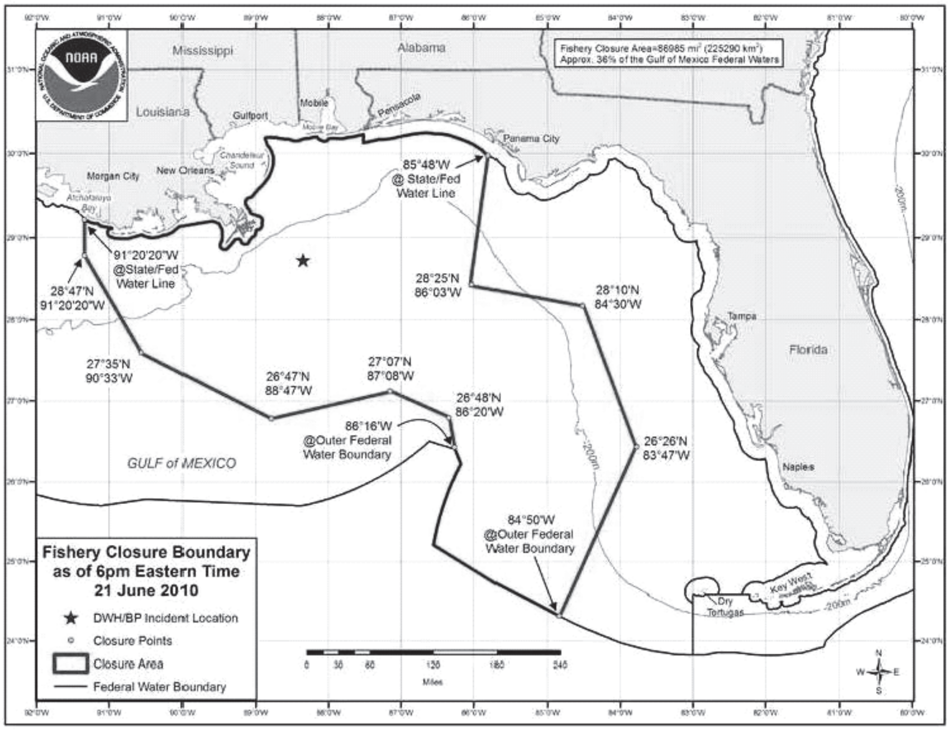

Figure 2: Fishery closure boundary as of 6pm EST on June 21, 2010, due to the DWH spill. Credit: NOAA.[75]

[75] "NOAA Expands Fishing Closed Area in Gulf of Mexico." *NOAA*. 21 June 2010. http://www.noaanews.noaa.gov/stories2010/20100621_closure.html.

OCE-1 This Supplemental EIS states that the purpose of the proposed action is to offer for lease certain OCS blocks located in the WPA that may contain economically recoverable oil and gas resources. While Oceana contends that the proposed action meets this purpose, they stated that it fails to do so in a manner that maintains competition and achieves other important national needs. WPA Lease Sale 218 is one of the sales in the 2007-2012 5-Year Program, the programmatic EIS for which addressed policy concerns such as those raised here by Oceana. Although the proposed action is cited as helping to reduce the need for oil imports, the defined need for the proposed action is to further the orderly development of OCS resources. Oceana contends that the amount of oil and gas potentially recoverable will have a negligible impact on our Nation's dependence on foreign reserves since the U.S. consumes substantially more than may be recovered in the WPA. Although it is true that any single lease sale contributes a relatively small percentage of total hydrocarbon resources used in the U.S., the overall OCS Program contributes a significant amount. Oceana compared the figures of potentially recoverable oil with the overall demand rather than to that portion that is imported. As stated in this Supplemental EIS, approximately 57 percent of oil used in the U.S. is imported. Based upon BOEMRE's estimates of between 0.222 and 0.423 billion barrels of oil that will be developed due to WPA Lease Sale 218, this production will be used in the U.S. and is expected to therefore contribute to a reduction of the amount of oil and gas that would otherwise be imported to fill that need.

OCE-2 Oceana contends that this Supplemental EIS failed to provide such a clear basis for decisionmaking because it does not consider two reasonable alternatives, specifically increasing renewable energy and conservation or delaying the lease sale until studies of the impacts of the DWH oil spill are completed. Furthermore, Oceana contends that the stated need for the proposed action is to decrease the Nation's reliance on foreign oil and gas. Therefore, Oceana stated that an alternative should discuss the reduction of imports on foreign oil by shifting the Nation's transportation fleet away from gasoline and diesel.

If the proposed action were to evaluate means of deriving energy from the OCS, then an analysis of renewable energy alternatives on the OCS would be a viable alternative. However, the proposed action defined in this Supplemental EIS is the offering of leases in the WPA on the OCS for oil and gas exploration and production as part of the approved 2007-2012 5-Year Program. In accordance with 40 CFR 1502.14, alternatives must be derived from the stated purpose. The alternatives presented in this Supplemental EIS are reasonable alternatives within the framework of leasing the OCS for oil and gas exploration. Additionally, the stated purpose of this Supplemental EIS is to further the orderly development of OCS resources, not as Oceana contends, to decrease the Nation's reliance on foreign oil and gas. Therefore, an analysis of renewable/alternative energy and conservation alternatives would not be considered as derived from the stated purpose and need of this Supplemental EIS. Renewable/alternative energy and conservation are discussed under Alternative 10 (No Action) in the 2007-2012 5-Year Program EIS (USDOI, MMS, 2007a). Energy alternatives are also discussed in *Energy Alternatives and the Environment* (King, 2007).

OCE-3 Oceana commented that there was no alternative that considered delaying the lease sale until adequate impact assessments of the DWH event are completed and can be fully considered. Oceana also stated that the lack of available data on the environmental impacts of the DWH spill prohibited a full and fair discussion of significant environmental impacts, invalidating this Supplemental EIS.

The analyses in this Supplemental EIS considered changes to baseline conditions that may have occurred since the Multisale EIS and the 2009-2012 Supplemental EIS, including the DWH event. As acknowledged in this Supplemental EIS, credible scientific data regarding the potential short-term and long-term impacts of the DWH event is incomplete. In light of the absence of this information, BOEMRE considered what information was relevant and essential to its analysis of alternatives based upon the resource analyzed. If essential to a reasoned choice among the alternatives, BOEMRE considered whether it was possible to obtain the information, if the cost of obtaining it is exorbitant, and if it cannot be obtained, apply acceptable scientific methodologies to inform the analysis in light of this incomplete or unavailable information. Information on many impacts of the DWH event and oil spill, particularly as part of the NRDA process, may not be available for years, and certainly not within the contemplated timeframe of this NEPA process. In its place, subject-matter experts have used the scientifically credible information available and scientific methodologies to evaluate impacts to the resources while this information is unavailable. Information that is available was analyzed by subject-matter experts, who determined that the resources in the WPA were not significantly affected or, in most cases, not affected at all by the DWH event. Fore example, many species of birds found in the WPA have migration and residency patterns which indicate that they would be unlikely to migrate laterally from the area affected by the spill into the WPA, or were at breeding grounds far to the north and outside of the area of impacts at the time of the DWH event. The data obtained to support the conclusions within this Supplemental EIS indicate that, due primarily to its geographical location and distance from the DWH site, the area to be offered for lease in the proposed WPA lease sale did not experience any significant adverse effects from the DWH event. The environmental baseline relevant to resources located in that area is essentially unchanged. Resources that are known to migrate to the WPA from the CPA could have been impacted by the spill, and analysis of those resources reflects these potential impacts; however, none were determined to be significant.

OCE-4 Oceana stated that, by not including necessary information to gauge the impact of the DWH spill, this Supplemental EIS violates 40 CFR 1502.22, which states that "[i]f the incomplete information . . . is essential to a reasoned choice among alternatives and the overall costs of obtaining it are not exorbitant, the agency shall include the information in the environmental impact statement."

In accordance with Section 1502.22 of NEPA, "Incomplete or Unavailable information," when an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS and there is incomplete or unavailable information, the agency shall always make clear that such information is lacking. However, NEPA does not require that all informational gaps be addressed before an EIS is completed and a decision is made. In accordance with 1502.22, where relevant information on reasonably foreseeable significant adverse impacts is incomplete or unavailable, the need for the information was evaluated to determine if it was essential to a reasoned choice among the alternatives, and if so, was either acquired or in the event it was impossible or exorbitant to acquire the information, accepted scientific methodologies were applied in its place. Language in **Chapter 4.1**, "Incomplete or Unavailable Information," was clarified to prevent any misperceptions on this issue and the individual resource analyses sections identify this issue where appropriate.

OCE-5 This Supplemental EIS evaluates impacts for the first lease sale to be held after the DWH event. Additional NEPA documents will be prepared for future lease sales. Where relevant information on reasonably foreseeable significant adverse impacts is incomplete or unavailable, the need for the information was evaluated to determine if it was essential to a reasoned choice among the alternatives, and if so, was either acquired or, in the event it was impossible or exorbitant to acquire the information, accepted scientific methodologies were applied in its place. The subject matter experts evaluated the potential impacts to each resource that could be expected in light of this unavailable and incomplete information, and they found that the impacts were not significant. Language in **Chapter 4.1**, "Incomplete or Unavailable Information," was clarified to prevent any misperceptions on this issue and the individual resource analyses sections identify this issue where appropriate.

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Nonetheless, as additional information becomes available, additional regulations and mitigations can be implemented if long-term impacts to Atlantic bluefin tuna are discovered. This is consistent with a recent NOAA determination for the species. The NOAA has stated that "The status review team also looked at the best available information on the potential effects of the 2010 Deepwater Horizon BP oil spill on the future abundance of the western stock of bluefin tuna and found that it did not substantially alter the results of the extinction risk analysis." This was part of their scientific review for the decision that, at this time, Atlantic bluefin tuna do not warrant species protection under the ESA. While the oil slick from the DWH event did occurred within known Atlantic bluefin tuna spawning grounds, it was in one portion of the entire Gulf of Mexico and these tuna could use other areas throughout the Gulf of Mexico and not just where the oil slick occurred. This can be seen in Teo et al. (2007), where most of his tagged tuna were west of Mississippi Canyon Block 252.

OCE-6 While the probability of a high-volume oil spill is still very low, particularly in light of improved safety requirements for OCS activities, BOEMRE has nonetheless conducted an analysis of the effects of accidental oil spills on environmental and socioeconomic resources.

OCE-7 Climate change is a global phenomenon influenced by many activities worldwide. The BOEMRE's policy is to address programmatic issues such as global warming at the 5-Year Program level rather than at the individual lease sale level. Global warming is addressed in the 2007-2012 5-Year Program EIS (USDOI, MMS, 2007a).

OCE-8 The assumption that deeper water and well depth increases the risk of a spill is overly simplistic.

Water depth is not used to calculate the risk of future spills. Data on the numbers, types, sizes, and other information on past spills were reviewed to develop the spill scenario for analysis in this Supplemental EIS. The spill scenario provides the set of assumptions and estimates of future spills; the type, frequency, quantity, and fate of the spilled oil for specific scenarios; and the rationale for the scenario assumptions or estimates. Modeling spill trajectories is a complex process that requires BOEMRE review and testing. There had been no trend of increased number of oil spills based on exploration in deeper water prior to the DWH event. The modeling group in BOEMRE's Headquarters is always investigating changes and improvements to our oil-spill modeling efforts; it would be premature at this point to drastically change the model as a result of the DWH event since data is still forthcoming.

The Draft Supplemental EIS describes the new regulations and requirements, such as the Drilling Safety Rule and Workplace Safety Rule, that have been introduced and reduce the risk of future blowouts (**Chapter 1.3.1**), but these changes do not eliminate the risk entirely. Two new NTL's provide additional guidance related to spill-response efforts and subsea blowout containment. The NTL 2010-N06, "Information Requirements for Exploration Plans, Development and Production Plans, and Development Operations Coordination Documents on the OCS," outlines how operators must certify that they are prepared to deal with a potential blowout and describe measures they propose to enhance their ability to prevent or reduce the likelihood of a blowout and to conduct early and effective intervention, including measures for drilling a relief well. The NTL 2010-N10, "Statement of Compliance with Applicable Regulations and Evaluation of Information Demonstrating Adequate Spill Response and Well Containment Resources," informs operators that they must attest that they will conduct all authorized activities in compliance with all applicable regulations and that they have the demonstrated capacity to deploy containment resources that could adequately and promptly respond to a blowout/loss of well control. The BOEMRE has focused on improving the way wells are designed and drilled to prevent ever getting into a well control incident that would require the use of the BOP. In doing so, BOEMRE believes that, since the DWH event, BOEMRE has lowered the overall risk by lowering the probability that a well control incident occurs.

OCE-9 The capacity of both government and industry to respond to oil spills, both from a regulatory and technological perspective, is continually being updated and improved. Many of these issues are outside of BOEMRE's authority (e.g., the USCG is responsible for response to and clean up of spills on the OCS). For the purposes of this NEPA analysis, BOEMRE has taken a conservative approach, assumed for purposes of impact analysis that a catastrophic spill may occur, and has not relied on untested technological advances in oil-spill response in our analysis of impacts. This Supplemental EIS presents impact analyses that presume contact with oil and, where known, the effect of cleanup operations.

OCE-10 **Appendix B** is intended to be an overview of potential effects of a catastrophic spill, not specifically the DWH event. It was never envisioned to provide a site-specific analysis but instead be a reference to the type of impacts associated with a catastrophic spill. A specific spill scenario is too speculative. The analysis contained in **Appendix B** best suits a situation where there are a wide range of scenarios associated with an unexpected and unlikely low-probability event.

The best example for long-term impacts from a catastrophic oil spill in the Gulf of Mexico is the *Ixtoc* spill of 1979, which BOEMRE has incorporated where appropriate in this Supplemental EIS. The *Exxon Valdez* spill occurred in such vastly different conditions and circumstances in Alaska that it probably is a poor example of impacts and recovery from an oil spill in the Gulf of Mexico, although this spill may be relevant to discussions of impacts of oil on individual resources.

Since publication of the Draft Supplemental EIS on April 22, 2011, the subject-matter experts incorporated relevant information and updated this Supplemental EIS accordingly. The incorporation of relevant information is time consuming, as it must be obtained and reviewed by subject-matter experts in the context of the source of the data, research methodology, and data quality. As is necessary under every NEPA analysis, at some point the subject-matter experts had to finalize their analyses to allow time for the Final Supplemental EIS to be prepared and presented to the decisionmaker.

OCE-11 The BOEMRE agrees that there were many images of oil-soaked birds from the DWH spill. Pages B-17 and B-31 of **Appendix B** states that oiling is one of the primary concerns for effects on birds.

OCE-12 When **Appendix B** was written, the intent was only to consider events in the Gulf of Mexico, which is why the *Exxon Valdez* spill was not discussed. Section 5.2.2.1 of **Appendix B** states that "there is a high probability of underestimating the impacts of oil spills on avian species" and further states that such effects may have long-term population-level effects. Citing the Alaska example, the commenter makes valid points that later surveys discovered many more affected birds and that some bird populations have not recovered in 20 years. Section 5.2.2.1 of **Appendix B** has been changed to reflect this point.

The following clarifying language was added to the document: "Some populations could take years or decades before reaching a full recovery, and some may never recover."

OCE-13 Section 5.2.2.1 of **Appendix B** states that "there is a high probability of underestimating the impacts of oil spills on avian species. . . ." The commenter makes a valid point that some birds are able to fly despite being oiled and may later be found far from the original catastrophic oil-spill site. Section 5.2.2.1 of **Appendix B** has been changed to reflect this point.

The following clarifying language was added to the document: "Despite being oiled, some birds are able to fly and may later be killed from exposure to the oil, far from the catastrophic oil spill site."

OCE-14 The BOEMRE agrees that, while short-term impacts to birds from contact with oil is easier to evaluate, the long-term impacts to the population can take years to evaluate. Section 5.2.2.1 of **Appendix B** was written to reflect these uncertainties with the recognition that a catastrophic oil spill may have population-level effects. The commenter is correct in pointing out that impacts to prey species may also affect the bird populations. While Section 3.2.2.1 acknowledges this point, Section 5.2.2.1 of **Appendix B** has been changed to more clearly reflect this point.

The following clarifying language was added to the document: "The long-term impacts of potential food stress for bird species from an altered ecosystem are unknown, but disturbances to the ecosystem can cause long-term sublethal impacts, including malnourishment and decreased reproductive success."

OCE-15 The **Appendix B** is a general analysis and is not specific to the DWH spill, but it is the most relevant example of a catastrophic spill in the Gulf of Mexico. Further, the commenter's discussion of the timing of bluefin tuna spawning and larval stages to the DWH spill is an example of the possible effects from a long-term, population-level impact to one species and of the possible effects this may have on fisheries in the future. Sections 2.2.2.2, 3.2.2.2, 4.2.2.2, and 5.2.2.2 discuss the possible impacts on fish, while Sections 2.2.2.5, 3.2.2.6, 3.2.2.7, and 5.2.2.8 discuss the impacts on benthic habitat; Sections 2.2.3.2, 3.2.3.2, 4.2.3.2, and 5.2.3.2 discuss impacts on commercial fishing; and Sections 2.2.3.3, 3.2.3.3, 4.2.3.3, and 5.2.3.3 discuss impacts on recreational resources and fishing. Section 3.2.2.2 also states "early life stages of animals are usually more sensitive to oil than adults (Boesch and Rabalais, 1987; NRC, 2005)"; the analysis is consistent with the point that the commenter makes here.

OCE-16 The BOEMRE agrees with the commenter; the example of the areas closed to fisheries is an important impact, as exemplified by the areas closed as a result of the DWH spill. **Appendix B** discusses these impacts in Sections 2.2.3.2, 3.2.3.2, 4.2.3.2, and 5.2.3.2 regarding impacts on commercial fishing and in Sections 2.2.3.3, 3.2.3.3, 4.2.3.3, and 5.2.3.3 regarding impacts on recreational resources and fishing.

OCE-17 While **Appendix B** is a general analysis and is not specific to the DWH spill, the commenter provides the excellent example of an unusual mortality event as another possible result from a catastrophic oil spill. In **Appendix B**, Sections 2.2.2.3, 3.2.2.3, 4.2.2.3, and 5.2.2.3 discuss possible impacts to marine mammals. Specifically, Section 5.2.2.3 discusses the possible long-term and population-level impacts and the various ways that the spill could contribute to these impacts. However, this section did not mention Unusual Mortality Events. This section has been revised to specify that Unusual Mortality Events could be caused by a catastrophic oil spill.

It is also important to note that the 2010-2011 unusual mortality event cited by the commenter (USDOC, NOAA, 2011d) actually began before the DWH oil spill occurred. However, BOEMRE recognizes that the DWH oil spill could have further impacted the unusual mortality event and will review the data being collected through the NRDA process.

OCE-18 While the total number of marine mammals killed from the DWH oil spill is speculative, BOEMRE agrees that the detection rate of carcasses is low and that it is probable that there have been more deaths caused by the DWH oil spill than observed. In **Appendix B**, Sections 2.2.2.3, 3.2.2.3, 4.2.2.3, and 5.2.2.3 discuss possible impacts to marine mammals. Specifically, Section 3.2.2.3 discusses the DWH oil spill and the numbers of marine mammals that had been collected as of September 22, 2010. Section 3.2.2.3 states "this number represents only those marine mammals collected (either dead or alive) and does not address all potential impacts to the population. Based on these data, it is reasonable to assume that a catastrophic oil spill lasting up to 120 days could have population-level effects on many species of marine mammals (e.g. sperm whales, Bryde's whales, etc.)." This section has been updated to further reflect the probable underestimate of deaths due to the low detection rate of carcasses and has also been updated to reflect the most recent Consolidated Fish and Wildlife Collection Reports after the DWH oil spill as of April 20, 2011.

The following clarifying language was added to **Appendix B**: "Due to known low detection rates of carcasses, it is likely that the deaths of marine mammals are underestimated (Williams et al., 2011)."

OCE-19 While **Appendix B** does not discuss the full life history, habitats, and range of sea turtles, the Supplemental EIS does provide this information in **Chapter 4.1.1.11**. The same is also incorporated by reference from the Multisale EIS and the 2009-2012 Supplemental EIS, which provides a thorough background on sea turtles.

Sea turtles are discussed in Sections 2.2.2.4, 3.2.2.4, 4.2.2.4, and 5.2.2.4 of **Appendix B**. Section 4.2.2.4 discusses the three species of sea turtle that nest in the U.S. Gulf of Mexico and the impacts that a catastrophic oil spill could have on nesting sea turtles. The commenter provides a citation for the nesting sites for sea turtles. This section of **Appendix B** has been updated to use this citation.

The OBIS-SEAMAP (2009) reference was added to the document.

OCE-20 *Sargassum* is discussed in **Appendix B** in Section 3.2.2.5 for offshore habitats, as well as in Section 4.2.2.4 for sea turtles and finally in Section 5.2.2.7 for open water habitats. Sections 4.2.2.6 and 5.2.2.7 discuss seagrass beds. Coral reefs are discussed in Sections 2.2.2.5, 3.2.2.6, 3.2.2.7, and 5.2.2.6. Further, Section 3.2.2.4 for sea turtles also discusses coral reefs as important sea turtle habitat. Consistent with the discussions in these sections, BOEMRE agrees with the commenter that the destruction of these habitats from a catastrophic oil spill would be harmful to sea turtles. The BOEMRE agrees that declines in the food supply for sea turtles, which include invertebrates and sponge populations could also affect sea turtle populations. Section 5.2.2.4 has been updated to reflect this change.

The following clarifying language was added to the document: "Declines in the food supply for sea turtles, which include invertebrates and sponge populations could also affect sea turtle populations."

OCE-21 Comment noted.

OCE-22 In this Supplemental EIS, **Chapter 4.1.1.11.2** discusses the impacts from routine events on sea turtles, which includes offshore activities. **Chapter 4.1.1.11.3** discusses the impacts from accidental events on sea turtles. This section states, in regards to an accidental event at the lease sale site, "exposure to hydrocarbons persisting in the sea following the dispersal of an oil slick are expected to most often result in sublethal impacts (e.g., decreased health and/or reproductive fitness, increased vulnerability to disease) to sea turtles."

In **Appendix B**, sea turtles are discussed in Sections 2.2.2.4, 3.2.2.4, 4.2.2.4, and 5.2.2.4. Section 2.2.2.4 discusses how sea turtles may be impacted near the site of a catastrophic event if they are near the blowout and within the initially released oil. Section 3 of this analysis is specific to a catastrophic oil spill that is growing in size. Section 3.2.2.4 states that sea turtles are more likely to be affected by a catastrophic spill in shallow water, citing the typical habitat for Kemp's ridley, hawksbill, and green sea turtles. This is not to say that sea turtles could not or would not be affected by an oil spill in the open ocean. The BOEMRE agrees with the commenter that sea turtles travel through the open ocean.

The **Appendix B** and the main body of the Supplemental EIS do not downplay the impacts of an offshore catastrophic oil spill on essential habitat for turtles in the open ocean convergence zones; rather, Appendix B only states that more sea turtles are likely to be affected in shallower waters.

OCE-23 The BOEMRE agrees that catastrophic oil spills have the potential to affect sea turtles in many ways, including the following: (1) oil or dispersants on the sea turtle's skin and body can cause skin irritation, chemical burns, and infections; (2) inhalation of volatile petroleum compounds or dispersants can damage the respiratory tract and lead to diseases; (3) ingesting oil or dispersants may cause injury to the gastrointestinal tract; and (4) chemicals that are inhaled or ingested may damage liver, kidney, and brain function, cause anemia and immune suppression, or lead to reproductive failure or death.

Chapter 4.1.1.11.3 of this Supplemental EIS discusses impacts from accidental events on sea turtles. **Appendix B** furthers the discussion of the impacts on sea turtles in Sections 2.2.2.4, 3.2.2.4, 4.2.2.4, and 5.2.2.4. However, to capture the point made by the commenter, the commenter's list of potential impacts has been added to Section 5.2.2.4 of **Appendix B**.

The following clarifying language was added to the document: "While all of the pathways that an oil spill or the use of dispersants can affect sea turtles is poorly understood, some pathways may include the following: (1) oil or dispersants on the sea turtle's skin and body can cause skin irritation, chemical burns, and infections; (2) inhalation of volatile petroleum compounds or dispersants can damage the respiratory tract and lead to diseases; (3) ingesting oil or dispersants may cause injury to the gastrointestinal tract; and (4) chemicals that are inhaled or ingested may damage liver, kidney, and brain function, cause anemia and immune suppression, or lead to reproductive failure or death."

OCE-24 **Chapter 4.1.1.11.3** of this Supplemental EIS provides a general overview of the impacts from accidental events on sea turtles, while the effects of a catastrophic oil spill on sea turtles are further discussed in Sections 2.2.2.4, 3.2.2.4, 4.2.2.4, and 5.2.2.4 of **Appendix B**. Effects on nesting sites were discussed in Section 4.2.2.4 of **Appendix B**. The full life history of sea turtles are discussed in the Multisale EIS and the 2009-2012 Supplemental EIS, which were incorporated by reference, as well as in **Chapter 4.1.1.11** of this Supplemental EIS. **Appendix B** discusses Sea turtle habitat (including *Sargassum*), seagrass beds, and coral reefs throughout the appendix. **Appendix B** has been updated, however, to reflect the examples and suggestions from this commenter, which improve upon the discussion on impacts to prey species and the effects on sea turtles.

OCE-25 Phytoplankton and zooplankton do play a major role in the marine environment. However, several laboratory and field experiments and observations in the past decades have shown that impacts to planktonic and microbial populations are generally short lived and do not affect all groups evenly, and in some cases stimulate growth of important species (Gonzalez et al., 2009; Graham et al., 2010; Hing et al., 2011; Dunstan et al., 1975, in **Appendix B**).

Information was added to **Appendix B** to include the role of plankton in the marine environment.

OCE-26 The consideration of additional biomass from hydrocarbon-consuming microbiota contributing to benthic hypoxia along the Louisiana continental shelf (and potentially other areas of the documented "dead zone" sometimes stretching offshore Texas) is a valid point. The cause of the existing hypoxic zone is primarily derived from the decent of overlying plankton biomass rather than benthic origins, but hydrocarbon consuming bacteria would also occur in the water column. Their associated increased biomass after sinking to the seafloor could have a cumulative impact on benthic oxygen demand.

OCE-27 Comment noted. This data is not available yet but will be considered by BOEMRE in the future if and when made public.

OCE-28 Data from David Valentine, a microbial geochemist at the University of California, Santa Barbara, contradict the assertion of long-term impacts to dissolved oxygen. His data indicate the methane was gone in 3 months after the Macondo well was capped, without appreciable impact to dissolved oxygen. John Kessler, an oceanographer from Texas A&M University, found similar results. The Joye et al. Nature Geoscience letter reference speculates about the persistence of oxygen depletion in hydrocarbon-enriched waters. "We *suggest* that microbial consumption of these gases *could* lead to the extensive and persistent depletion of oxygen in hydrocarbon-enriched waters." There is no current field evidence supporting it. It is also worth consideration of the massive flux of hydrocarbons into the water column of the Gulf of Mexico on a continuous basis (including continuous methane seeps).

OCE-29 The reference that corals have been shown to be resilient to oil contact remains accurate and is based on field research and science in the literature. One summary source is the most recent National Research Council's 2003 book on Oil in the Sea. There are adverse impacts that can result from exposure of coral to oil. The Panama study referred to in this comment was funded by this Agency. Some excerpts from page 141 of this NRC reference are as follows: "long-term effects (greater than five years) of oil in Panama were more pronounced and detrimental due likely to repeat inoculation of oil from the surrounding mangroves into the coral ecosystem." "In contrast, no long-lasting effects to the coral reef ecosystem were reported from the Persian Gulf War spills" (120 fold greater volume of oil). Absent another catastrophic spill in the near term, and repeated exposure to oil, this re-exposure situation would not occur at the Flower Gardens or any other coral habitat in the northern Gulf of Mexico. Also, research done on direct exposure of coral to oil was summarized by one reference (Peters et al., 1997) including, "no adverse effects were measured for exposure of less than one hour." This refers to the submersion of living corals in oil for up to a full hour with no impact.

The BOEMRE feels that the conclusion in the Supplemental EIS that deepwater coral is unlikely to be impacted by an oil plume from a blowout remains accurate. The likelihood of a deepwater coral habitat being impacted by any blowout event would have little to do with its proximity to the well site alone and would be more related to use of dispersants. The potential impacts of oil, including that which may be dispersed subsurface, is discussed in this Supplemental EIS. It should be noted that other deepwater coral sites revisited 20-30 mi (32-48 km) north of the Macondo well site (which were part of a BOEMRE/NOAA OER funded high-resolution imagery survey from before the spill), did not have any observable impacts from the spill.

OCE-30 The BOEMRE agrees with the commenter and with the data from the Census of Marine Life. **Appendix B** is a hypothetic general analysis and therefore does not include all species. It is also not specific to the DWH spill, but takes it, along with the *Ixtoc* spill into account. Since data from the DWH spill have not yet been released on the effects to individual species, nor to biodiversity, BOEMRE has considered the effects from the *Ixtoc* spill. The data indicate that the impacts were relatively short term and did not significantly reduce the biodiversity of the Gulf of Mexico. However, BOEMRE agrees with the commenter that that the overall ecosystem and the biodiversity in the Gulf of Mexico could be disrupted in the case of another catastrophic oil spill.

OCE-31 The microbial loop is an essential part of the marine ecosystem. The comments are noted and **Appendix B** has been updated. However, the study cited (Widger et al., 2011) does not support the argument of lasting effects to the spill on coastal microbial communities and pathogens. The study had only one pre-spill and one during spill time-point each, with no post-spill component to monitor trends. Further, the pathogens noted are commonly found in coastal waters after significant rain events and occur as a result of untreated freshwater reaching the coast (Stumpf et al., 2010; Wetz et al., 2008; Hsieh et al., 2007). The study (Widger et al., 2011) does not address the potential that the increase in microbial pathogens are a result of storm water run-off, and indeed does not even address if there was a significant rain event upstream that could have carried these terrestrial-derived pathogens to the coastal zone. (The above references can be found in **Appendix B**.)

OCE-32 The BOEMRE is very aware of the character and significance of the Flower Garden Banks, as this Agency began protective measures and the stewardship of these unique ecosystems in the early 1970's, long before they were designated as a National Marine Sanctuary. Attention and concern for these resources is warranted. Their sensitivity and unique biological assemblages have been carefully considered by BOEMRE over the past decades. The BOEMRE is an equal partner with the Sanctuary in the continuing environmental monitoring of the East and West Flower Garden Banks, the longest continuous coral monitoring project in the world. A detailed description of the Flower Garden Banks and other topographic features, including Stetson Bank, which is a part of the Flower Garden Bank National Marine Sanctuary, appears in previous EIS documents referenced in this Supplemental EIS (i.e., the Multisale EIS and the 2009-2012 Supplemental EIS). The potential for oil-spill impacts to the Flower Garden Banks have been specifically considered. Additional evaluation of any unique potential impacts to the Flower Garden Banks and Sanctuary will be considered.

OCE-33 The **Appendix B** is a general overview of hypothetical impacts from a nonspecific hypothetical spill and, thus, there are no specific location or maps associated with it.

OCE-34 The BOEMRE does not have access to the NRDA data that is being generated, as much of it has not been made publicly available. It may well be years before the results of NRDA are made available. While we do not dispute the other facts in the comment, they do not add value to the impact analysis for the proposed lease sale or the **Appendix B**.

OCE-35 The BOEMRE agrees with the commenter that **Appendix B** in no way is a complete list of all species and subspecies that may have been affected by the DWH oil spill or that may be affected by any future catastrophic events in the Gulf of Mexico. The Campagna et al. (2011) paper referenced by the commenter states that there are many unprotected species that were also likely affected, including bluefin tuna, several species of sharks, and several coral species. The BOEMRE agrees that, assuming a catastrophic spill, such impacts would be probable. Thus, **Appendix B** addresses impacts that are common among species and addresses those impacts. In cases where the discussion requires, for purpose of impact analysis, a distinction between species, such distinction is made. Section 3.2.2.2 of **Appendix B** does discuss particular concern for whale sharks based on sightings after the DWH oil spill. Further, **Chapter 4.1.1.13** of this Supplemental EIS does list many species of fish and sharks that could be impacted.

Campagna, C., F.T. Short, A.A. Polidoro, R. McManus, B.B. Collette, N.J. Pilcher, Y.S. de Mitcheson, S.N. Stuart, and K.E. Carpenter. 2011. Gulf of Mexico oil blowout increases risks to globally threatened species. Bioscience 61:393.

OCE-36 Comment noted.

From: usacitizen1 usacitizen1 [usacitizen1@live.com]
Sent: Wednesday, April 20, 2011 10:48 AM
To: WPA Supplemental EIS; americanvoices@mail.house.gov; comments@whitehouse.gov; sf.nancy@mail.house.gov
Subject: public comment on federal register FW: oil profiteers still stickint it to american citizens w/govt help

USA CIT-1

i do not believe this lease sale should go forward at this time. it is clear this agency has done absolutely zero to improve regulation of these oil profiteers. the oil profiteers dont care how much they pollute because they just write it off as not paying taxes, so in fact the us citizen is left holding the bag for oil pollution. the profits of all oil companies should be from where pollutiion costs comr from and and no tax write off shoudl be allowed for oil pollution events. NO TAX WRITEOFF AT ALL. IT IS CLEAR OIL PROFITEERS ARE STILL STICKING IT TO USA TAXPAYER/CITIZENS. IT IS CLEAR OUR REGULATORS ARE IN BED WITH THEOIL PROFITEERS. IT IS CLEAR OUR REGULATORS ARE STILL NOT PROTECTING AMERICA. THIS LEASE SALE SHOULD NOT GO FORWARD AT THIS TIME. WE NEED TO CLEAN UP THIS WHOLE MESS.
EXXON STILL HASNT FULLY PAID FOR POLLUTION FROM 30 YEARS AGO.
JEAN PUBLIC ADDRESS IF REQUIRED

[Federal Register Volume 76, Number 76 (Wednesday, April 20, 2011)]
[Notices]
[Page 22139]
From the Federal Register Online via the Government Printing Office [www.gpo.gov]
[FR Doc No: 2011-9701]

DEPARTMENT OF THE INTERIOR

Bureau of Ocean Energy Management, Regulation and Enforcement

Gulf of Mexico (GOM), Outer Continental Shelf (OCS), Western Planning Area (WPA), Oil and Gas Lease Sale for the 2007-2012 5-Year OCS Program

AGENCY: Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), Interior.

ACTION: Notice of Availability (NOA) of a Draft Supplemental Environmental Impact Statement (SEIS) and Public Meetings.

SUMMARY: BOEMRE has prepared a Draft SEIS on an oil and gas lease sale tentatively scheduled in late 2011 for WPA Lease Sale 218, which is the final WPA lease sale in the 2007-2012 5-Year OCS Program. The proposed sale is in the Gulf of Mexico's WPA off the States of Texas and Louisiana. This Draft SEIS updated the environmental and socioeconomic analyses for the WPA Lease Sale 218, originally evaluated in the Gulf of Mexico OCS Oil and Gas Lease Sales: 2007-2012; WPA Sales 204, 207, 210, 215, and 218; Central Planning Area (CPA) Sales 205, 206, 208, 213, 216, and 222, Final EIS (OCS EIS/EA MMS 2007-018) (Multisale EIS), completed in April 2007. This Draft SEIS also updated the environmental and socioeconomic analyses for the WPA Lease Sale 218 in the GOM OCS Oil and Gas Lease Sales: 2009-2012; CPA Sales 208, 213, 216, and 222; WPA Sales 210, 215, and 218; Final Supplemental EIS (OCS EIS/EA MMS 2008-041) (2009-2012 SEIS), completed in September 2008.

DATES: Public meetings to obtain additional comments and information regarding the Draft SEIS scheduled for May 17, 2011, and May 19, 2011. For additional information see SUPPLEMENTARY INFORMATION.

FOR FURTHER INFORMATION CONTACT: For more information on the Draft SEIS or the public meetings, you may contact Mr. Gary D. Goeke, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, 1201 Elmwood Park Boulevard (MS 5412), New Orleans, Louisiana 70123-2394, or by e-mail at WPASupplementalEIS@boemre.gov. You may also contact Mr. Goeke by telephone at (504) 736-3233.

SUPPLEMENTARY INFORMATION: BOEMRE developed the Draft SEIS for WPA Lease Sale 218 to reflect new information made available since completion of the Multisale EIS and the 2009-2012 SEIS and to consider the Deepwater Horizon event. This Draft SEIS provides updates on the baseline conditions and potential environmental effects of oil and natural gas leasing, exploration, development, and production in the WPA. BOEMRE conducted an extensive search for such new information, from scientific journals; interviews with personnel from academic institutions; Federal, state, and local agencies; and various other sources. BOEMRE has reexamined potential impacts of routine activities and accidental events, including a possible large-scale event, associated with the proposed WPA lease sale. BOEMRE has also re-analyzed the proposed lease sale's incremental contribution to the cumulative impacts on environmental and socioeconomic resources. Like the Multisale EIS and the 2009-2012 SEIS, the oil and gas resource estimates and scenario information for this Draft SEIS are presented as a range that would encompass the resources and activities estimated for this proposed lease sale.

Draft Supplemental EIS Availability: To obtain a single printed or CD-ROM copy of the Draft SEIS for WPA Lease Sale 218, you may contact BOEMRE, Gulf of Mexico OCS Region, Public Information Office (MS 5034), 1201 Elmwood Park Boulevard, Room 114, New Orleans, Louisiana 70123-2394 (1-800-200-GULF). An electronic copy of the Draft SEIS (as well as links to the Multisale EIS and the 2009-2012 SEIS) is available at BOEMRE's Internet Web site at http://www.gomr.boemre.gov/homepg/regulate/environ/nepa/nepaprocess.html. The CD-ROM version of the Draft SEIS also contains copies of the Multisale EIS and the 2009-2012 SEIS.

Several libraries along the Gulf Coast have been sent copies of the

Draft SEIS. To find out which libraries and their locations have copies of the Draft Supplemental EIS for review, you may contact BOEMRE's Public Information Office or visit BOEMRE's Internet Web site at http://www.gomr.boemre.gov/homepg/regulate/environ/libraries.html.

Comments: Federal, State, and local government agencies and other interested parties are requested to send their written comments on the Draft Supplemental EIS in one of the following two ways:

1. In written form enclosed in an envelope labeled ``Comments on the WPA Lease Sale 218 Draft Supplemental EIS'' and mailed (or hand carried) to the Regional Supervisor, Leasing and Environment (MS 5410), Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, 1201 Elmwood Park Boulevard, New Orleans, Louisiana 70123-2394.

2. Electronically to the BOEMRE e-mail address: WPASupplementalEIS@boemre.gov. Comments should be submitted no later than 45 days from the publication of this NOA.

Public Meetings: BOEMRE will hold public meetings to obtain additional comments and information regarding the Draft SEIS. These meetings are scheduled as follows:

Tuesday, May 17, 2011; Houston Airport Marriott at George Bush Intercontinental, 18700 John F. Kennedy Boulevard, Houston, Texas 77032, beginning at 1 p.m. and 6 p.m. CDT; and

Thursday, May 19, 2011, Bureau of Ocean Energy Management, Regulation and Enforcement, 1201 Elmwood Park Boulevard, New Orleans, Louisiana 70123, beginning at 1 p.m. and 6 p.m. CDT.

Authority: This NOA is published pursuant to the regulations (40 CFR 1503) implementing the provisions of the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321 et seq. (1988)).

Dated: April 18, 2011.

L. Renee Orr,

Acting Associate Director for Offshore Energy and Minerals Management.

[FR Doc. 2011-9701 Filed 4-19-11; 8:45 am]

BILLING CODE 4310-MR-P

USACIT-1 Comment noted. The decision on which alternative (including whether to cancel the lease sale) will be selected will be made after the Supplemental EIS is finalized and, if the decision is to hold a lease sale under either Alternative A or B, it will be announced in a Final Notice of Sale.

ANADARKO PETROLEUM CORPORATION

TEL. 832/ 636-1000
P.O. BOX 1330 • HOUSTON, TEXAS 77251-1330

June 6, 2011

Mr. Gary D. Goeke
Chief, Environmental Assessment Section
Leasing and Environment (MS 5410)
Bureau of Ocean Energy Management, Regulation and Enforcement
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Via E-mail to WPASupplementalEIS@boemre.gov

RE: Draft Supplemental Environmental Impact Statement for the Western Planning Area Lease Sale

Dear Mr. Goeke:

Anadarko Petroleum Corporation (Anadarko) submits these comments for your consideration as the Bureau of Ocean Energy Management Regulation and Enforcement (BOEMRE) finalizes its analysis of for the above-captioned draft environmental impact statement (DEIS) released for public comment on April 20, 2011. 76 Fed. Reg. 22139 (April 20, 2011). Anadarko is one of the largest independent oil and gas exploration companies, and we hold substantial lease interests in the Gulf of Mexico. As such, we have a strong interest in the continued orderly development of the oil and gas resources in the Gulf of Mexico.

ANAD-1

The DEIS supplements prior analyses conducted by BOEMRE for lease sales in the Gulf as enumerated in the DEIS. In particular this analysis supplements that prepared by the BOEMRE in the Gulf of Mexico OCS Oil and Gas Lease Sales: 2007-2012 Western Planning Area Sales 204, 207, 210, 215 and 218; Central Planning Area Sales 205, 206, 208, 213, 216 and 222 Final Environmental Impact Statement (Multisale EIS, USDOI, MMS, 2007b). The DEIS analyzes the same three alternatives as analyzed in the Multisale EIS. The Proposed Alternative (Alternative A) would offer all unleased blocks within the Western Planning Area (WPA) for sale except those in certain enumerated areas. Alternative B is similar to A; however, it would further restrict the parcels offered by exempting those blocks subject to the Topographic Features Stipulation. The third alternative (Alternative C) would cancel the lease sale. Anadarko strongly urges the BOMRE to adopt alternative A. The analysis in the document fully supports this alternative, especially when viewed in light of the extensive new regulations the BOEMRE has adopted in the past year. Alternative B is not supportable given the extensive acreage that would be unnecessarily removed from the lease sale. We strongly object to Alternative C – lease cancellation. Adoption of this alternative would remove substantial lease acreage from potential development without a sound scientific basis for doing so. This is particularly true in light of the DEIS' fundamental conclusion that, "based on the information known at this time, there is no reason to believe that the conclusions [regarding potential environmental impacts of future oil and gas operations in the WPA] reached in the Multisale EIS and the 2009-2012 Supplemental

EIS . . . have been altered or changed" as the result of either the Deepwater Horizon event ("DWH") or other newly-developed information (refer to page 4-6).

Anadarko urges the BOEMRE to expeditiously complete this document and issue a record of decision such that Lease Sale 218 can be held this year.

Sincerely,

Ernest Leyendecker
Vice President, Gulf of Mexico Exploration

ANAD-1 Comment noted. The decision on which alternative will be selected will be made after the Supplemental EIS is finalized and, if the decision is to hold a lease sale under either Alternative A or B, it will be announced in the Final Notice of Sale.

CHICKASAW DISTRIBUTORS, INC.

800 BERING DR., SUITE 330 HOUSTON, TEXAS 77057 TEL 713-974-2905 1-800-231-5902 FAX 713-974-3109

May 25, 2011

Mr. Gary D. Goeke
Chief, Environmental Assessment Section
Leasing and Environment (MS 5410)
Bureau of Ocean Energy Management, Regulation and Enforcement
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, LA 70123-2394

Re: GOM Oil and Gas Lease Sale 218

Dear Mr. Goeke:

BAKER-1

For reasons of national security and economic welfare of our nation, enough environmental impact studies have been made and there should be no further delay in the Gulf of Mexico Oil and Gas Lease Sale 218. Thank you.

Sincerely,

Brad Baker

BRADFORD S. BAKER

BSB:ps

AN AMERICAN INDIAN COMPANY

BAKER-1 Comment noted.

on envelope - Comments on WPA Draft ...

Gary D. Goeke
chief
Environmental Assessment Section
MS 5410.
Bureau of ocean Energy mang. Reg & En.
Gulf of Mexico OCS Region
1201 Elmwood Park Blvd.
New Orleans LA. 70123-2394.

Dear Sir:

I wish to be on record as a citizen's comment concerning final Supplemental Environmental gas lease Sale 218.

I witnessed first hand the recent tragic events & the aftermath during the B.P. oil Spill. The human & wildlife toll was immense. My comment will be a follows:

The dubious melding of the corporate state - B.P. & sub-contractors from a myriad of retirees of oil companies (ex:) Swift T.R.G. etc. & the U.S. Coast Guard was very troubling. The Government was never in control of this spill as was testified by Admiral Mary Landry. All decisions were B.P.'s & still are. Now how can you police an oil company that caused the spill; they were policing themselves. Hello! The bureacracy of the government

was completely thrown off -
it Had neither the skill or
money to handle it in an
effective manner. I believe
President Obama's moritorium
was just + leases should not
be granted. We do not have
in place as a government or
even in Private industry
mechanisms to handle another
devastating spill. Big oil +
government are anti-theatical
to one another + government
must have in place a rigorous
system of safety inspectors

crawling all over those rigs.
2,000 rigs - one inspector - U.S.C.G. - unbribable
for each rig. We must watch STATIONED
Big Oil's - rush to profits - Greed
caused the oil spill by ignoring
safety protocols.

B.P. sprayed dispersments after
being ordered not to by the E.P.A.?
Nothing ever happens - until someone
goes jail for killing 11 men + 2,000 birds
dolphins fish OYSTERS SHRIMP pelicans - this ~~cult~~ culture will
not change unless someone goes
to jail. When you look at
the lives destroyed + the
massive die off of a whole species +

contamenation of the coral + subsea strata by the Spill. One must conclude that leases should not be granted unless real + enforceable safety protocals are seriously put in place on each + every rig by the government + paid for sign off on by oil companies as we will have the same thing as deepwater Horizon + more loss of life + ruined ecosystem. .

DAVID-1

Dwight David -
Retired Earth Science Teacher
P.O. Box 277
Youngsville, LA - 70592 .

DAVID-1 Comments noted. The decision on which alternative will be selected (including whether to cancel the lease sale) will be made after the Supplemental EIS is finalized and, if the decision is to hold a lease sale under either Alternative A or B, it will be announced in the Final Notice of Sale. But please note that this Supplemental EIS does take into account and analyze new regulations finalized and implemented since the DWH event to reduce the threat of catastrophic spills and to increase safety, new capabilities in industry that are either in place or being developed for spill containment, and improved inspection protocols.

CHAPTER 6

REFERENCES CITED

6. REFERENCES CITED

Abramson, D., I. Redlener, T. Stehling-Ariza, J. Sury, A. Banister, and Y. Park. 2010. Impact on children and families of the *Deepwater Horizon* oil spill. National Center for Disaster Preparedness. Mailman School of Public Health, Columbia University, New York, NY.

Acevedo, R., R. Morelock, and R.A. Olivieri. 1989. Modification of coral reef zonation by terrigenous sediment stress. Palaios 4:92-100.

Ackerman, J.T., J.Y. Takekawa, K.L. Kruse, D.L. Orthmeyer, J.L. Yee, C.R. Ely, D.H. Ward, K.S. Bollinger, and D.M. Mulcahy. 2004. Using radiotelemetry to monitor cardiac response of free-living tule greater white-fronted geese (*Anser albifrons elgasi*) to human disturbance. Wilson Bulletin 116:146-151.

Adams, J.A. 1960. A contribution to the biology and postlarval development of the Sargassum fish, *Histrio histrio* (Linnaeus), with a discussion of the Sargassum complex. Bull. Mar. Sci. of the Gulf and Caribbean 10:55-82.

Adcroft, A., R. Hallberg, J.P. Dunne, B.L. Samuels, J.A. Galt, C.H. Barker, and D. Payton. 2010. Simulations of underwater plumes of dissolved oil in the Gulf of Mexico. Geophys. Res. Lett. 37, L18605, doi:10.1029/2010GL044689.

Aguilar-Perera, A. and A. Tuz-Sulub. 2010. Non-native, invasive red lionfish (*Pterois volitans* [Linnaeus 1758]: Scorpaenidae), is the first recorded in the southern Gulf of Mexico, off the Northern Yucatan Peninsula, Mexico. Aquatic Invasions, Volume 5, Supplement 1:S9-S12.

Aguilera, F., J. Méndez, E. Pásaro, and B. Laffon. 2010. Review on the effects of exposure to spilled oils on human health. Journal of Applied Toxicology 30:291-301, doi:10.1002/jat.1521.

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

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

Alexander-Bloch, B. 2010. Vietnamese-American fishers fight for oil spill claim approval. *The Times Picayune*. Internet website: http://www.nola.com/news/gulf-oil-spill/index.ssf/2010/12/vietnamese-american_fishermen.html. Accessed February 16, 2011.

Allen, A. 2010. Observations & lessons learned: Offshore operations, *Deepwater Horizon* oil spill. Spiltec. 9 pp. Internet website: http://www.boemre.gov/forums/documents/Panel_II_Presentation_3_anchorage.pdf. Posted Summer 2010. Accessed December 23, 2010.

Alonso-Alvarez, C., C. Perez, and A. Velando. 2007a. Effects of acute exposure to heavy fuel oil from the *Prestige* spill on a seabird. Aquatic Toxicology 84:103-110.

Alonso-Alvarez, C., I. Munilla, M. Lopez-Alonso, and A. Velando. 2007b. Sublethal toxicity of the *Prestige* oil spill on yellow-legged gulls. Environment International 33:773-781.

Alsop, F.J. III. 2001. Birds of North America. Smithsonian Handbook. New York: DK Publishing. 1,008 pp.

American Association of Port Authorities. 2007. US port ranking by cargo volume 2005. Internet website: http://aapa.files.cms-plus.com/PDFs/adv_table_3-12-07.pdf. Accessed October 5, 2010.

American Petroleum Institute (API). 1989. Effects of offshore petroleum operations on cold water marine mammals: A literature review. Washington, DC: American Petroleum Institute. 385 pp.

American Petroleum Institute (API). 2004. Development of a safety and environmental management program for offshore operations and facilities. Recommended Practice (RP) 75.

Amos, A.F. 1989. The occurrence of hawksbills (*Eretmochelys imbricata*) along the Texas coast. Proceedings of the 9th Annual Workshop on Sea Turtle Conservation and Biology. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-SEFSC-232. Pp. 9-11.

Anchor Environmental CA, L.P. 2003. Literature review of effects of resuspended sediments due to dredging operations. Prepared for the Los Angeles Contaminated Sediments Task Force, Los Angeles, CA 140 pp.

Anderson, J.B. 2007. The formation and future of the upper Texas coast: A geologist answers questions about sand, storms, and living by the sea. 1st ed. Texas A&M University Press. Gulf Coastal Studies No. 11. 184 pp.

Anderson, C.M. 2010. Official communication. Email regarding the anticipated OCS spill rate post-Macondo event. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Herndon, VA. August 3, 2010.

Anderson, C.M. and R.P. LaBelle. 2000. Update of comparative occurrence rates for offshore oil spills. Spill Science and Technology Bulletin 6(5/6):302-321.

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

Armstrong, H.W., K. Fucik, J.W. Anderson, and J.M. Neff. 1977. Effects of oilfield brine effluent on benthic organisms in Trinity Bay, Texas. API Publication No. 4201. Washington, DC: American Petroleum Institute.

Atauz, A.D., W. Bryant, T. Jones, and B. Phaneuf. 2006. Mica shipwreck project: Deepwater archaeological investigation of a 19th century shipwreck in the Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2006-072. 116 pp.

Atkins, M., S. Mirza, J. Skinner, A. Mathew, and T. Edward. 2006. Pipeline damage assessment from Hurricane Ivan in the Gulf of Mexico. Minerals Management Service, Herndon, VA. TA&R 553.

Atkins, M., T. Edward, D. Johnson, and M. Dance. 2007. Pipeline damage assessment from Hurricanes Katrina and Rita in the Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Herndon, VA. TA&R 581.

Atlantic and Gulf States Marine Fisheries Commissions. 2004. Guidelines for marine artificial reef materials. Second edition. Number 121. 205 pp. Internet website: http://www.gsmfc.org/pubs/SFRP/Guidelines_for_Marine_Artificial_Reef_Materials_January_2004.pdf.

Aurell, J. and B.K. Gullett. 2010. Aerostat sampling of PCDD/PCDF emissions from the Gulf oil spill in situ burns. U.S. Environmental Protection Agency, Office of Research and Development, National Risk Management Research Laboratory, Research Triangle Park, NC. 22 pp. Internet website: http://www.epa.gov/research/dioxin/docs/Gulfinsituburnemissionsampling.pdf. Accessed April 13, 2011.

Austin, D., K. Coelho, A. Gardner, R. Higgins, and T. McGuire. 2002a. Social and economic impacts of outer continental shelf activities on individuals and families. Volume I: Final report. U.S. Dept. of the Interior, Minerals Management Service, New Orleans, LA. OCS Study MMS 2002-022. 298 pp.

Austin, D.E., A. Gardner, R. Higgins, J. Schrag-James, S. Sparks, and L. Stauber. 2002b. Social and economic impacts of outer continental shelf activities on individuals and families. Volume II: Case studies of Morgan City and New Iberia, Louisiana. U.S. Dept. of the Interior, Minerals Management Service, New Orleans, LA. OCS Study MMS 2002-023. 197 pp.

Austin-American Statesman. 2010. Land commissioner says state getting most ever in oil and gas proceeds though oil production topped out in 1970s. Internet website: http://www.politifact.com/texas/statements/2010/may/02/jerry-patterson/land-commissioner-says-state-getting-most-ever-oil/. Posted May 3, 2010. Accessed October 12, 2010.

Austin Post. 2010. New leads on Texas tar balls. July 10, 2010. Internet website: http://www.austinpost.org/content/new-leads-texas-beach-tar-balls-finding. Accessed May 31, 2011.

Australian Maritime Safety Authority. 2003. Post spill monitoring: Background paper. Prepared by Wardrop Consulting and the Cawthron Institute for the Australian Maritime Safety Authority and the Marine Safety Authority of New Zealand. Published by the Australian Maritime Safety Authority, Canberra. ISBN: 0 642 70991 2.

Australian Maritime Safety Authority. 2010. Oil spill dispersants: Top 20 frequently asked questions (FAQs). Internet website: http://www.amsa.gov.au/Marine_Environment_Protection/National_plan/General_Information/Dispersants_Information/FAQ_Oil_Spills_Dispersants.asp. Accessed June 29, 2010.

Aversa, J. 2010. Oil spill's economic damage may not go beyond Gulf. Internet website: http://dailycaller.com/2010/06/28/oil-spills-economic-damage-may-not-go-beyond-gulf/. Accessed February 16, 2011.

Avery, M.L., P.F. Springer, and N.S. Dailey. 1980. Avian mortality at man-made structures: An annotated bibliography (revised). U.S. Dept. of the Interior, Fish and Wildlife Service, Biological Services Program. FWS/OBS-80/54.

Avian Power Line Interaction Committee. 1994. Mitigating bird collisions with power lines: The state of the art in 1994. Edison Electric Institute, Washington, DC.

Awbrey, F.T. and A.E. Bowles. 1990. The effects of aircraft noise and sonic booms on raptors: A preliminary model and a synthesis of the literature on disturbance. Prepared for Noise and Sonic Boom Impact Technology (NSBIT), Advanced Development Program Office, Human Systems Division, OL-AC HSD-NSBIT, Wright-Patterson Air Force Base, OH. NSBIT Technical Operating Report No. 12.

Baca, B.J., T.E. Lankford, and E.R. Gundlach. 1987. Recovery of Brittany coastal marshes in the eight years following the *Amoco Cadiz* incident. In: Proceedings of the 1987 International Oil Spill Conference. Washington, DC: American Petroleum Institute. Pp. 459-464.

Baca, B., G.A. Ward, C.H. Lane, and P.A. Schuler. 2005. Net environmental benefit analysis (NEBA) of dispersed oil on nearshore tropical ecosystems derived from the 20 year "TROPICS" field study. In: Proceedings of the International Oil Spill Conference. May 15-19, 2005. Miami Beach, FL.

Bahr, L.M., Jr., J.W. Day, and J.H. Stone. 1982. Energy cost accounting of Louisiana fishery production. Estuaries 5(3):209-215.

Bailey H. and P. Thompson. 2010. Effect of oceanographic features on fine-scale foraging movements of bottlenose dolphins. Marine Ecology Progress Series 418:223-233.

Baird, P.H. 1990. Concentrations of seabirds at oil-drilling rigs. Condor 92:768-771.

Bak, R.P. 1978. Lethal and sublethal effects of dredging on coral reefs. Marine Pollution Bulletin 9(1):14-16.

Bak, R.P.M. and J.H.B.W. Elgershuizen. 1976. Patterns of oil-sediment rejection in corals. Marine Biology 37:105-113.

Baker, J.M., M.L. Guzman, P.D. Bartlett, D.I. Little, and C.M. Wilson. 1993. Long-term fate and effects of untreated thick oil deposits on salt marshes. In: Proceedings of the 1993 International Oil Spill Conference. Washington, DC: American Petroleum Institute. Pp. 395-399.

Balsam, W.L. and J.P. Beeson. 2003. Sea-floor sediment distribution in the Gulf of Mexico. Deep Sea Research Part I. Oceanographic Research Papers 50(12):1421-1444.

Balseiro, A., A. Espi, I. Marquez, V. Perez, M.C. Ferreras, J.F. Garcia Marin, and J.M. Prieto. 2005. Pathological features in marine birds affected by the *Prestige*'s oil spill in the north of Spain. Journal of Wildlife Diseases 41:371-378.

Barnea, N., J. Michel, B. Bray, Z. Nixon, G. Imahori, and C. Moegling. 2009. Marine debris response planning in the north-central Gulf of Mexico. June 2009. U.S. Dept. of Commerce, NOAA Technical Memorandum NOS-OR&R-31.

Barras, J.A., S. Beville, D. Britsch, S. Hartley, S. Hawes, J. Johnston, P. Kemp, Q. Kinler, A. Martucci, J. Porthouse, D. Reed, K. Roy, S. Sapkota, and J. Suhayda. 2003. Historical and projected coastal Louisiana land changes: 1978-2050. USGS Open File Report 03-334.

Barringer, F. 2010. As mess is sent to landfills, officials worry about safety. *The New York Times*, June 14, 2010. Internet website: http://www.nytimes.com/2010/06/15/science/earth/15waste.html. Accessed July 1, 2010.

Barry A. Vittor and Associates, Inc. 1985. Tuscaloosa Trend regional data search and synthesis study. Volume I: Synthesis report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico Regional OCS Office, Metairie, LA. OCS Study MMS 85-0056. 398 pp.

Barstow, D., L. Dodd, J. Glanz, S. Saul, and I. Urbina. 2010. Regulators failed to address risks in oil Rig fail-safe device. *The New York Times*, June 20, 2010. Internet website: http://www.nytimes.com/2010/06/21/us/21blowout.html?_r=1&pagewanted=1. Accessed January 28, 2011.

Bass, A.S. and R.E. Turner. 1997. Relationships between salt marsh loss and dredged canals in three Louisiana estuaries. Journal of Coastal Research 13(3):895-903.

Bassin, N.J. and T. Ichiye. 1977. Flocculation behavior of suspended sediments and oil emulsions. Journal of Sedimentary Research 47(2):671-677.

Baumann, R.H. and R.E. Turner. 1990. Direct impacts of outer continental shelf activities on wetland loss in the central Gulf of Mexico. Environ. Geo. Water Sci. 15(3):189-198.

Baxter II, L., E.E. Hays, G.R. Hampson, and R.H. Backus. 1982. Mortality of fish subjected to explosive shock as applied to oil well severance on Georges Bank. Woods Hole Oceanographic Institution, Woods Hole, MA. Technical Report WHOI-82-54. 69 pp.

Bea, R.G., N.W. Lai, A.W. Niedoroda, and G.H. Moore. 1983. Gulf of Mexico shallow-water wave heights and forces. In: Proceedings of the Offshore Technical Conference, Houston, TX, May 1983. OTC 4586. Pp. 49-62.

Beale, C.M. 2007. The behavioral ecology of disturbance responses. International Journal of Comparative Psychology 20:111-120.

Beauchamp, G. 2002. Higher-level evolution of intraspecific flock-feeding in birds. Behavioral Ecology and Sociobiology 51:480-487.

Beauchamp, G. 2004. Reduced flocking by birds on islands with relaxed predation. Proceedings of the Royal Society of London B 271:1039-1042.

Beauchamp, G. 2008. What is the magnitude of the group-size effect on vigilance? Behavioral Ecology 19(6):1361-1368.

Beauchamp, G. and G.D. Ruxton. 2008. Disentangling risk dilution and collective detection in the antipredator vigilance of semipalmated sandpipers in flocks. Animal Behavior 75:1837-1842.

Beerkircher, L.R. 2009. Official communication. U.S. Dept. of Commerce, NOAA, National Marine Fisheries Service.

Behrens, E.W. 1988. Geology of a continental slope oil seep, northern Gulf of Mexico. American Association of Petroleum Geologists Bulletin 72(2):105-114.

Behrens, E.W., P.L. Parker, R.S. Scalan, J.K. Winters, J.M. Brooks, and B.B. Bernard. 1980. Chapter four. Marine benthic environment of the south Texas shelf. In: Flint, R.W. and N.N. Rabalais, eds. 1980. Environmental studies, south Texas outer continental shelf, 1975-1977. Volume I: Ecosystem description. Submitted to the U.S. Dept. of the Interior, Bureau of Land Management, Washington, DC. Contract AA551-CT8-51.

Beiras, R. and L. Saco-Álvarez. 2006. Toxicity of seawater and sand affected by the *Prestige* fuel-oil spill using bivalve and sea urchin embryogenesis bioassays. Water, Air, and Soil Pollution 177:457-466.

Belanger, L. and J. Bedard. 1990. Energetic cost of man-induced disturbance to staging snow geese. Journal of Wildlife Management 54:36-41.

Bell, W.B. 1972. Animal response to sonic booms. Journal of the Acoustic Society of America 51:758-765.

Bellrose, F.C. 1980. Ducks, geese, and swans of North America: A Wildlife Management Institute book sponsored jointly with the Illinois Natural History Survey. Washington, DC: Stackpole Books. 540 pp.

Berecz, E. and M. Balla-Achs. 1983. Gas hydrates. New York, NY: Elsevier. 343 pp.

Berman, A.E. 2005. The debate over subsidence in coastal Louisiana and Texas. Houston Geological Society. Internet website: http://www.hgs.org/en/art/?691. Posted November 24, 2005. Accessed October 5, 2010.

Berns, D.M. 2003. Physiological responses of *Thalassia testudinum* and *Ruppia maritima* to experimental salinity levels. M.Sc. Thesis, University of South Florida, St. Petersburg, FL. 71 pp.

Bindoff, N.L., J. Willebrand, V. Artale, A, Cazenave, J. Gregory, S. Gulev, K. Hanawa, C. Le Quéré, S. Levitus, Y. Nojiri, C.K. Shum, L.D. Talley, and A. Unnikrishnan. 2007. Observations; oceanic climate change and sea level. In: Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Avery, M. Tignor and H.L. Miller, eds. Climate change 2007: The physical science basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. Internet website: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch5.html.

Birchwood, R., S. Noeth, and E. Jones. 2008. Safe drilling in gas-hydrate prone sediments: Findings from the 2005 drilling campaign of the GOM gas hydrates Joint Industry Project (JIP). U.S. Dept. of Energy, National Energy Technology Laboratory, Fire in the Ice. Methane Hydrate Newsletter. Winter 2008. Pp. 1-8. Internet website: http://www.netl.doe.gov/technologies/oil-gas/FutureSupply/MethaneHydrates/newsletter/newsletter.htm.

Birkett, S.H. and D.J. Rapport. 1999. A stress-response assessment of the northwestern Gulf of Mexico ecosystem. In: Kumpf, H., K. Steidinger, and K. Sherman, eds. The Gulf of Mexico large marine ecosystem: Assessment, sustainability, and management. Malden, MA: Blackwell Science, Inc. Pp. 438-458.

Bittner, J.E. 1996. Cultural resources and the *Exxon-Valdez* oil spill: An overview. In: Proceedings of the *Exxon-Valdez* Oil Spill Symposium. American Fisheries Society Symposium 18:814-818.

Block, B.A., H.D. Susanna, B. Blackwell, T.D. Williams, E.D. Prince, C.J. Farwell, A. Boustany, S.L.H. Teo, A. Seitz, A. Walli, and D. Fudge. 2001. Migratory movements, depth preferences, and thermal biology of Atlantic bluefin tuna. Science 293(5533):1310-1314.

Blum, M.D. and H.H. Roberts. 2009. Drowning of the Mississippi Delta due to insufficient sediment supply and global sea-level rise. Nature Geoscience 2:488-491. Internet website: http://www.deltas2010.com/blum2009.pdf.

Boehm, P.D. and D.L. Fiest. 1982. Subsurface distributions of petroleum from an offshore well blowout. The *Ixtoc I* Blowout, Bay of Campeche. Environmental Science and Technology 16(2):67-74.

Boehm, P., D. Turton, A. Raval, D. Caudle, D. French, N. Rabalais, R. Spies, and J. Johnson. 2001. Deepwater program: Literature review, environmental risks of chemical products used in Gulf of Mexico deepwater oil and gas operations. Volume I: Technical report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2001-011. 326 pp.

Boesch D.F. and N.N. Rabalais, eds. 1987. Long-term environmental effects of offshore oil and gas development. Abingdon, Oxford, UK: Taylor and Francis.

Boesch, D.F., M.N. Josselyn, A.J. Mehta, J.T. Morris, W.K. Nuttle, C.A. Simestad, and D.J.P. Swift. 1994. Scientific assessment of coastal wetland loss, restoration and management in Louisiana. Journal of Coastal Research Special Issue 20:1-103.

Boland, G.S. 1986. Discovery of co-occurring bivalve *Acesta* sp. and chemosynthetic tube worms Lamellibrachia. Nature 323:759.

Boland, G.S. and P.W. Sammarco. 2005. Observations of the antipatharian "black coral" *Plumapathes pennacea* (Pallas, 1766) (Cnidaria: Anthozoa), northwest Gulf of Mexico. Gulf of Mexico Science 23:127-132.

Bologna, P.A.X. and K.L. Heck, Jr. 1999. Macrofaunal associations with seagrass epiphytes: Relative importance of trophic and structural characteristics. Journal of Experimental Marine Biology and Ecology 242(1):21-39.

Bortone, S.A., P.A. Hastings, and S.B. Collard. 1977. The pelagic Sargassum ichthyofauna of the eastern Gulf of Mexico. Northeast Gulf Science 1:60-67.

Boswell, R., T. Collett, D. McConnell, M. Frye, B. Shedd, S. Mrozewski, G. Guerin, A. Cook, P. Godfriaux, R. Dufrene, R. Roy, and E. Jones. 2009. Joint industry project Leg II discovers rich gas hydrate accumulations in sand reservoirs in the Gulf of Mexico. U.S Dept. of Energy, National Energy Technology Laboratory, Fire in the Ice. Methane Hydrate Newsletter. Summer 2009. Pp. 1-5. Internet website: http://www.netl.doe.gov/technologies/oil-gas/FutureSupply/MethaneHydrates/newsletter/newsletter.htm.

Bourgeois, M. 2010. Official communication (email). Fish kills in the MRGO. Louisiana Dept. of Wildlife and Fisheries. August 23, 2010.

Bowers, Q.D. 2008. The treasure ship *New York*: Her story, 1837-1846. Stack's, New York.

Bricker, S., B. Longstaff, W. Dennison, A. Jones, K. Boicourt, C. Wicks, and J. Woerner. 2007. Effects of nutrient enrichment in the Nation's estuaries: A decade of change. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Centers for Coastal Ocean Science, Silver Spring, MD. NOAA Coastal Ocean Program Decision Analysis Series No. 26. 328 pp.

Briggs, K.T., S.H. Yoshida, and M.E. Gershwin. 1996. The influence of petrochemicals and stress on the immune system of seabirds. Regulatory Toxicology and Pharmacology 23:145-155.

Bright, T.J. and R. Rezak. 1978. Northwestern Gulf of Mexico topographic features study: Final report. U.S. Dept. of the Interior, Bureau of Land Management, New Orleans OCS Office, New Orleans, LA. Study No. 1978-4. 692 pp. Internet website: http://www.gomr.boemre.gov/PI/PDFImages/ESPIS/3/4069.pdf.

Bright, T.J., R. Rezak, A.H. Bouma, W.R. Bryant, and W.E. Pequegnat. 1976. A biological and geological reconnaissance of selected topographical features on the Texas continental shelf. Final report to the U.S. Dept. of the Interior, Bureau of Land Management, New Orleans OCS Office, New Orleans, LA. Contract # 08550-CT5-4.

Britsch, L.D. and J.B. Dunbar. 1993. Land loss rates: Louisiana coastal plain. Journal of Coastal Research 9(2):324-338.

Broder, J.M. 2010. Drillers fault study on moratorium losses. *The New York Times*. Internet website: http://green.blogs.nytimes.com/2010/09/16/drillers-fault-study-on-moratorium-losses/. Accessed December 12, 2010.

Brody, S., S. Bernhardt, H. Grover, C. Spence, Z. Tang, and B. Whitaker. 2006. Identifying potential conflict associated with oil and gas exploration in Texas state coastal waters: A multi-criteria spatial analysis. Environmental Management 38:597-617.

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

Brooks, J.M., C. Fisher, H. Roberts, B. Bernard, I. McDonald, R. Carney, S. Joye, E. Cordes, G. Wolff, and E. Goehring. 2009. Investigations of chemosynthetic communities on the lower continental slope of the Gulf of Mexico: Interim report 2. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2009-046. 360 pp. Internet website: http://www.gomr.boemre.gov/PI/PDFImages/ESPIS/4/4877.pdf.

Brown, Jr., L.F., J.L Brewton, J.H. McGowen, T.J. Evans, W.L. Fisher, and C.G. Groat. 1976. Environmental geologic atlas of the Texas coastal zone: Corpus Christi area. Austin, TX: The University of Texas at Austin, Bureau of Economic Geology.

Brown, Jr, L.F., J.H. McGowen, T.J. Evans, C.S. Groat, and W.L. Fisher. 1977. Environmental geological atlas of the Texas coastal zone: Kingsville area. Austin, TX: The University of Texas at Austin, Bureau of Economic Geology.

Bruseth, J.E. and T.S. Turner. 2005. From a watery grave: the discovery and excavation of La Salle's shipwreck *La Belle*. Texas Historical Commission, Austin.

Bryant, W. and J.Y. Lui. 2000. Chapter 3: Geology. In: Continental Shelf Associates, Inc. Deepwater Gulf of Mexico environmental and socioeconomic data search and literature study. Volume I: Narrative report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-049. Pp. 25-59.

Bryant, W., N. Slowey, S. DiMarco, D. Bean, and D. Berti. 2004. DeepSea furrows: Physical characteristics, mechanisms of formation and associated environmental processes. Final report prepared for Research Partnership to Secure Energy for America. 4 pp.

Burger, J. 1977. Determinants of hatching success in diamond-back terrapin, *Malaclemys terrapin*. American Midland Naturalist 97:444-464

Burger, J. 1981. Behavioural responses of herring gulls *Larus argentatus* to aircraft noise. Environmental Pollution Series A, Ecological and Biological 24:177-184.

Burger, A.E. 1993. Estimating the mortality of seabirds following oil spills: Effects of spill volume. Marine Pollution Bulletin 26:140-143.

Burger, J. 1994. Immediate effects of oils spills on organisms in the Arthur Kill. In: Burger, J., ed. Before and after an oil spill: The Arthur Kill. New Brunswick, NJ: Rutgers University Press. Pp. 115-130.

Burns, K.A. and A.H. Knap. 1989. The Bahia las Minas oil spill. Hydrocarbon uptake by reef building corals. Marine Pollution Bulletin 20(8):391-398.

Burns, K.A. and J.M. Teal. 1973. Hydrocarbons in the pelagic sargassum community. Deep Sea Research and Oceanographic Abstracts 20(2):207-211.

Burns, K.A., S.D. Garrity, and S.C. Levings. 1993. How many years until mangrove ecosystems recover from catastrophic oil spills? Marine Pollution Bulletin 26(5):239-248.

Burns III, G.H., C.A. Benson, T. Eason, J. Michel, S. Kelly, and B. Benggio. 1994. Recovery of submerged oil at San Juan, Puerto Rico 1994. International Oil Spill Conference. Internet website: http://www.iosc.org/papers/01798.pdf.

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

Butler, J.A., R.A. Seigel, and B. Mealey. 2006. *Malaclemys terrapin*—diamondback terrapin. In: Meylan, P.A., ed. Biology and conservation of Florida turtles. Chelonian Research Monographs 3:279-295.

Byrd, G.V., J.H. Reynolds, and P.L. Flint. 2009. Persistence rates and detection probabilities of bird carcasses on beaches of Unalaska Island, Alaska, following the wreck of the M/V *Selendang Ayu*. Marine Ornithology 37:197-204.

Byrne, C. 1989. Effects of the water-soluble fractions of No. 2 fuel oil on the cytokinesis of the Quahog clam (*Mercenaria mercenaria*). Bulletin of Environmental Contamination and Toxicology 42:81-86.

Byrne, C.J. and J.A. Calder. 1977. Effect of the water-soluble fractions of crude, refined, and waste oils on the embryonic and larval stages of the Quahog clam *Mercenaria* sp. Marine Biology 40:225-231.

Byrne, J.H. and J.L. Roberts, eds. 2009. From molecules to networks: An introduction to cellular and molecular neuroscience. 2nd ed. Elsevier: New York, NY.

Byrnes, M.R., R.M. Hammer, B.A. Vittor, J.S. Ramsey, D.B. Snyder, K.F. Bosma, J.D. Wood, T.D. Thibaut, and N.W. Phillips. 1999. Environmental survey of identified sand resource areas offshore Alabama: Volume I: Main text. Volume II: Appendices. U.S. Dept. of the Interior, Minerals Management Service, International Activities and Marine Minerals Division (INTERMAR), Herndon, VA. OCS Report MMS 99-0052. 326 pp. + 132 pp. appendices.

Cadlow, C., R. Clark, K. Edwards, S.D. Hile, C. Menza, E. Hickerson, and G.P. Schmahl. 2009. Biogeographic characterization of fish communities and associated benthic habitats within the Flower Garden Banks National Marine Sanctuary: Sampling design and implementation of SCUBA surveys on the coral caps. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Silver Spring, MD. NOAA Technical Memorandum NOS NCCOS 81. 134 pp.

Caetano, M., M.J. Madureira, and C. Vale. 2003. Metal remobilization during resuspension of anoxic contaminated sediment: Short-term laboratory study. Water, Air, and Soil Pollution 143:23-40.

Cagle, F.R. 1952. A Louisiana terrapin population (*Malaclemys*). Copeia 1952:74-76.

Camilli, R., C.M. Reddy, D.R. Yoerger, B.A.S. Van Mooy, M.V. Jakuba, J.C. Kinsey, C.P. McIntyre, S.P. Sylva, and J.V. Maloney. 2010. Tracking hydrocarbon plume transport and biodegradation at Deepwater Horizon. Published online August 19, 2010. Science 8 October 2010: 330:6001(201-204). DOI: 10.1126/science. 1195223.

Campbell, T., L. Benedict, and C.W. Finkl. 2005. Regional strategies for coastal restoration along Louisiana barrier islands. Journal of Coastal Research Special Issue 44. Pp. 245-267.

Camphuysen, K.C.J., M. Heubeck, S.L. Cox, R. Bao, D. Humple, C. Abraham, and A. Sandoval. 2002. The *Prestige* oil spill in Spain. Atlantic Seabirds 4:131-140.

Camphuysen C.J., J. Chardine, M. Frederiksen, and M. Nunes. 2005. Review of the impacts of recent major oil spills on seabirds. In: Anonymous, ed. Report of the Working Group on Seabird Ecology, Texel, 29 March – 1 April 2005. Oceanography Committee, ICES CM 2005/C:05, Ref. ACME+E, International Council for the Exploration of the Sea. Copenhagen, Denmark.

Cardiff, S. 2006. Official communication. List of seabirds of the northern Gulf of Mexico. Avian Biologist, Louisiana State University Museum of Natural Sciences, Baton Rouge, LA.

Carls, M.G., G.D. Marty, T.R. Meyers, R.E. Thomas, and S.D. Rice. 1998. Expression of viral hemorrhagic septicemia virus in prespawning Pacific herring (*Clupea pallasi*) exposed to weathered crude oil. Canadian Journal of Fisheries and Aquatic Sciences 55(10):2300-2309.

Carlson, P.R., Jr. and K. Madley. 2007. Statewide summary for Florida. In: Handley, D.A., D. Altsman, and R. DeMay, eds. Seagrass status and trends in the northern Gulf of Mexico: 1940-2002. U.S. Dept. of the Interior, Geological Survey Scientific Investigations Report 2006-5287 and U.S. Environmental Protection Agency 855-R-04-003. Pp. 99-114. Internet website: http://pubs.usgs.gov/sir/2006/5287/.

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

Carney, R.S. 1997. Workshop on environmental issues surrounding deepwater oil and gas development: Final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 98-0022. 164 pp.

Carney, R.S. 1999. Status of environmental and physical oceanography information on the continental slope in the Gulf of Mexico—results of a workshop. In: McKay, M. and J. Nides, eds. Proceedings: Seventeenth annual Gulf of Mexico information transfer meeting, December 1997. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 99-0042. 419 pp. Internet website: http://www.gomr.boemre.gov/PI/PDFImages/ESPIS/3/3206.pdf.

Carney, K.M. and W.J. Sydeman. 1999. A review of human disturbance effects on nesting colonial waterbirds. Waterbirds 22:68-79.

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

Carpenter, E.J. and J.L. Cox. 1974. Production of pelagic Sargassum and a blue-green epiphyte in the western Sargasso Sea. Limnology and Oceanography 19(3):429-436.

Carr, A. 1987. New perspectives on the pelagic stages of sea turtle development. Conservation Biology 1(2):103-121.

Carr, A. and A.B. Meylan. 1980. Evidence of passive migration of green turtle hatchlings in Sargassum. Am. Soc. Ichthyologists and Herpetologists 2:366-368.

Carr, R.S., D.C. Chapman, B.J. Presley, J.M. Biedenbach, L. Robertson, P. Boothe, R. Kilada, T. Wade, and P. Montagna. 1996. Sediment porewater toxicity assessment studies in the vicinity of offshore oil and gas production platforms in the Gulf of Mexico. Canadian Journal of Fisheries and Aquatic Science 53:2618-2682.

Carson, R.T. and W.M. Hanemann. 1992. A preliminary economic analysis of recreational fishing losses related to the *Exxon Valdez* oil spill. A Report to the Attorney General of the State of Alaska. 16 pp.

Casselman, B. 2010. Aging oil rigs, pipelines expose Gulf to accidents. *The Wall Street Journal*. December 14, 2010. Internet website: http://online.wsj.com/article/SB10001424052748704584804575644463302701660.html. Accessed December 2010.

Casselman, B. and D. Gilbert. 2011a. Drilling is stalled even after ban is lifted. *The Wall Street Journal*. Internet website: http://online.wsj.com/article/SB10001424052970204204004576050451696859780.html?mod=WSJ_hp_LEFTTopStories. Posted January 3, 2011. Accessed January 3, 2011.

Casselman, B. and D. Gilbert. 2011b. Path clears for deep-water drilling. *The Wall Street Journal*. Internet website: http://online.wsj.com/article/SB10001424052748704111504576060122314549528.html?mod=WSJ_hp_MIDDLENexttoWhatsNewsTop. Posted January 4, 2011. Accessed January 4, 2011.

Castege, I., Y. Lalanne, V. Gouriou, G. Hemery, M. Girin, F. D'Amico, C. Mouches, J. D'Elbe, L. Soulier, J. Pensu, D. Lafitte, and F. Pautrizel. 2007. Estimating actual seabirds mortality at sea and relationship with oil spills: lesson from the "Prestige" oil spill in Aquitaine (France). Ardeola 54:289-307.

Castellanos, D.L. and L.P. Rozas. 2001. Nekton use of submerged aquatic vegetation, marsh, and shallow unvegetated bottom in the Atchafalaya River Delta, a Louisiana tidal freshwater ecosystem. Estuaries 24(2):184-197.

Centers for Disease Control and Prevention. 2010. Gulf oil spill 2010: Light crude oil information for health professionals. Internet website: http://emergency.cdc.gov/gulfoilspill2010/light_crude_health_professionals.asp. Accessed July 21, 2011.

Chabreck, R.H., T. Joanen, and S.L. Paulus. 1989. Southern coastal marshes and lakes. In: Smith, L.M., R.L. Pederson, and R.M. Kaminski, eds. Habitat management for migrating and wintering waterfowl in North America. Texas Tech University Press, Lubbock.

Chaisson, C. 2011. Official communication. Port Fourchon post-moratorium status as of June 2011. Executive Director, Greater Lafourche Port Commission, Port Fourchon, LA. June 27, 2011.

Chambers, M. 2010. Gulf Coast ports surrounding the *Deepwater Horizon* oil spill. U.S. Dept of Transportation, Research and Innovative Technology Administration, Fact Sheet. June 2010. 4 pp. Internet website: http://www.bts.gov/publications/bts_fact_sheets/2010_001/pdf/entire.pdf.

Chan, E.I. 1977. Oil pollution and tropical littoral communities: Biological effects of the 1975 Florida Keys oil spill. In: Proceeding of the 1977 Oil Spill Conference, March 8-10, 1977, New Orleans, LA. Washington, DC: American Petroleum Institute.

Chapman, P.M., E.A. Power, R.N. Dexter, and H.B. Andersen. 1991. Evaluation of effects associated with and oil platform, using the sediment quality triad. Environmental Toxicology and Chemistry 10:407-424.

Chin, C.S. and J. Church. 2010. Field report: Fort Livingston, Grand Terre Island (September 9-10, 2010. National Center for Preservation Technology and Training, Natchitoches, LA. Internet website: http://www.ncptt.nps.gov/2011/field-report-fort-livingston-grand-terre-island/. Accessed March 18, 2011.

Cho, H.J. and C.A. May. 2008. Short-term spatial variations in the beds of *Ruppia maritima* (Ruppiaceae) and *Halodule wrightii* (Cymodoceaccae) at Grand Bay National Estuarine Research Reserve, Mississippi, USA. Journal of the Mississippi Academy of Sciences 53(2-3):133-145.

Cho, H.J., P. Biber, and C. Nica. 2009. The rise of *Ruppia maritima* in seagrass beds: changes in coastal environment and research needs. In: Drury, E.K. and T.S. Pridgen, eds. Handbook on Environmental Quality. Hauppauge, NY: Nova Science Publishers, Inc. 418 pp.

Church, R.A. and D.J. Warren. 2008. Viosca Knoll wreck: Discovery and investigation of an early nineteenth-century sailing ship in 2,000 feet of water. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2008-018. 41 pp.

Church, R., D. Warren, R. Cullimore, L. Johnston, W. Schroeder, W. Patterson, T. Shirley. M. Kilgour, N. Morris, and J. Moore. 2007. Archaeological and biological analysis of World War II shipwrecks in the Gulf of Mexico: Artificial reef effect in deep water. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2007-015. 387 pp.

City of New Orleans. n.d. The New Orleans city assisted evacuation plan. Internet website: http://www.nola.gov/~/media/Files/Emergency%20Prepardness/Emergency%20Preparedness%20Documents/Assisted_Evac_Plan.ashx. Accessed February 17, 2011.

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

Clark, R.B. 1982. The impact of oil pollution on marine populations, communities, and ecosystems: A summing up. Philosophical Transactions of the Royal Society of London. B 297:433-443.

Clark, R.B. 1984. Impact of oil pollution on seabirds. Environmental Pollution Series A 33:1-22.

Clark, C.E. and J.A. Veil. 2009. Produced water volumes and management practices in the United States. Prepared by the Environmental Science Division, Argonne National Laboratory for the U.S.

Dept. of Energy, Office of Fossil Energy, National Energy Technology Laboratory under Contract DE-AC02-06CH11357. ANL/EVS/R-09/1. Internet website: http://www.evs.anl.gov/pub/dsp_detail.cfm?PubID=2437.

Clarke, D.G. and D.H. Wilber. 2000. Assessment of potential impacts of dredging operations due to sediment resuspension. DOER Technical Notes Collection. ERDC TN-DOER-EP. U.S. Dept. of the Army, Research and Development Center, Vicksburg, MS.

Clausen, C.J. and J.B. Arnold III. 1975. Magnetic delineation of individual shipwreck sites; a new control technique. Bull. of the Texas Archaeological Soc. 46:69-86.

Coastal Environments, Inc. (CEI). 1977. Cultural resources evaluation of the northern Gulf of Mexico continental shelf. Prepared for the U.S. Dept. of the Interior, National Park Service, Office of Archaeology and Historic Preservation, Interagency Archaeological Services, Baton Rouge, LA. 4 vols.

Coastal Environments, Inc. (CEI). 1982. Sedimentary studies of prehistoric archaeological sites. Prepared for the U.S. Dept. of the Interior, National Park Service, Division of State Plans and Grants, Baton Rouge, LA.

Coastal Response Research Center. 2007. Submerged oil—State of the practice and research needs. Prepared by the Coastal Response Research Center, Durham, NN. 29 pp. + app. Internet website: http://www.crrc.unh.edu/workshops/submerged_oil/submerged_oil_workshop_report.pdf. Accessed December 27, 2010.

Cohen, Y., A. Nissenbaum, and R. Eisler. 1977. Effects of Iranian crude oil on the Red Sea octocoral *Heteroxenia fuscescens*. Environmental Pollution 12:173-186.

Cohen, J.E., C. Small, A. Mellinger, J. Gallup, and J. Sachs. 1997. Estimates of coastal populations. Science 278:1211–1212.

Cole, K.L. and S.F. DiMarco. 2010. Low-frequency variability of currents in the deepwater eastern Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2010-015. 136 pp.

Collard, S. 1990. Leatherback turtles feeding near a water mass boundary in the eastern Gulf of Mexico. Marine Turtle Newsletter 50:12-14.

Collard, S.B. and A. Lugo-Fernandez. 1999. Coastal upwelling and mass mortalities of fishes and invertebrates in the northeastern Gulf of Mexico during spring and summer 1998. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS-99-0049. 20 pp.

Collett, T.S. 2002. Energy resource potential of natural gas hydrates. American Association of Petroleum Geologists Bulletin 86(11):1971-1992.

Collins, M.A. 1995. Dredging-induced near-filed resuspended sediment concentrations and source strengths. Final Report D-95-2. U.S. Dept. of the Army, Corps of Engineers. 229 pp.

Collins Center for Public Policy. 2010. Potential impacts of oil and gas explorations in the Gulf. A report to the Century Commission for a Sustainable Florida. 40 pp.

Conan, G. 1982. The long-term effects of the *Amoco Cadiz* oil spill. Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences 297(1087). The long-term effects of oil pollution on marine populations, communities, and ecosystems. Pp. 323-333.

Conant, T.A., P.H. Dutton, T. Eguchi, S.P. Epperly, C.C. Fahy, M.H. Godfrey, S.L. MacPherson, E.E. Possardt, B.A. Schroeder, J.A. Seminoff, M.L. Snover, C.M. Upite, and B.E. Witherington. 2009. Loggerhead sea turtle (*Caretta caretta*) 2009 status review under the U.S. Endangered Species Act. Report of the Loggerhead Biological Review Team to the National Marine Fisheries Service, August 2009. 222 pp. Internet website: http://www.nmfs.noaa.gov/pr/pdfs/statusreviews/loggerheadturtle2009.pdf/. Accessed July 17, 2011.

Connor, M. 2010. US oil spill not sticking to bond issuers-Moody's. Internet website: http://www.xe.com/news/2010-11-22%2015:20:00.0/1539229.htm. Accessed December 8, 2010.

Continental Shelf Associates, Inc. (CSA). 1992. Preliminary report of potential effects of oil spilled from Texaco's proposed pipeline from Platform A in Garden Banks Block 189 to the subsea tie-in with High Island Pipeline System's (HIPS) existing pipeline in High Island Area Block A-377 (modified route). Prepared for Texaco Pipeline, Inc., Jupiter, FL.

Continental Shelf Associates, Inc. (CSA). 1994. Analysis of potential effects of oil spilled from proposed structures associated with Oryx's High Island Block 384 unit on the biota of the East Flower Garden Bank and on the biota of Coffee Lump Bank. Prepared for Oryx Energy Company, Jupiter, FL.

Continental Shelf Associates, Inc. (CSA). 1997. Gulf of Mexico produced water bioaccumulation study: Definitive component technical report. Prepared for the Offshore Operators Committee. 258 pp.

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

Continental Shelf Associates, Inc. (CSA). 2004a. Geological and geophysical exploration for mineral resources on the Gulf of Mexico outer continental shelf: Final programmatic environmental assessment. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EA/EIS MMS 2004-054. 466 pp.

Continental Shelf Associates, Inc. (CSA). 2004b. Gulf of Mexico comprehensive synthetic based muds monitoring program. Volume II: Technical. Final report. Prepared for SMB Research Group. 358 pp. Internet website: http://www.gomr.boemre.gov/PI/PDFImages/ESPIS/2/3051.pdf.

Continental Shelf Associates, Inc. (CSA). 2006a. Effects of oil and gas exploration and development at selected continental slope sites in the Gulf of Mexico. Volume II: Technical report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2006-045. 636 pp.

Continental Shelf Associates, Inc. (CSA). 2006b. Effects of oil and gas exploration and development at selected continental slope sites in the Gulf of Mexico. Volume I: Executive summary. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2006-044. 51 pp.

Council on Environmental Quality. 2010. Report regarding the Minerals Management Service's National Environmental Policy Act policies, practices, and procedures as they relate to outer continental shelf oil and gas exploration and development. August 16, 2010. 41 pp. Internet website: http://www.whitehouse.gov/sites/default/files/microsites/ceq/20100816-ceq-mms-ocs-nepa.pdf.

Cook, C.B. and A.H. Knap. 1983. Effects of crude oil and chemical dispersant on photosynthesis in the brain coral *Diploria strigosa*. Marine Biology 78:21-27.

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

CoreLogic. 2010. New CoreLogic data shows the potential impact of the BP *Deepwater Horizon* oil spill on coastal real estate. Internet website: http://www.corelogic.com/About-Us/News/New-CoreLogic-Data-Shows-the-Potential-Impact-of-the-BP-Deepwater-Horizon-Oil-Spill-on-Coastal-Real-Estate.aspx. Accessed November 9, 2010.

Coston-Clements, L., L.R. Settle, D.E. Hoss, and F.A. Cross. 1991. Utilization of the Sargassum habitat by marine invertebrates and vertebrates, a review. U.S. Dept. of the Interior, National Marine

Fisheries Service, NOAA, Southeast Fisheries Science Center, Beaufort Laboratory, Beaufort, NC. 32 pp.

Cox, S.A., E.H. Smith, and J.W. Tunnell, Jr. 1997. Macronektonic and macrobenthic community dynamics in a coastal saltmarsh: Phase I. Prepared for Texas Parks and Wildlife Dept., Wildlife Division. TAMU-CC-9701-CCS. Corpus Christi, TX. 67 pp.

Cox, J., C. Coomes, S. DiMarco, K. Donohue, G.Z. Forristall, P. Hamilton, R.R. Leben, and D.R. Watts. In preparation. Study of deepwater currents in the eastern Gulf of Mexico. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEMRE 2010-041. 473 pp.

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

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

Cutter, S.L., L. Barnes, M. Berry, C.G. Burton, E. Evans, E.C. Tate, and J. Webb. 2008. Community and regional resilience: Perspectives from hazards, disasters, and emergency management. CARRI Research Report 1. Oak Ridge, TN: Community and Regional Resilience Institute. 33 pp. Internet website: http://www.resilientus.org/library/FINAL_CUTTER_9-25-08_1223482309.pdf. Accessed February 16, 2011.

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

Dalton, M.S. and S.A. Jones, comps. 2010. Southeast Regional Assessment Project for the National Climate Change and Wildlife Science Center, U.S. Geological Survey. U.S. Dept. of the Interior, Geological Survey, Reston, VA. Open-File Report 2010-1213. 38 pp. Internet website: http://pubs.usgs.gov/of/2010/1213/pdf/ofr2010_1213.pdf.

Dames & Moore, Inc. 1979. Mississippi, Alabama, Florida outer continental shelf baseline environmental survey; MAFLA, 1977/78. Volume I-A. Program synthesis report. U.S. Dept. of the Interior, Bureau of Land Management, Washington, DC. BLM/YM/ES-79/01-Vol-1-A. 278 pp.

Dauterive, L.D. 2000. Rigs-to-Reefs policy, progress, and perspective. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 2000-073. 8 pp.

Davis, R.W. and G.S. Fargion, eds. 1996. Distribution and abundance of cetaceans in the north-central western Gulf of Mexico: Final report. Volume II: Technical report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 96-0027. 355 pp.

Davis, R.W., W.E. Evans, and B. Würsig, eds. 2000. Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. U.S. Dept. of the Interior, Geological Survey, Biological Resources Division, USGS/BRD/CR-1999-0006 and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-002. 346 pp.

Davis, B., D.S. Etkin, M. Landry, and K. Watts. 2004. Determination of oil persistence: A historical perspective. In: Proceedings, Fifth Biennial Freshwater Spills Symposium. Internet website: http://www.environmental-research.com/erc_papers/ERC_paper_19.pdf.

Dawes, C.J., J. Andorfer, C. Rose., C. Uranowski, and N. Ehringer. 1997. Regrowth of seagrass *Thalassia testudinum* into propeller scars. Aquatic Botany 59:139-155.

de Gouw, J.A., A.M. Middlebrook, C. Warneke, R. Ahmadov, E.L. Atlas, R. Bahreini, D.R. Blake, C.A. Brock, J. Brioude, D.W. Fahey, F.C. Fehsenfeld, J.S. Holloway, M. Le Henaff, R.A. Lueb, S.A. McKeen, J.F. Meagher, D.M. Murphy, C. Paris, D.D. Parrish, A.E. Perring, I.B. Pollack, A.R. Ravishankara, A.L. Robinson, T.B. Ryerson, J.P. Schwarz, J.R. Spackman, A. Srinivasan, and L.A. Watts. 2011. Organic aerosol formation downwind from the *Deepwater Horizon* oil spill. Science 331 (6022):1273-1274.

De Leon, M.T. and L.M. Smith. 1999. Behavior of migrating shorebirds at North Dakota prairie potholes. Condor 101:645-654.

Dean, T.A. and S.C. Jewett. 2001. Habitat-specific recovery of shallow subtidal communities following the *Exxon Valdez* oil spill. Ecological Applications 11(5):1456-1471.

Dean Runyan Associates. 2010. The economic impact of travel on Texas. Prepared for Texas Tourism, Office of the Governor, Texas Economic Development and Tourism. 141 pp.

DeBose, J.L., G.P.Schmahl, M.F.Nuttall, and E.L.Hickerson. 2008. Coral bleaching mortality and resilience at Stetson Bank, a high latitude coral community in the Gulf of Mexico. In: Proceedings of the 11th International Coral Reef Symposium, July 7-11, 2008, Fort Lauderdale, FL.

DeCort, T. 2010. Official communication. Gas release estimate for *Macondo*. September 14, 2010. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement, Gulf of Mexico OCS Region, Resource Evaluation, New Orleans, LA.

Defenbaugh, R.E. 1976. A study of the benthic macroinvertebrates of the continental shelf of the northern GOM. Unpublished Ph.D. dissertation, Texas A&M University, College Station, TX. 476 pp.

DeLaune, R.D., W.H. Patrick, and R.J. Buresh. 1979. Effect of crude oil on a Louisiana *Spartina alterniflora* salt marsh. Environmental Pollution 20:21-31.

DeLaune, R.D., R.P. Gambrell, J.H. Pardue, and W.H. Patrick, Jr. 1990. Fate of petroleum hydrocarbons and toxic organics in Louisiana coastal environments. Estuaries 132(1):72-80.

Deleersnijder, E., J.M. Beckers, and E.J.M. Delhez. 2006. The residence time of settling particles in the surface mixed layer. Environmental Fluid Mechanics 6:25-42.

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

den Hartog, C. and R.P.W.M. Jacobs. 1980. Effects of the "Amoco Cadiz" oil spill on an eelgrass community at Roscoff (France) with special reference to the mobile benthic fauna. Helgoländer Meeresunters 33:182-191.

Dennis, G.D. and T.J. Bright. 1988. Reef fish assemblages on hard banks in the northwestern Gulf of Mexico. Bulletin of Marine Science 43(2):280-307.

Diaz, R.J. and A. Solow. 1999. Ecological and economic consequences of hypoxia. Topic 2 Report for the Integrated Assessment on Hypoxia in the Gulf of Mexico. U.S. Dept. of Commerce, NOAA Coastal Ocean Program, Silver Spring, MD. NOAA Coastal Ocean Program Decision Analysis Series No. 16. 45 pp.

Diercks, A-R., R.C. Highsmith, V.L. Asper, DJ. Joung, Z. Zhou, L. Guo, A.M. Shiller, S.B. Joye, A.P. Teske, N. Guinasso, T.L. Wade, and S.E. Lohrenz. 2010. Characterization of subsurface polycyclic aromatic hydrocarbons at the *Deepwater Horizon* site. Geophysical Research Letters, Vol. 37, L20602, doi:10.1029/2010GL045046.

Digital Petrodata. 2010. Digital Petrodata. Internet website: http://www.scribd.com/doc/29413777/4-2010-Digital-Petrodata-BLM-STATE-MMS-Oil-Gas-Lease-Sale-Auction-2010-April. Accessed November 30, 2010.

Dillehay, T.D. 1989. Monte Verde: A late Pleistocene settlement in Chile. Washington, DC: Smithsonian Institution Press.

Dinsdale, E.A. and V.J. Harriot. 2004. Assessing anchor damage on coral reefs: A case study in selection of environmental indicators. Environmental Management 33(1):126-139.

Dismukes, D.E. 2010a. Official communication. More conservative scenario. Associate Director, Louisiana State University, Center for Energy Studies, Baton Rouge, LA. September 29, 2010.

Dismukes, D.E. 2010b. Official communication. Texas deepwater port? Associate Director, Louisiana State University, Center for Energy Studies, Baton Rouge, LA. December 1, 2010.

Dismukes, D.E. 2010c. Official communication. Gas processing. Associate Director, Louisiana State University, Center for Energy Studies, Baton Rouge, LA. October 20, 2010.

Dismukes, D.E. 2010d. Official communication. Pipeline landfalls. Associate Director, Louisiana State University, Center for Energy Studies, Baton Rouge, LA. October 26, 2010.

Dismukes, D.E. 2010e. Official communication. Waste disposal. Associate Director, Louisiana State University, Center for Energy Studies, Baton Rouge, LA. November 23, 2010.

Dismukes, D.E. 2010f. Official communication. E-mail entitled GOM employment observations. Associate Director, Louisiana State University, Center for Energy Studies, Baton Rouge, LA. December 8, 2010.

Dismukes, D.E. In preparation-a. OCS-related infrastructure fact book. Volume I: Post-hurricane impact assessment. U.S. Dept. of the Interior, Bureau of Ocean Energy, Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA.

Dismukes, D.E. In preparation-b. Fact book: Offshore oil and gas industry support sectors. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEMRE 2010-042.

Dismukes, D.E., M. Barnett, D. Vitrano, and K. Strellec. 2007. Gulf of Mexico OCS oil and gas scenario examination: Onshore waste disposal. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 2007-051. 5 pp.

D.K. Shifflet and Associates. 2010a. Texas destinations 2006-2009. Report prepared for the The Office of the Governor, Economic Development Tourism Division, McLean, VA. 124 pp.

D.K. Shifflet and Associates. 2010b. 2009-2010 destination attractions. [report]. McLean, VA. 21 pp.

Dloughy, J.A. 2010. Government gives notice on abandoned platforms: Rule tells industry to dismantle 'idle iron' and plug old oil, gas wells. *Houston Chronicle*, September 15, 2010. Internet website: http://www.reefrelieffounders.com/drilling/2010/09/16/houston-chroniclegovernment-gives-notice-on-abandoned-platforms-rule-tells-industry-to-dismantle-idle-iron-and-plug-old-oil-gas-wells-dont-blame-bp-alone-for-spill-hayward/. Accessed March 1, 2011.

Dobbs, C.D. and J.M. Vozarik. 1983. Immediate effects of a storm on coastal infauna. Marine Ecology Progress Series 11:273-279.

Dodge, R.E., R.C. Aller, and J. Thomson. 1974. Coral growth related to resuspension of bottom sediments. Nature 247:574-577.

Dodge, R.E., S.C. Wyers, A.H. Knap, H.R. Frith, T.D. Sleeter, and S.R. Smith. 1984. The effects of oil and oil dispersants on hermatypic coral skeletal growth (extension rate). Coral Reefs 3:191-198.

Dokka, R. 2006. Modern-day tectonic subsidence in coastal Louisiana. Geology 34(4):281-284.

Dokka, R.K., G.F. Sella, and T.H. Dixon. 2006. Tectonic control of subsidence and southward displacement of southeast Louisiana with respect to stable North America. American Geophysical Union, Geophysical Research Letters Volume 33, L23308. Internet website: http://www.ngs.noaa.gov/CORS/Articles/2006GL027250.pdf.

Dokken, Q., R. Lehman, J. Prouty, C. Adams, and C. Beaver. 1993. A preliminary survey of Sebree Bank (Gulf of Mexico, Port Mansfield, TX), August 23-27, 1993. Texas A&M University, Center for Coastal Studies, Corpus Christi, TX. Center for Coastal Studies Technical Report No. TAMU-CC-9305-CCS. 13 pp.

Dokken, Q.R., I.R. MacDonald, J.W. Tunnell, Jr., T. Wade, K. Withers, S.J. Dilworth, T.W. Bates, C.R. Beaver, and C.M. Rinaud. 2003. Long-term monitoring of the East and West Flower Garden Banks National Marine Sanctuary, 1998-2001: Final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2003-031. 89 pp.

Donato, K.M. 2004. Labor migration and the deepwater oil industry. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2004-057. 125 pp.

Donato, K.M., D.T. Robinson, and C.L. Bankston III. 1998. To have them is to love them: Immigrant workers in the offshore industry. Paper read at the Annual Meeting of the Latin American Studies Association, Chicago, IL, September 1998. 18 pp. (unnumbered Xerox).

Donohue, K., P. Hamilton, R. Leben, R. Watts, and E. Waddell. 2008. Survey of deepwater currents in the northwestern Gulf of Mexico. Volume II: Technical report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2008-031. 375 pp.

Dooley, J.K. 1972. Fishes associated with the pelagic Sargassum complex, with a discussion of the Sargassum community. Contrib. Mar. Science. 16:1-32.

Doran, K.S., N.G. Plant, H.F. Stockdon, A.H. Sallenger, and K.A. Serafin. 2009. Hurricane Ike: Observations of coastal change. U.S. Dept. of the Interior, Geological Survey, Reston, VA. Open-File Report 2009-1061. vi + 35 pp. Internet website: http://pubs.usgs.gov/of/2009/1061/pdf/ofr2009-1061.pdf.

Drewitt, A.L. and R.H.W. Langston. 2008. Collision effects of wind-power generators and other obstacles on birds. Annals of the New York Academy of Sciences 1134:233266.

Driver, A. 2010. Helix readying Gulf oil spill containment system. Reuters. December 8, 2010. Internet website: http://www.reuters.com/article/2010/12/08/spill-helix-idUSN0818292520101208. Accessed December 27, 2010.

Duarte, C.M., J.J. Middelburg, and N. Caraco. 2005. Major role of marine vegetation on the oceanic carbon cycle. Biogeosciences 2:1-8.

Dubois, S., C.G. Gelpi Jr., R.E. Condrey, M.A. Grippo, and J.W. Fleeger. 2009. Diversity and composition of macrobenthic community associated with sandy shoals of the Louisiana continental shelf. Biodiversity and Conservation 18(14):3759-3784.

Ducklow, H.W. and R. Mitchell. 1979. Composition of mucus released by coral reef Coelenterates. Limnology and Oceanography 24(2):706-714.

Dunne, R. and E. Miller. 2007. Post-release survival of oiled, rehabilitated waterfowl. In: Massey, J.G., ed. Proceedings of the Ninth International Effects of Oil on Wildlife Conference, Monterey, CA, 2007, University of California at Davis Wildlife Health Center, Davis.

Dunton, K.H., S.V. Shonberg, S. Herzka, P.A. Montagna, and S.A. Holt. 1998. Characterization of anthropogenic and natural disturbance on vegetated and nonvegetated bay bottom habitats in the Corpus Christi Bay National Estuarine Program Study Area. Volume II: Assessment of scarring in seagrass beds. CCBNEP-25B. 23 pp.

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

Eddleman, W.R., F.L. Knopf, B. Meanley, F.A. Reid, and R. Zembal. 1988. Conservation of North American rallids. Wilson Bulletin 100:458-475.

Edwards, R. 2008. Sea levels: Science and society. Progress in Physical Geography 32(5):557-574.

Eggleton, J. and K.V. Thomas. 2004. A review of factors affecting the release and bioavailability of contaminants during sediment disturbance events. Environment International 30:973-980.

Eleuterius, L.N. 1987. Seagrass ecology along the coasts of Alabama, Louisiana, and Mississippi. Florida Marine Research Publications, No. 42. Pp. 11-24.

Elgershuizen, J.H.B.W. and H.A.M. De Kruijf. 1976. Toxicity of crude oils and a dispersant to the stony coral *Madracis mirabilis*. Marine Pollution Bulletin 7(2):22-25.

Elliott-Smith, E., S.M. Haig, and B.M. Powers. 2009. Data from the 2006 International Piping Plover Census: U.S. Geological Survey Data Series 426. 332 pp.

Ellis, M.S., E.A. Wilson-Ormond, and E.N. Powell. 1996. Effects of gas-producing platforms on continental shelf macroepifauna in the northwestern Gulf of Mexico: Abundance and size structure. Canadian Journal of Fisheries and Aquatic Science 53:2589-2605.

Ellwood, B.B., W.L. Balsam, and H.H. Roberts. 2006. Gulf of Mexico sediment sources and sediment transport trends from magnetic susceptibility measurements of surface samples. Marine Geology 230:237-248.

Elsner, J.B., T.H. Jagger, M. Dickinson, and D. Rowe. 2008. Improving multiseason forecasts of North Atlantic hurricane activity. American Meteorological Society 21:1210-1219. Internet website: http://myweb.fsu.edu/jelsner/PDF/Research/ElsnerJaggerDickinsonRowe2008.pdf.

Ely, C.R., D.H. Ward, and K.S. Bollinger. 1999. Behavioral correlates of heart rates of free-living greater white-fronted geese. Condor 101:390-395.

Emery, W.J., K. Cherkauer, B. Shannon, and RW. Reynolds. 1997. Hull-mounted sea surface temperatures from ships of opportunity. American Meteorological Society, Boston, MA. Journal of Atmospheric and Oceanic Technology 14:1237-1251.

Energo Engineering. 2010. Assessment of damage and failure mechanisms for offshore structures and pipelines in Hurricanes Gustav and Ike. U.S. Dept. of the Interior, Minerals Management Service, Herndon, VA. TA&R 642.

Engel, J. and R. Kvitek. 1998. Effects of otter trawling on a benthic community in Monterey Bay National Marine Sanctuary. Conservation Biology 12(6):1204-1214.

Engle, V.D., J.L. Hyland, and C. Cooksey. 2008. Effects of Hurricane Katrina on benthic macroinvertebrate communities along the northern Gulf of Mexico coast. Environmental Monitoring Assessment 150:193-209.

Enright, J.M., R. Gearhart II, D. Jones, and J. Enright. 2006. Study to conduct National Register of Historic Places evaluations of submerged sites on the Gulf of Mexico outer continental shelf. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2006-036. 136 pp.

Environmental Science & Research Limited. 1998. The effects of air pollution on New Zealand ecosystems: Review of national and international research: Technical report no. 1. Ministry for the Environment, New Zealand. 77 pp. Internet website: http://www.mfe.govt.nz/publications/air/research-review-jun98.pdf. Accessed February 12, 2007.

Energy Resources Co., Inc. (ERCO). 1982. Ixtoc oil spill assessment: Final report. 3 vols. Prepared for the U.S. Dept. of the Interior, Bureau of Land Management, Gulf of Mexico OCS Region, New Orleans, LA. Contract No. AA851-CTO-71. Study Nos. 1982-34, 1982-35, and 1982-37.

Erftemeijer, P.L.A. and R.R.R. Lewis III. 2006. Environmental impacts of dredging on seagrass: A review. Marine Pollution Bulletin 52:1553-1572.

Espey, Huston & Associates, Inc. 1990a. Ground truthing anomalies, Port Mansfield entrance channel, Willacy County, Texas. Prepared for the U.S. Dept. of the Army, Corps of Engineers, Galveston District, Galveston, TX. Contract no. DACW64-89-D-0002. Delivery order no. 0006. Texas Antiquities permit no. 857. 60 pp.

Espey, Huston & Associates, Inc. 1990b. National Register assessment of the *SS Mary*, Port Aransas, Nueces County, Texas. Prepared for the U.S. Dept. of the Army, Corps of Engineers, Galveston District, Galveston, TX. Contract no. DCCW64-89-D-0002. Delivery order no. 0005. Texas Antiquities permit no. 858.

Essink, K. 1999. Ecological effects of dumping of dredging sediments; options for management. Journal of Coastal Conservation 5(1):69-80.

Etkin, D.S. 2009. Analysis of U.S. oil spillage. American Petroleum Institute, Regulatory and Scientific Affairs Department. API Publication 356. 86 pp. Internet website: http://www.api.org/ehs/water/spills/upload/356-Final.pdf.

European Inland Fisheries Advisory Commission. 2010. Methodologies for assessing socioeconomic benefits of European inland recreational fisheries. EIFAC Occasional Paper No. 46.

European Wind Energy Association. 2011. The European offshore wind industry key trends and statistics 2010. 3 pp. Internet website: http://www.ewea.org/fileadmin/ewea_documents/documents/00_POLICY_document/Offshore_Statistics/110120_Offshore_stats_Exec_Sum.pdf.

Exxon Valdez Oil Spill Trust Council. 2010. Killer whales. Internet website: http://www.evostc.state.ak.us/Recovery/status_orca.cfm. Accessed July 17, 2011.

Fanning, K., K.L. Carder, and P.R. Betzer. 1982. Sediment resuspension by coastal waters: A potential mechanism for nutrient re-cycling on the ocean's margins. Deep-Sea Research 29:953-965.

Farmer, A. and F. Durbian. 2006. Estimating shorebird numbers at migration stopover sites. Condor 108:792-807.

Fauchald, K. and P.A. Jamurs. 1979. The diet of worms: A study of polychaete feeding guilds. Oceanography and Marine Biology: An Annual Review 17:193-284.

Fedde, M.R. and W.D. Kuhlmann. 1979. Cardiopulmonary responses to inhaled sulfur dioxide in the chicken. Poultry Science 58:1584-1591.

Federal Register. 1997a. Hydrogen sulfide requirements for operations in the outer continental shelf. Final rule. 62 FR 17, pp. 3793-3800. Internet website: http://www.boemre.gov/federalregister/PDFs/h2sfr.pdf.

Federal Register. 1997b. Blowout preventer (BOP) testing requirements for drilling and completion operations. Proposed rule. July 15, 1997. 62 FR 135, pp. 37819-37824. Internet website: http://www.boemre.gov/federalregister/PDFs/BOPTesting.PDF.

Federal Register. 1998. Blowout preventer (BOP) testing requirements for drilling and completion operations. Final rule. June 1, 1998. 63 FR 104, pp. 29604-29608. Internet website: http://www.boemre.gov/federalregister/PDFs/Bop.pdf.

Federal Register. 1999. Rules and regulations, Department of the Interior, Fish and Wildlife Service 50 CFR Part 17: Endangered and threatened wildlife and plants; removal of the American peregrine falcon from the Federal list of endangered and threatened wildlife and removal of the similarity of appearance provision for free-flying peregrines in the conterminous United States. Final rule. August 25, 1999. 64 FR 164, pp. 46542-46558.

Federal Register. 2001. Rules and regulations, Department of the Interior, Fish and Wildlife Service, 50 CFR Part 17: Endangered and threatened wildlife and plants; final determinations of critical habitat for wintering piping plovers. Final rule. July 10, 2001. 66 FR 132, pp. 36037-36086.

Federal Register. 2005. 30 CFR Parts 250 and 282: Oil and gas and sulphur operations in the outer continental shelf—Plans and information. Final rule. 70 FR 167, pp. 51478-51519. Internet website: http://frwebgate1.access.gpo.gov/cgi-bin/PDFgate.cgi?WAISdocID=PoRRmE/2/2/0&WAISaction=retrieve. Accessed July 15, 2011.

Federal Register. 2006a. Oil and gas and sulphur in the outer continental shelf (OCS)—Safety and Environmental Management Systems. Advanced notice of proposed rule. 71 FR 98, pp. 29277-29280. Internet website: http://edocket.access.gpo.gov/2006/pdf/E6-7790.pdf.

Federal Register. 2006b. Oil and gas and sulphur operations in the outer continental shelf—Incident reporting requirements. Final rule. 71 FR 73, pp. 19640-19646. Internet website: http://www.boemre.gov/federalregister/PDFs/AC57-4-17-06.pdf.

Federal Register. 2007. Rules and regulations, Department of the Interior, Fish and Wildlife Service, 50 CFR Part 17: Endangered and threatened wildlife and plants; removal of the bald eagle from the federal list of endangered and threatened wildlife. Final rule. July 9, 2007. 72 FR 130, pp. 37346-37372.

Federal Register. 2008. Record of decision for the final programmatic environmental impact statement for alternative energy development and production and alternate use of facilities on the outer continental shelf. January 10, 2007. 73 FR 7, pp. 1894-1895.

Federal Register. 2009a. Safety and environmental management systems for outer continental shelf oil and gas operations. Proposed rule. 74 FR 115, pp. 28639-28654. Internet website: http://www.gpo.gov/fdsys/pkg/FR-2009-06-17/pdf/E9-14211.pdf.

Federal Register. 2009b. Renewable energy and alternate uses of existing facilities on the outer continental shelf. Final rule. April 29, 2009. 74 FR 81, pp. 19638-19871.

Federal Register. 2009c. Standards for living organisms in ships' ballast water discharged in U.S. waters: Notice of proposed rulemaking. 74 FR 106, August 28, 2009. Internet website: http://www.uscg.mil/hq/cg5/cg522/cg5224/docs/USCG-2001-10486-0138.pdf.

Federal Register. 2009d. Rules and regulations, Department of the Interior Fish and Wildlife Service 50 CFR Part 17: Endangered and threatened wildlife and plants; removal of the brown pelican (*Pelecanus occidentalis*) from the federal list of endangered and threatened wildlife. Final rule. November 17, 2009. 74 FR 220, pp. 59443-59472.

Federal Register. 2010a. Oil and gas and sulphur operations in the outer continental shelf—Safety and environmental management systems. Final rule. 75 FR 199, pp. 63610-63654. Internet website: http://edocket.access.gpo.gov/2010/pdf/2010-25665.pdf.

Federal Register. 2010b. Oil and gas and sulphur operations in the outer continental shelf—Increased safety measures for energy development on the outer continental shelf. Interim final rule. 75 FR 198, pp. 63346-63377. Internet website: http://www.gpo.gov/fdsys/pkg/FR-2010-10-14/pdf/2010-25256.pdf.

Federal Register. 2010c. Outer Continental Shelf (OCS),Western and Central Planning Areas, Gulf of Mexico (GOM) oil and gas lease sales for the 2007-2012 5-Year OCS Program. November 10, 2010. 75 FR 217, pp. 69122-69123.

Federal Register. 2010d. Outer Continental Shelf (OCS), Western and Central Planning Areas, Gulf of Mexico (GOM) oil and gas lease sales for the 2007-2012 5-Year OCS Program. November 16, 2010. 75 FR 220, pp. 70023-70024.

Federal Register. 2010e. Approval and promulgation of air quality implementation plans; Louisiana; Baton Rouge 8-hour ozone nonattainment area; determination of attainment of the 8-hour ozone standard. 75 FR 174, pp. 54778-54779. September 9, 2010.

Federal Register. 2010f. Listing endangered and threatened wildlife and plants; 90-day finding on a petition to list bluefin tuna as threatened or endangered under the Endangered Species Act. Proposed rule. 50 CFR 223 and 224. Tuesday, September 21, 2010.

Federal Register. 2010g. Cancellation of oil and gas Lease Sale 215 in the Western Planning Area on the outer continental shelf in the Gulf of Mexico. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement. July 28, 2010. 75 FR 144, p. 44276. Internet website: http://edocket.access.gpo.gov/2010/pdf/2010-18425.pdf.

Federal Register. 2011. Endangered and threatened wildlife and plants: Endangered Species Act listing determination for Atlantic bluefin tuna. June 1, 2011. 50 CFR 223 and 224. Pp. 31556-31570.

Feldman, S. 2009. China beats US to offshore wind development. Internet website: http://solveclimate.com/news/20090403/china-beats-us-offshore-wind-development. Posted April 3, 2009. Accessed March 23, 2011.

Fenner, D. and K. Banks. 2004. Orange cup coral *Tubastraea coccinea* invades Florida and the Flower Garden Banks, northwestern Gulf of Mexico. Coral Reefs 23(4):505-507.

Field, J. C., D.F. Boesch, D. Scavia, R. Buddemeier, V.R. Burkett, and D. Cayan. 2001. Potential consequences of climate variability and change on coastal areas and marine resources. In: Climate change impacts on the United States. New York: Cambridge University Press.

Fingas, M. 1995. Oil spills and their cleanup. Chemistry and Industry. Internet website: http://findarticles.com/p/articles/mi_hb5255/is_n24/ai_n28664618/. Accessed December 23, 2010.

Fingas, M., F. Ackerman, P. Lambert, K. Li, Z. Wang, J. Mullin, L. Hannon, D. Wang, A. Steenkammer, R. Hiltabrand, R. Turpin, and P. Campagna. 1995. The Newfoundland offshore burn experiment: Further results of emissions measurement. In: Proceedings of the Eighteenth Arctic and Marine Oilspill Program Technical Seminar, Volume 2, June 14-16, 1995, Edmonton, Alberta, Canada. Pp. 915-995.

Fire in the Ice. 2009. Gulf of Mexico gas hydrate drilling and logging expedition underway. U.S Dept. of Energy, National Energy Technology Laboratory, Methane Hydrate Newsletter. Spring 2009. Pp. 1-10. Internet website: http://www.netl.doe.gov/technologies/oil-gas/publications/Hydrates/Newsletter/MHNewsSpring09.pdf#Page=1.

Fischel, M., W. Grip, and I.A. Mendelssohn. 1989. Study to determine the recovery of a Louisiana marsh from an oil spill. In: Proceedings, 1989 Oil Spill Conference. February 13-16, 1989, San Antonio, TX. Washington, DC: American Petroleum Institute. Pp. 383-387.

Fisher, C.R. 1995. Characterization of habitats and determination of growth rate and approximate ages of the chemosynthetic symbiont-containing fauna. In: MacDonald, I.R., W.W. Schroeder, and J.M. Brooks, eds. 1995. Chemosynthetic ecosystems study: Final report. Volume 2: Technical report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 95-0022. Pp. 5.1-5.47.

Fisher, M. 2010. Official communication. Fish kills in Texas and effects of BP spill on Texas oysters. Texas Parks and Wildlife Department. Texas Parks and Wildlife Department, Rockport Marine Lab. August 6, 2010.

Fisher, M. 2011. Official communication. Fishing effort and catch data. Texas Parks and Wildlife Department, Rockport Marine Lab. April 12, 2011.

Fisher, W.L., J.H. McGowen, L.F. Brown, Jr., and C.G. Groat. 1972. Environmental geologic atlas of the Texas coastal zone: Galveston-Houston area. Austin, TX: The University of Texas at Austin, Bureau of Economic Geology.

Fisher, W.L., L.F. Brown, Jr., J.H. McGowen, and C.G. Groat. 1973. Environmental geologic atlas of the Texas coastal zone: Beaumont-Port Arthur area. Austin, TX: The University of Texas at Austin, Bureau of Economic Geology.

Fisher, C.R., I. Urcuyo, M.A. Simpkins, and E. Nix. 1997. Life in the slow lane: Growth and longevity of cold-seep vestimentiferans. Marine Ecology 18:83-94.

Flemer, D.A., B.F. Ruth, and C.M. Bundrick. 2002. Effects of sediment type on macrobenthic infaunal colonization of laboratory micrococosms. Hydrobiologia 485:83-96.

Flint, R.W. and N.N. Rabalais, eds. 1980. Environmental studies, south Texas outer continental shelf, 1975-1977. Volume I: Ecosystem description. Submitted to the U.S. Dept. of the Interior, Bureau of Land Management, Washington, DC. Contract AA551-CT8-51.

Florida A&M University. 1988. Meteorological database and synthesis for the Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 89-0064. 430 pp.

Florida Dept. of Environmental Protection and U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration. 2000. Final restoration plan/environmental assessment for the August 10, 1993 Tampa Bay oil spill. Volume 2: Human use and recreational injuries. 52 pp.

Florida Fish and Wildlife Conservation Commission. 2008. FAQs: Sea turtles and hurricanes. Internet website: http://myfwc.com/Newsroom/Resources/News_Resources_SeaTurtlesAndHurricanes.htm. Accessed September 5, 2008.

Florida Fish and Wildlife Conservation Commission. 2010. Manatee mortality statistics. Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute. Internet website: http://myfwc.com/media/1329325/2010_cumulative_category_summary09jun_2011.pdf. Accessed July 11, 2011.

Foley, B. 2010. Impact of fishing on shipwrecks: In: Archaeology in deep water. Woods Hole Oceanographic Institution, Woods Hole, MA. Internet website: http://www.whoi.edu/sbl/liteSite.do?litesiteid=2740&articleId=4965. Accessed August 31, 2010.

Ford, B., A. Borgens, W. Bryant, D. Marshall, P. Hitchcock, C. Arias, and D. Hamilton. 2008. Archaeological excavation of the Mardi Gras shipwreck (16GM01), Gulf of Mexico continental slope. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 2008-037. 313 pp.

Fourqurean, J.W. and L.M. Rutten. 2004. The impact of Hurricane Georges on soft-bottom, back reef communities: Site-and species-specific effects in south Florida seagrass beds. Bulletin of Marine Science 75(2):239-257.

Fowler, G.S., J.C. Wingfield, and P.D. Boersma. 1995. Hormonal and reproductive effects of low levels of petroleum fouling in Magellanic penguins (*Spheniscus magellancus*). Auk 112:382-389.

Francaviglia, R.V. 1998. From sail to steam. University of Texas Press, Austin. 324 pp.

Frank, D.J., W. Sackett, R. Hall, and A. Fredericks. 1970. Methane, ethane, and propane concentrations in the Gulf of Mexico. American Association of Petroleum Geologist Bulletin 54:1933-1938.

Fraser, G.S. and J. Ellis. 2008. Offshore hydrocarbon and synthetic hydrocarbon spills in eastern Canada: The issue of follow-up and experience. Journal of Environmental Assessment Policy and Management 10(2):173-187. June 2008.

Fraser, G.S., J. Russell, and W.M. von Zharen. 2006. Produced water from offshore oil and gas installations on the Grand Banks, Newfoundland and Labrador: Are the potential effects to seabirds sufficiently known? Marine Ornithology 34:147-156.

Frazier, D.E. 1967. Recent deltaic deposits of the Mississippi River: Their development and chronology. In: Sandridge, J.R., ed. Transactions Gulf Coast Association of Geological Societies, San Antonio, TX, 27:287-315. Internet website: http://search.datapages.com/data/gcags/data/017/017001/pdfs/0287.pdf.

French-McCay, D.P. 2004. Oil spill impact modeling: Development and validation. Environmental Toxicology and Chemistry 23(10):2441-2456.

Frid, A. and L.M. Dill. 2002. Human-caused disturbance stimuli as a form of predation risk. Conservation Ecology 6:11. Internet website: http://www.consecol.org/vol6/iss1/art11/.

Frithsen, J.B., R. Elmgren, and D.T. Rudnick. 1985. Responses of benthic meiofauna to long-term, low-level additions of No. 2 fuel oil. Marine Ecology Progress Series 23:1-14.

Fritts, T.H., A.B. Irvine, R.D. Jennings, L.A. Collum, W. Hoffman, and M.A. McGehee. 1983. Turtles, birds, and mammals in the northern Gulf of Mexico and nearby Atlantic waters. U.S. Dept. of the

Interior, Fish and Wildlife Service, Division of Biological Services, Washington, DC. FWS/OBS-82/65. 455 pp.

Fry, D.M., J. Swenson, L.A. Addiego, C.R. Grau, and A. Kang. 1986. Reduced reproduction of wedge-tailed shearwaters exposed to weathered Santa Barbara crude oil. Archives of Environmental Contamination and Toxicology 15:453-463.

Fry, D.M., S.I. Fefer, and L. Sileo. 1987. Ingestion of plastic debris by laysan albatross and wedge-tailed shearwaters in the Hawaiian islands. Marine Pollution Bulletin 18(6B):339-343.

Fucik, K.W., T.J. Bright, and K.S. Goodman. 1984. Measurements of damage, recovery, and rehabilitation of coral reefs exposed to oil. In: Cairns, J. and A.L. Buikema, Jr., eds. Restoration of habitats impacted by oil spills. Boston, MA: Butterworth Publishers. 1984.

Fucik, K.W., K.A. Carr, and B.J. Balcom. 1995. Toxicity of oil and dispersed oil to the eggs and larvae of seven marine fish and invertebrates from the Gulf of Mexico. In: Lane, P., ed. The use of chemicals in oil spill response. STP 1252. Ann Arbor, MI. Pp. 135-171.

Gabe, T., G. Falk, M. McCarty, and V.W. Mason. 2005. Hurricane Katrina: Social-demographic characteristics of impacted areas; November 4, 2005. Congressional Research Service Report for Congress. 35 pp. Internet website: http://gnocdc.s3.amazonaws.com/reports/crsrept.pdf. Accessed February 17, 2011.

Gable, E. 2008. Gulf recovery: Biologists assess Ike's effects on Gulf Coast ecosystems. Landletter, October 9, 2008. Internet website: http://www.eenews.net/public/Landletter/2008/10/09/6. Accessed December 2010.

Gagliano, S.M. 1999. Faulting, subsidence and land loss in coastal Louisiana. In: Louisiana Coastal Wetlands Conservation and Restoration Task Force and Wetlands Conservation and Restoration Authority, Coast 2050: Toward a Sustainable Coastal Louisiana, Appendix B—Technical methods, Louisiana Dept. of Natural Resources, Baton Rouge, LA.

Gagliano, S.M. 2005a. Effects of earthquakes, fault movements, and subsidence on the south Louisiana landscape. Reprinted from The Louisiana Civil Engineer, Journal of the Louisiana Section of The American Society of Civil Engineers, Baton Rouge, LA. February 2005, 13(2):5-7, 19-22. Internet website: http://www.coastalenv.com/EffectofEarthquakeFaultMovementsandSubsidence.pdf.

Gagliano, S.M. 2005b. Effects of natural fault movement on land submergence in coastal Louisiana. Proceedings, 14th Biennial Coastal Zone Conference, New Orleans, LA, July 17-21, 2005. 5 pp.

Gallaway, B.J. 1981. An ecosystem of oil and gas development on the Texas-Louisiana continental shelf. U.S. Dept. of the Interior, Fish and Wildlife Service, Office of Biological Services, Washington, DC. FWS/OBS-81/27. 89 pp.

Gallaway, B.J. and G.S. Lewbell. 1982. The ecology of petroleum platforms in the northwestern Gulf of Mexico: A community profile. U.S. Dept. of the Interior, Fish and Wildlife Service, Office of Biological Services, Washington, DC. FWS/OBS-82/27. Bureau of Land Management, Gulf of Mexico OCS Regional Office, New Orleans, LA. Open-File Report 82-03. xiv + 92 pp.

Gallaway, B.J. and M.C. Kennicutt II. 1988. Chapter 2. The characterization of benthic habitats of the northern Gulf of Mexico. In: Gallaway, B.J., ed. Northern Gulf of Mexico continental slope study, final report: Year 4. Vol. II: Synthesis report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 88-0053. Pp. 2-1 to 2-45.

Gallaway, B.J., L.R. Martin, and R.L. Howard, eds. 1988. Northern Gulf of Mexico continental slope study, annual report: Year 3. Volume II: Technical narrative. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 87-0060. 586 pp.

Gallaway, B.J., J.G. Cole, and R.G. Fechhelm. 2003. Selected aspects of the ecology of the continental slope fauna of the Gulf of Mexico: A synopsis of the northern Gulf of Mexico continental slope study, 1983-1988. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2003-072. 44 pp.

Galveston.com. 2010. Summer season puts Galveston tourism back on track. Internet website: http://www.galveston.com/cvb083010/.

Ganning, B., D.J. Reish, and D. Straughan. 1984. Recovery and restoration of rocky shores, sandy beaches, tidal flats, and shallow subtidal bottoms impacted by oil spill. In: Cairns, J., Jr. and A.L. Buikema, Jr., eds. Restoration of habitats impacted by oil spills. Boston, MA.

Gardner, J.V., L.A. Mayer, J.E. Hughes Clarke, and A. Kleiner. 1998. High-resolution multibeam bathymetry of East and West Flower Gardens and Stetson Banks, Gulf of Mexico. Gulf of Mexico Science 16:131-143.

Gardner, J.V., J.D. Beaudoin, J.E. Hughes Clarke, and P. Dartnell. 2002. Multibeam mapping of selected areas of the outer continental shelf, northwestern Gulf of Mexico—Data, images, and GIS. U.S. Dept. of the Interior, Geological Survey. Open File Report 02-411. Internet website: http://geopubs.wr.usgs.gov/open-file/of02-411/index.html. Accessed September 9, 2010.

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

Garza, M.D., A. Prada, M. Marela and M.X. Vasquez Rodruguez. 2009. Indirect assessment of economic damages from the *Prestige* oil spill: Consequences for liability and risk prevention. Disasters 2009.

Gaston, G.R., C.F. Rakocinski, S.S. Brown, and C.M. Cleveland. 1998. Trophic function in estuaries: Response of macrobenthos to natural and contaminant gradients. Marine and Freshwater Research. 49:833-846.

Gearhart II, R., D. Jones, A. Borgens, S. Laurence, T. DeMunda, and J. Shipp. In press. Impacts of recent hurricane activity in historic shipwrecks in the Gulf of Mexico outer continental shelf. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEMRE 2011-003.

Gentner, B. and S. Steinback. 2008. The Economic contribution of marine angler expenditures in the United States, 2006. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS F/SPO-94.

Gentner Consulting Group. 2010. Economic impacts of recreational fishing closures resulting from the *Deep Horizon* oil spill: Preliminary estimates. Internet website: http://www.keepamericafishing.org/-/pdf/econimpactsgulfoil2.pdf.

Geoscience Earth & Marine Services, Inc. 2005. Integrated study of the Great White Development Area, Blocks 813, 814, 857, and 858, Alaminos Canyon Area, Gulf of Mexico. Report for Shell Offshore, Inc. Project No. 0105-945d.

Geraci, J.R. and D.J. St. Aubin. 1980. Offshore petroleum resource development and marine mammals: A review and research recommendations. Marine Fisheries Review 42:1-12.

Geraci, J.R. and D.J. St. Aubin, eds. 1990. Sea mammals and oil: Confronting the risks. San Diego, CA: Academic Press, Inc. 282 pp.

Getter, C.D., G. Cintron, B. Kicks, R.R. Lewis III, and E.D. Seneca. 1984. The recovery and restoration of salt marshes and mangroves following an oil spill. In: Cairn, J., Jr. and A.L. Buikema, Jr., eds. Restoration of habitats impacted by oil spills. Boston, MA: Butterworth Publishers, Ann Arbor Science Book. Pp. 65-104.

Gibeaut, J.C., W.A. White, T. Hepner, R. Gutierrez, T.A. Tremblay, R. Smyth, and J. Andrews, with assistance from R. Waldinger, D. Sassen, L. Xu, and Y. Qiu. 2008. Texas shoreline change project, Gulf of Mexico shoreline change from the Brazos River to Pass Cavallo. A Report of the Texas

Coastal Coordination Council pursuant to National Oceanic and Atmospheric Administration Award No. NA870Z0251. Internet website: http://coastal.tamug.edu/am/capturedwebsites/texasshorelinechange/report.pdf. Accessed January 2011.

Gilbert, D. 2011. New scrutiny slams near shore exploration. *The Wall Street Journal*. Internet website: http://online.wsj.com/article/SB10001424052970204204004576050442684314836.html?KEYWORDS=new+scrutiny+slams+near-shore+exploration. Posted January 3, 2011. Accessed January 4, 2011.

Gill, J.A., K. Norris, and W.J. Sutherland. 2001. Why behavioural responses may not reflect the population consequences of human disturbance. Biological Conservation 97:265-268.

Gitschlag, G.R., J.S. Schrripa, and J.E. Powers. 2000. Estimation of fisheries impacts due to underwater explosives used to sever and salvage oil and gas platforms in the U.S. Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-087. 80 pp.

Gittelsohn, J. 2010. Oil spill may cost $4.3 billion in property values. Bloomberg, June 11, 2010. Internet website: http://www.bloomberg.com/news/2010-06-11/bp-spill-may-cost-homeowners-4-3-billion-in-property-values-along-shore.html. Accessed June 14, 2011.

Gittings, S.R. 1998. Reef community stability on the Flower Garden Banks, northwest Gulf of Mexico. Gulf of Mexico Science 16(2):161-169.

Gittings, S.R., comp. 2006. Conservation science in NOAA's National Marine Sanctuaries: Description and recent accomplishments. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Silver Spring, MD. Marine Sanctuaries Conservation Series ONMS-06-04. 30 pp. Internet website: http://sanctuaries.noaa.gov/science/conservation/pdfs/accomplishments.pdf.

Gittings, S.R., G.S. Boland, K.J.P. Deslarzes, D.K. Hagman, and B.S. Holland. 1992a. Long-term monitoring at the East and West Flower Garden Banks. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 92-0006. 206 pp.

Gittings, S.R., T.J. Bright, W.W. Schroeder, W.W. Sager, J.S. Laswell, and R. Rezak. 1992b. Invertebrate assemblages and ecological controls on topographic features in the northeast Gulf of Mexico. Bulletin of Marine Science 50(3):435-455.

Gittings, S.R., G.S. Boland, K.J.P. Deslarzes, C.L. Combs, B.S. Holland, and T.J. Bright. 1992c. Mass spawning and reproductive viability of reef corals at the East Flower Garden Bank, northwest Gulf of Mexico. Bulletin of Marine Science 51(3):420-428.

Gittings, S.R., G.S. Boland, C.R.B. Merritt, J.J. Kendall, K.J.P. Deslarzes, and J. Hart. 1994. Mass spawning by reef corals in the Gulf of Mexico and Caribbean Sea. A Report on Project Reef Spawn '94. Flower Gardens Fund Technical Series Report Number 94-03.

Gobert, A. 2010. OCS pipelines (DOT jurisdiction) that terminate onshore Louisiana. Excel spreadsheet provided by Angie Gobert, Field Operations, to Perry Boudreaux, Leasing and Environment, Gulf of Mexico Region, Bureau of Ocean Energy Management, Regulation and Enforcement by e-mail on April 2, 2010.

Goh, B.P.L. and C.S. Lee. 2008. A study of the effect of sediment accumulation on the settlement of coral larvae using conditioned tiles. In: Proceedings of the 11th International Reef Symposium. July 7-11, 2008. Session No. 24. Fort Lauderdale, FL.

Gómez Gesteira, J.L. and J.C. Dauvin. 2000. Amphipods are good bioindicators of the impact of oil spills on soft-bottom macrobenthic communities. Marine Pollution Bulletin 40(11):1017-1027.

Gong, C., A. Milkov, D. Grass, M. Sullivan, T. Searcy, P. Depret, and L. Dzou. 2011. The impact of weathering on MC 252 oil chemistry and its fingerprinting: Poster presentation. In: Proceedings of the International Oil Spill Conference, May 23-26, 2011, Portland, OR.

Gonzalez, A. 2010. U.S. gas boom orphans LNG. *The Wall Street Journal*. October 22, 2010. Internet website: http://online.wsj.com/article/SB10001424052702304023804575566570816389914.html. Accessed March 1, 2011.

Gonzalez, A. and N. Malik. 2010. Collision causes crude oil spill in Texas. *The Wall Street Journal*. January 24, 2010. Internet website: http://online.wsj.com/article/SB10001424052748704562504575021540843701582.html. Accessed November 24, 2010.

Good, B., J. Buchtel, D. Meffert, J. Radford, K. Rhinehart, and R. Wilson. 1995. Louisiana's major coastal navigation channels. Louisiana Dept. of Natural Resources, Baton Rouge, LA. 35 pp. Internet website: http://dnr.louisiana.gov/crm/D%20R%20S%20Reports/General/La.%20Navigation%20Channels/Channels_1.pdf.

Goodyear, A.C. 2005. Evidence for pre-Clovis sites in the Eastern United States. In: Bonnichsen, R., B.T. Lepper, D. Stanford, and M.R. Waters, eds. Paleoamerican origins: Beyond Clovis. College Station, Texas: Center for the Study of the First Americans, distributed by Texas A&M University Press. Pp 103-112.

Gordon, J.C.D., D. Gillespie, L.E. Rendell, and R. Leaper. 1996. Draft report on playback of ATOC like sounds to sperm whales (*Physeter macrocephalus*) off the Azores. Wildlife Conservation Research Unit, Dept. of Zoology, Oxford, UK.

Gore, R.H. 1992. The Gulf of Mexico. Pineapple Press, Florida.

Gosselink, J.G., C.L. Cordes, and J.W. Parsons. 1979. An ecological characterization study of the Chenier Plain coastal ecosystem of Louisiana and Texas. 3 vols. U.S. Dept. of the Interior, Fish and Wildlife Services. FWS/OBS-78/9 through 78/11.

Gower, J. and S. King. 2008. Satellite images show the movement of floating Sargassum in the Gulf of Mexico and Atlantic Ocean. Nature Precedings: hdl:10101/npre.2008.1894.1.

Gower, J., C. Hu, G. Borstad, and S. King. 2006. Ocean color satellites show extensive lines of floating Sargassum in the Gulf of Mexico. IEEE Trans. Deosci. Rem. Sens. 44(12):3619-3625.

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

Green, M.M. 2006. Coastal restoration annual project reviews, December 2006. Louisiana Dept. of Natural Resources, Baton Rouge, LA. 116 pp. Internet website: http://lacoast.gov/reports/apr/2006%20Coastal%20Restoration%20Annual%20Project%20Reviews.pdf.

Green, A. 2008. Facing the facts: A literacy forecast for Texas. Texas Workforce Commission. 4 pp. Internet website: http://www.twc.state.tx.us/svcs/adultlit/facing_facts.pdf.

Greenberg, J. 2010. Offshore outlook: Still no deepwater drilling permits. Internet website: http://www.workboat.com/blogpost.aspx?id=4295000422. Accessed December 14, 2010.

Greenberg, J. 2011. OSV day rates. Workboat. May 2011, Vol. 68, No. 5.

Greene, C.R. 1986. Underwater sounds from the semisubmersible drill rig SEDCO 708 drilling in the Aleutian Islands. Section 1. American Petroleum Institute, Washington, DC. API Publication 4438. 69 pp.

Greene, G., C. Moss, and T. Spreen. 1997. Demand for recreational fishing in Tampa Bay, Florida: A random utility approach. Marine Resource Economics 12:293-305.

Gulf Coast Claims Facility. 2010a. Program statistics & overall summary, and state status reports. Internet website: http://www.gulfcoastclaimsfacility.com/reports. Accessed November 27, 2010.

Gulf Coast Claims Facility. 2010b. Program frequently asked questions. Internet website: http://gulfcoastclaimsfacility.com/faq#Q11. Accessed November 2010.

Gulf Coast Claims Facility. 2011. Texas program statistics (as of April 9, 2011). Internet website: http://www.gulfcoastclaimsfacility.com/reports. Accessed April 12, 2011.

Gulf of Mexico Alliance. 2009a. Gulf of Mexico Alliance water quality. Internet website: http://gulfofmexicoalliance.org/issues/welcome.html. Last updated June 2, 2009. Accessed March 15, 2010.

Gulf of Mexico Alliance. 2009b. Gulf of Mexico Alliance priority issues. Internet website: http://gulfofmexicoalliance.org/issues/welcome.html. Last updated June 2, 2009. Accessed March 15, 2010.

Gulf of Mexico Fishery Management Council (GMFMC). 2005. Generic amendment number 3 for addressing essential fish habitat requirements, habitat areas of particular concern, and adverse effects of fishing in the following fishery management plans of the Gulf of Mexico: shrimp fishery of the Gulf of Mexico, United States waters red drum fishery of the Gulf of Mexico, reef fish fishery of the Gulf of Mexico coastal migratory pelagic resources (mackerels) in the Gulf of Mexico and South Atlantic, stone crab fishery of the Gulf of Mexico, spiny lobster in the Gulf of Mexico and South Atlantic, coral and coral reefs of the Gulf of Mexico. Gulf of Mexico Fishery Management Council, Tampa, FL.

Gulf of Mexico Fishery Management Council (GMFMC). 2010a. Federal fishing rules for the Gulf of Mexico. Internet website: http://www.gulfcouncil.org/fishrules.htm. Accessed August 5, 2010.

Gulf of Mexico Fishery Management Council (GMFMC). 2010b. Supplemental recreational red snapper season to open October 1, 2010. Internet website: http://www.gulfcouncil.org/news_resources/Press%20Releases/2010RedSnapperReopening.pdf.

Gulf of Mexico Fishery Management Council (GMFMC). 2011. Recreational fishing regulations for Gulf of Mexico federal waters. Internet website: http://www.gulfcouncil.org/Beta/GMFMCWeb/downloads/rec_brochure_2010.pdf.

Guo, J., D.W. Hughes, and W.R. Keithly. 1998. An analysis of Louisiana Highway 1 in relation to expanding oil and gas activities in the Central Gulf of Mexico. In: Lafourche Parish and Port Fourchon, Louisiana: Effects of the Outer Continental Shelf Petroleum Industry on the Economy and Public Services, Part 1. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2001-019. 42 pp.

Guzmán, H.M. and I. Holst. 1993. Effects of chronic oil-sediment pollution on the reproduction of the Caribbean reef coral *Siderastrea siderea*. Marine Pollution Bulletin 26(5):276-282.

Guzmán, H.M., J.B.C. Jackson, and E. Weil. 1991. Short-term ecological consequences of a major oil spill on Panamanian subtidal reef corals. Coral Reefs 10:1-12.

Guzmán, H.M., K.A. Burns, and J.B.C. Jackson. 1994. Injury, regeneration, and growth of Caribbean reef corals after a major oil spill in Panama. Marine Ecology Progress Series 105:231-241.

Haab, T.C., J.C. Whitehead, and T. McConnell. 2000. The economic value of marine recreational fishing in the southeast United States: 1997 southeast economic data analysis; final report, July 2000. 105 pp. Internet website: http://www.st.nmfs.noaa.gov/st5/RecEcon/Publications/SE_vol2.pdf. Accessed April 4, 2011.

Haab, T.C., R. Hicks, K. Schnier, and J.C. Whitehead. 2010. Angler heterogeneity and the species-specific demand for marine recreational fishing. Appalachian State University, Department of Economics Working Paper. Number 10-02. 43 pp. Internet website: http://econ.appstate.edu/RePEc/pdf/wp1002.pdf.

Haag, W.G. 1992. The Monte Sano site. In: Jeter, M.D., ed. Southeastern Archaeological Conference: Abstracts of the Forty-ninth Annual Meeting, Arkansas' Excelsior Hotel, October 21-24, 1992. Little Rock, AR. 18 pp.

Haby, M.G., R.J. Miget, and L.L. Falconet. 2009. Hurricane damage sustained by the oyster industry and the oyster reefs across the Galveston Bay system with recovery recommendations. A Texas AgriLife Extension Service/SeaGrant Extension Program Staff Paper. The Texas A&M University System, College Station, TX. TAMU-SG-09-201. 51 pp.

Haddad, R. and S. Murawski. 2010. Analysis of hydrocarbons in samples provided from the cruise of the R/V *Weatherbird II*, May 23-26, 2010. U.S. Dept. of Commerce, National Oceanographic and Atmospheric Administration, Silver Spring, MD. 14 pp.

Haig, S.H. and C.L. Ferland. 2002. 2001 international piping plover census. U.S. Dept. of the Interior, Geological Survey, Forest and Rangeland Ecosystem Science Center, Corvallis, OR. 293 pp.

Hale, L.F. and J.K. Carlson. 2007. Characterization of the shark bottom longline fishery, 2005-2006. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-SEFSC-554. 28 pp.

Hale, L.F., L.D. Hollinsead, and J.K. Carlson. 2007. Characterization of the shark bottom longline fishery, 2007. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-SEFSC-564. 25 pp.

Hale, L.F., S.J.B. Gulak, and J.K. Carlson. 2009. Characterization of the shark bottom longline fishery, 2008. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-SEFSC-586. 23 pp.

Hall, R.J., A.A. Belisle, and L. Sileo. 1983. Residues of petroleum hydrocarbons in tissues of sea turtles exposed to the *Ixtoc I* oil spill. Journal of Wildlife Diseases 19(2):106-109.

Hamilton, P. and A. Lugo-Fernandez. 2001. Observations of high speed deep currents in the northern Gulf of Mexico. Geophysical Research Letters 28:2767-2870.

Hamilton, P., J.J. Singer, E. Waddell, and K. Donuhue. 2003. Deepwater observations in the northern Gulf of Mexico from in-situ current meters and PIES: Final report. Volume II. Technical report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS-2003-049. 95 pp.

Hammer, D. 2011. Ken Feinberg reaches deal to pay subsistence claims for commercial fishermen who consume a portion of their catch (April 2011). *The Times-Picayune*. Internet website: http://www.nola.com/news/gulf-oil-spill/index.ssf/2011/04/post_31.html. Accessed April 28, 2011.

Handley, D.A., D. Altsman, and R. DeMay, eds. 2007. Seagrass status and trends in the northern Gulf of Mexico: 1940-2002. U.S. Dept. of the Interior, Geological Survey Scientific Investigations Report 2006-5287 and U.S. Environmental Protection Agency 855-R-04-003. Internet website: http://pubs.usgs.gov/sir/2006/5287/.

Haney, J.L, Y. Wei, and S.G. Douglas. 2004. A preliminary assessment of on-shore air quality impacts for the eastern Gulf Coast (Louisiana to Florida) using the 2000 Gulfwide Emissions Inventory: Draft report. Prepared for the U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA, by ICF Consulting, San Rafael, CA.

Harbison, R.N. 1968. Geology of De Soto Canyon. Journal of Geophysical Research 73:5175-5185.

Hargreaves, S. 2010. Drilling ban: Jobs at stake. Internet website: http://money.cnn.com/2010/06/24/news/economy/drilling_jobs_at_stake/index.htm?postversion=2010062410. Accessed June 30, 2010.

Harper, D.E., Jr. 1991. Macroinfauna and macroepifauna. In: Brooks, J.M., ed. 1991. Mississippi-Alabama continental shelf ecosystem study: Data summary and synthesis. Volume II: Technical narrative. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 91-0063. 862 pp.

Harper, D.E., Jr., L.D. McKinney, J.M. Nance, and R.R. Salzer. 1991. Recovery responses of two benthic assemblages following an acute hypoxic event on the Texas continental shelf, northwestern Gulf of Mexico. Geological Society, London, Special Publications 58:49-64.

Harrison, P. 1983. Seabirds: An identification guide. Boston, MA: Houghton Mifflin Co. 448 pp.

Harrison, P. 1996. Seabirds of the world. Princeton, NJ: Princeton University Press. 317 pp.

Hart, A.D., K.D. Spring, J.M. Brooks, B.J. Presley, and B.A. Vittor. 1989. Fate and effects of drilling fluid and cutting discharges in shallow, nearshore waters. Washington, DC: American Petroleum Institute.

Hartung, R. 1995. Assessment of the potential for long-term toxicological effects of the *Exxon Valdez* oil spill on birds and mammals. ASTM (American Society for Testing Materials) Special Technical Publication.

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

Hayes, M.O., D.D. Domeracki, C.D. Getter, T.W. Kana, and G.I. Scott. 1980. Sensitivity of coastal environments to spilled oil, south Texas coast. Research Planning Institute, Inc. Report No. RPI/R/80/4/11-12. Prepared for the U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Office of Marine Pollution Assessment, Columbia, SC. 89 pp.

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

Hazen, T.C., E.A. Dubinsky, T.Z. DeSantis, G.L. Andersen, Y.M. Picento, N. Singh, J.K. Jansson, A. Probst, S.E. Borglin, J.L. Fortney, W.T. Stringfellow, M. Bill, M.S. Conrad, L.M. Tom, K.L. Chavarria, T.R. Alusi, R. Lamendella, D.C. Joyner, C. Spier, J. Baelum, M. Auer, M.L. Zelma, R. Chakraborty, E.L. Sonnenthal, P. D'haeseleer, H.N. Holman, S. Osman, Z. Lu, J.D. Van Nostrand, Y. Deng, J. Zhou, and O.U. Mason. 2010. Deep-sea oil plume enriches indigenous oil-degrading bacteria. Published online: Science Express August 24, 2010. Science 330:6001(204-208).

Heck, K.L., G. Hays, and R.J. Orth. 2003. Critical evaluation of the nursery role hypothesis for seagrass meadows. Marine Ecology Progress Series 253:123-136.

Helicopter Safety Advisory Conference. 2009. HSCA 2009 safety statistics. Internet website: http://www.hsac.org/Minutes/may2010/2009SAFETYSTAT.pdf. Accessed December 17, 2010.

Hell, J.W. and M.D. Ehlers, eds. 2008. Structural and functional organization of the synapse. New York, NY: Springer. 801 pp.

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

Hemmerling, S.A. and C.E. Colten. In preparation. Environmental justice: A comparative perspective in Louisiana. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA. Prepared under Contract No. 30951-72404.

Heneman, B. and the Center for Environmental Education. 1988. Persistent marine debris in the North Sea, northwest Atlantic Ocean, wider Caribbean area, and the west coast of Baja California. Final report for the Marine Mammal Commission. Contract MM3309598-5. Washington, DC. Available from NTIS, Springfield, VA: PB89-109938. 161 pp.

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

Henningsson, S.S. and T. Alerstam. 2005. Barriers and distances as determinants for the evolution of bird migration links: The Arctic shorebird system. In: Proceedings; Biological Sciences, 2005. London: Royal Society of London 272(1578):2251-2258.

Henriet, J.P. and J. Mienert. 1998. Gas hydrates; relevance to world marginal stability and climate change. Geological Society of London, England. Geological Society Special Publication No. 137. 338 pp.

Hernandez, F., S. Powers, and W. Graham. 2010. Seasonal variability in ichthyoplankton abundance and assemblage composition in the northern Gulf of Mexico off Alabama. Fishery Bulletin 108(2):193-207.

Hickerson, E.L. 2008. Flower Garden Banks National Marine Sanctuary draft—Post Hurricane Ike quick look cruise report. Prepared by the U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration. October 17, 2008. 17 pp. Internet website: http://flowergarden.noaa.gov/document_library/science/postike.pdf.

Hickerson, E.L. and G.P. Schmahl. 2007. Hurricane Rita impacts at the Flower Garden Banks National Marine Sanctuary. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration. February 2007. 13 pp. Internet website: http://flowergarden.noaa.gov/document_library/science/cruises/hurricaneritareport.pdf.

Hickerson, E.L., G.P. Schmahl, M. Robbart, W.F. Precht, and C. Caldow. 2008. The state of coral reef ecosystems of the Flower Garden Banks, Stetson Bank, and other banks in the northwestern Gulf of Mexico. In: Waddell, J.E. and A.M. Clarke, eds. The state of coral reef ecosystems of the United States and Pacific freely associated states: 2008. Center for Coastal Monitoring and Assessment's Biogeography Team, Silver Spring, MD. U.S. Dept. of Commerce, NOAA Technical Memorandum NOS NCCOS 73. NOAA/NCCOS. 569 pp.

Hickerson, E., M. Nuttall, G.P. Schmahl, L. Horn, G. Taylor, J. Reed, J. Voss, C. Menza, E. Ebert, D. Walker, M. Shetler, D. Henagan, and D. Cooley. 2010. Flower Garden Banks National Marine Sanctuary baseline benthic and fish surveys: A collaborative cruise with FGBNMS, NCCOS, and Harbor Branch Oceanographic Institute. Quick Look Report—FGBNMS-DFH14. May 16-21, 2010. 3 pp.

Hiett, R.L. and J.W. Milon. 2002. Economic impact of recreational fishing and diving associated with offshore oil and gas structures in the Gulf of Mexico: Final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2002-010. 98 pp.

Hobaugh, W.C., C.D. Stutzenbaker, and E.L. Flickinger. 1989. The rice prairies. In: Smith, L.M., R.L. Pederson, and R.M. Kaminski, eds. Habitat management for migrating and wintering waterfowl in North America. Texas Tech University Press, Lubbock.

Hogan, J.L. 2003. Occurrence of the diamondback terrapin (*Malaclemys terrapin littoralis*) at South Deer Island in Galveston Bay, Texas, April 2001–May 2002. U.S. Dept. of the Interior, Geological Survey, Austin, TX. USGS Open-File Report 03-022. 30 pp.

Holand, P. 1999. Reliability of subsea BOP systems for deepwater application, phase II DW. SINTEF Report prepared for the U.S. Dept. of the Interior, Minerals Management Service. TA&R Project 319. 118 pp. + apps. Internet website: http://www.boemre.gov/tarprojects/319/319AA.pdf.

Holand, P. and P. Skalle. 2001. Deepwater kicks and BOP performance. SINTEF Report prepared for U.S. Dept. of the Interior, Minerals Management Service. TA&R Project 383. 108 pp. + apps. Internet website: http://www.boemre.gov/tarprojects/383/383%20AB%20Final%20report%20Deepwater%20Kicks%20and%20BOP%20Performance.pdf.

Holdway, D.A. 2002. The acute and chronic effects of wastes associated with offshore oil and gas production on temperate and tropical marine ecological processes. Marine Pollution Bulletin 44:185-203.

Howard, R.K. and F.T. Short. 1986. Seagrass growth and survivorship under the influence of epiphyte grazers. Aquatic Botany 24(3):287-302.

Hsu, S.A. 1979. An operational forecasting model for the variation of mean maximum mixing heights across the coastal zone. Boundary-Layer Meteorology 16:93-98.

Hu, C. and F.E. Muller-Karger. 2007. Response of sea surface properties to Hurricane Dennis in the eastern Gulf of Mexico. Geophysical Research Letters Vol. 34, L07606, doi:10.1029/2006GL028935.

Hua, J. 1999. Behavior of chemically dispersed oil in marine sediment. Journal of Marine Science and Technology 7(1):35-42.

Hudson, J.H. and D.M. Robbin. 1980. Effects of drilling mud on the growth rate of reef-building coral, *Montastraea annularis*. The R&D Program for OCS Oil and Gas Operations. U.S. Dept. of the Interior, Geological Survey, Fisher Island Station, Miami Beach, FL.

Hudson, J.H., E.A. Shinn, and D.M. Robbin. 1982. Effects of offshore oil drilling on Philippine reef corals. Bulletin of Marine Science 32(4):890-908.

Hughes, D.W., J.M. Fannin, W. Keithly, W. Olatubi, and J. Guo. 2001. Lafourche Parish and Port Fourchon, Louisiana: Effects of the outer continental shelf petroleum industry on the economy and public services, part 2. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2001-020. 51 pp.

Hunt D. 2006. Official communication. Impacts of Hurricanes Rita and Katrina on bird habitat. U.S. Dept. of the Interior, Fish and Wildlife Service, Southeastern Louisiana Wildlife Refuges, Lacombe, LA. September 2006.

Hyland, J.L. and E.D. Schneider. 1976. Petroleum hydrocarbons and their effects on marine organisms, populations, communities, and ecosystems. In: Sources, effects and sinks of hydrocarbons in the aquatic environment. Proceedings of the Symposium, Washington, DC. August 9-11, 1976. Arlington, VA: American Institute of Biological Sciences. Pp. 465-506.

Iledare, O.O. and M.J. Kaiser. 2007. Competition and performance in oil and gas lease sales and development in the U.S. Gulf of Mexico OCS region, 1983-1999. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2007-034. 106 pp.

Inoue, M., S.E. Welsh, L.J. Rouse, Jr., and E. Weeks. 2008. Deepwater currents in the eastern Gulf of Mexico: Observations at 25.5ºN and 87ºW. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2008-001. 95 pp.

Intergovernmental Panel on Climate Change. 2007. Summary for policymakers. In: Climate change 2007: The physical science basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller, eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY. 24 pp. Internet website: http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf.

International Tanker Owners Pollution Federation Limited (ITOPF). 2007. Fate of marine oil spills. Technical Information Paper. London, United Kingdom. 8 pp. Internet website: http://www.itopf.com/_assets/documents/tip2.pdf. Accessed December 2, 2010.

International Tanker Owners Pollution Federation Limited (ITOPF). 2010a. Weathering process. Internet website: http://www.itopf.com/marine-spills/fate/weathering-process/. Accessed January 4, 2011.

International Tanker Owners Pollution Federation Limited (ITOPF). 2010b. Containment & recovery. Internet website: http://www.itopf.com/spill-response/clean-up-and-response/containment-and-recovery/. Accessed December 23, 2010.

Irion, J.B. and R.J. Anuskiewicz. 1999. MMS seafloor monitoring project: First annual technical report, 1997 field season. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico Region, New Orleans, LA. OCS Report MMS 99-0014. 63 pp.

Irion, J.B. and D.A. Ball. 2001. The *New York* and the *Josephine*: Two steamships of the Charles Morgan Line. International Journal of Nautical Archaeology 30(1):48-56.

Irvine, G. 2000. Persistence of spilled oil on shores and its effects on biota. In: Seas at the millennium: An environmental evaluation. Volume III: Global issues and processes. Elsevier Science Ltd.

Izon, D., E.P. Danenberger, and M. Mayes. 2007. Absence of fatalities in blowouts encouraging in MMS study of OCS incidents 1992-2006. Drilling Contractor, July/August. Pp. 84-90. Internet website: http://drillingcontractor.org/dcpi/dc-julyaug07/DC_July07_MMSBlowouts.pdf.

Jackson, J.B.C., J.D. Cubit, B.D. Keller, V. Batista, K. Burns, H.M. Caffey, R.L. Caldwell, S.D. Garrity, C.D. Getter, C. Gonzalez, H.M. Guzman, K.W. Kaufmann, A.H. Knap, S.C. Levings, M.J. Marshall, R. Steger, R.C. Thompson, and E. Weil. 1989. Ecological effects of a major oil spill on Panamanian coastal marine communities. Science 243:37-44.

Jackson, L.E., J.C. Kurtz, and W.S. Fisher. 2000. Evaluation guidelines for ecological indicators. U.S. Environmental Protection Agency, Research Triangle Park, NC. EPA/620/R-99/005. Internet website: http://www.epa.gov/emap/html/pubs/docs/resdocs/ecol_ind.pdf.

Jacob, J.S., S.W. Moulton, and R.A. Lopez. 2006. Texas coastal wetlands: Introduction. Internet website: http://www.texaswetlands.org/index.htm. Posted January 27, 2003. Accessed January 28, 2011.

Jefferson, T.A., S. Leatherwood, L.K.M. Shoda, and R.L. Pitman. 1992. Marine mammals of the Gulf of Mexico: A field guide for aerial and shipboard observers. Texas A&M University Printing Center, College Station, TX. 92 pp.

Jenssen, B.M. 1994. Review article: Effects of oil pollution, chemically treated oil, and cleaning on the thermal balance of birds. Environmental Pollution 86:207-215.

Jenssen, B.M. and M. Ekker. 1991. Effects of plumage contamination with crude oil dispersant mixtures on thermoregulation in common eiders and mallards. Archives of Environmental Contamination and Toxicology 20:398-403.

Jernelöv, A. and O. Lindén. 1981. *Ixtoc I*: A case study of the world's largest oil spill. Ambio 10(6):299-306.

Ji, Z.-G., W.R. Johnson, C.F. Marshall, and E.M. Lear. 2007. Oil spill risk analysis: Gulf of Mexico outer continental shelf (OCS) lease sales, Central Planning Area and Western Planning Area, 2007-2012, and Gulfwide OCS Program, 2007-2046. U.S. Dept. of the Interior, Minerals Management Service, Environmental Division, Herndon, VA. OCS Report MMS 2007-040. 59 pp.

Jindal, B. 2010. Governor Jindal letter to President Obama and Secretary Salazar: Severe impacts of moratorium on deepwater drilling. Press Release, June 3, 2010. Internet website: http://emergency.louisiana.gov/Releases/06032010-letter.html. Accessed January 13, 2011.

Jochens, A.E., L.C. Bender, S.F. Di Marco, J.W. Morse, M.C. Kennicutt II, M.K. Howard, and W.D. Nowlin, Jr. 2005. Understanding the processes that maintain the oxygen levels in the deep Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2005-032. 129 pp.

Jochens, A., D. Biggs, K. Benoit-Bird, D. Engelhaupt, J. Gordon, C. Hu, N. Jaquet, M. Johnson, R. Leben, B. Mate, P. Miller, J. Ortega-Ortiz, A. Thode, P. Tyack, and B. Würsig. 2008. Sperm whale seismic study in the Gulf of Mexico: Synthesis report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2008-006. 341 pp.

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

Johnsgard, P.A. 1975. Waterfowl of North America. Bloomington, IN: Indiana University Press. 624 pp.

Johnson, W.B. and J.G. Gosselink. 1982. Wetland loss directly associated with canal dredging in the Louisiana coastal zone. In: Boesch, D.F., ed. Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, Baton Rouge, LA. U.S. Dept. of the Interior, Fish and Wildlife Service. FWS/OBS-82/59. Pp. 60-72.

Johnston, J.B., D.R. Cahoon, and M.K. La Peyre. 2009. Outer continental shelf (OCS)-related pipelines and navigation canals in the Western and Central Gulf of Mexico: Relative impacts on wetland habitats and effectiveness of mitigation. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2009-048. 200 pp.

Joint Analysis Group. 2010a. Review of R/V *Brooks McCall* data to examine subsurface oil. Internet website: http://www.noaa.gov/sciencemissions/PDFs/JAG_Report_1_BrooksMcCall_Final_June20.pdf. Accessed October 14, 2010.

Joint Analysis Group. 2010b. Review of preliminary data to examine oxygen levels in the vicinity of MC525#1. May 8 to August 9, 2010. Internet website: http://www.noaa.gov/sciencemissions/PDFs/JAG_Oxygen_Report%20(FINAL%20090410).pdf. Accessed October 19, 2010.

Jones, P. and G. Wells. 1987. Shuttle views the Earth: Oceans from space. Space shuttle views and explanation. LPI slide set contribution no. 1181. Slide nos. 30 and 31. Shuttle views from 1987. The Lunar and Planetary Institute, NASA. Contract # NASW-4574 operated by the Universities Space Research Association. Internet website: http://www.lpi.usra.edu/publications/slidesets/oceans/index.shtml. Accessed December 2011.

Judd, F.W., R.I. Lonard, J.H. Everitt, and R. Villarreal. 1988. Effects of vehicular traffic in the secondary dunes and vegetated flats of South Padre Island, Texas. 5 vols. Coastal Zone ’89. New York, NY: American Society of Civil Engineers. Pp. 4,634-4,645.

Kahn, R.A. and P. Ryan. 1991. Long-term effects of crude oil on common murres (*Uria aalge*) following rehabilitation. Bulletin of Environmental Contamination and Toxicology 46:216-218.

Kaplan, M.F. and C. Whitman. Unpublished. Measuring the economic impact of tourism and recreation industries on Gulf Coast communities—Relationship between OCS development and coastal resources (2008). U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. Contract No. 1435-01-99-CA-30951-18261. x + 164 pp.

Kaplan, M.F., A. Laughland, and J. Mott. In preparation. OCS-related infrastructure fact book. Volume II: Communities in the Gulf of Mexico. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA.

Karl, T.R., J.M. Melillo, and T.C. Peterson, eds. 2009. Global climate change impacts in the United States. New York, NY: Cambridge University Press. 180 pp. Internet website: http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf.

Keim, B. and R.A. Muller. 2009. Hurricanes of the Gulf of Mexico. Louisiana State University Press, Baton Rouge, LA.

Kelley, W.R. 2002. Socioeconomic and environmental issues analysis of oil and gas activity on the outer continental shelf of the western Gulf of Mexico: Final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2002-011. 72 pp.

Kemp, W.M. 1989. Estuarine seagrasses. In: Day, J.W., Jr., C.A.S. Hall, W.M. Kemp, and A. Yanez-Arancibia, eds. Estuarine ecology. New York, NY: John Wiley & Sons. 558 pp.

Kendall, J.J. and G. Rainey. 1991. Produced waters: Findings of recent studies in the coastal waters of Louisiana; session introduction. In: Geo-Marine, Inc., comp. Proceedings: Eleventh Annual Gulf of Mexico Information Transfer Meeting, November 1990. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 91-0040. 524 pp.

Kennedy, C.J., N.J. Gassman, and P.J. Walsh. 1992. The fate of benzo[a]pyrene in the Scleractinian corals *Favia fragrum* and *Montastrea annularis*. Marine Biology 113:313-318.

Kennet, J.P. 1982. Marine geology. Englewood Cliff, NJ: Prentice-Hall. 752 pp.

Kennicutt II, M.C., ed. 1995. Gulf of Mexico offshore operations monitoring experiment, Phase I: Sublethal responses to contaminant exposure, final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 95-0045. 709 pp.

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

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

Kennicutt II, M.C., P.N. Boothe, T.L. Wade, S.T. Sweet, R. Rezak, F.J. Kelly, J.M. Brooks, B.J. Presley, and D.A. Wiesenburg. 1996. Geochemical patterns in sediments near offshore production platforms. Canadian Journal of Fisheries and Aquatic Science 53: 2554-2566.

Kenworthy, W.J. and M.S. Fonseca. 1996. Light requirements of seagrasses *Halodule wrightii* and *Syringodium filiforme* derived from the relationship between diffuse light attenuation and maximum depth distribution. Estuaries 19(3):740-750.

Kenworthy, W.J., M.J. Durako, S.M.R. Fatemy, H. Valavis, and G.W. Thayer. 1993. Ecology of seagrasses in northeastern Saudi Arabia one year after the Gulf War spill. Marine Pollution Bulletin 27:213-222.

Kessler, J.D., D.L Valentine, M.C. Redmond, M. Du., E.W. Chan, S.D. Mendes, E.W. Quiroz, C.J. Villanueva, S.S. Shusta, L.M. Werra, S.A. Yvon-Lewis, and T.C. Weber. 2011. A persistent oxygen anomaly reveals the fat of spilled methane in the deep Gulf of Mexico. Science Express, 10.1126/science.1199697. Internet website: http://www.sciencemag.org/content/early/2011/01/05/science.1199697. Posted January 6, 2011. Accessed January 13, 2011.

Kilpatrick, A.M., S.L. LaDeau, and P.P. Marra. 2007. Ecology of West Nile virus transmission and its impact on birds in the Western Hemisphere. Auk 124:1121-1136.

King, W.E. 2007. Energy alternatives and the environment. U.S. Dept. of the Interior, Minerals Management Service, Herndon, VA. OCS Report MMS 2007-016. 46 pp.

Kingston, P.F. 1995. The *Exxon Valdez* and *Braer* oil spills; a comparison of their impacts on the marine environment. Deutsche Hydrographische Zeitschrift Supplement 5:59-72.

Kingston, P.F., I.M.T. Dixon, S. Hamilton, and D.C. Moore. 1995. The impact of the *Braer* oil spill on the macrobenthic infauna of the sediments off the Shetland Isles. Marine Pollution Bulletin 189:159-170.

Klasing, K., R. Donohoe, and J. Yamamoto. 2007. Dietary exposure to naphthalene in the Japanese quail (*Coturnix coturnix japonica*). In: Massey, J.G., ed. Proceedings of the Ninth International Effects of Oil on Wildlife Conference, Monterey, California, 2007, University of California at Davis Wildlife Health Center.

Klein, M.L., S.R. Humphrey, and H.F. Percival. 1995. Effects of ecotourism on distribution of waterbirds in a wildlife refuge. Conservation Biology 9:1454-1465.

Kleypas, J.A., J.W. McManus, and L.A.B. Meñtz. 1999. Environmental limits to coral reef development: Where do we draw the line? American Zoologist 39:146-159.

Knap, A.H. 1987. Effects of chemically dispersed oil on the brain coral, *Diploria strigosa*. Marine Pollution Bulletin 18(3):119-122.

Knap, A.H., J.E. Solbakken, R.E. Dodge, T.D. Sleeter, S.J. Wyers, and K.H. Palmork. 1982. Accumulation and elimination of (9-^{14}C) phenanthrene in the reef-building coral (*Diploria strigosa*). Bulletin of Environmental Contamination and Toxicology 28:281-284.

Knap, A.H., T.D. Sleeter, R.E. Dodge, S.C. Wyers, H.R. Frith, and S.R. Smith. 1983. The effects of oil spills and dispersant use on corals: A review and multidisciplinary experimental approach. Oil and Petrochemical Pollution 1(3):157-169.

Knap, A.H., S.C. Wyers, R.E. Dodge, T.D. Sleeter, H.R. Frith, S.R. Smith, and C.B. Cook. 1985. The effects of chemically and physically dispersed oil on the brain coral *Diploria strigosa* (Dana)—a summary review. In: Proceedings, 1985 Oil Spill Conference. February 25-28, 1985, Los Angeles, CA. Washington, DC: American Petroleum Institute. Pp. 547-551.

Ko, J-Y. 2007. The economic value of ecosystem services provided by the Galveston Bay estuary system. A Report Prepared for the Texas Commission on Environmental Quality. Texas A&M University, Dept. of Marine Sciences & Center for Texas Beaches and Shores, Galveston, TX. Contract Number 582-4-65067. 39 pp.

Ko, J-Y. and J.W. Day. 2004a. A review of ecological impacts of oil and gas development on coastal ecosystems in the Mississippi delta. Ocean and Coastal Management 47(11-12):597-623.

Ko, J-Y. and J.W. Day. 2004b. Wetlands: Impacts of energy development in the Mississippi Delta. Encyclopedia of Energy, Volume 6. Elsevier Inc. Pp. 397-408. Internet website: http://www.lsu.edu/cei/research_projects/Wetlands_final.pdf.

Korschgen, C.E., L.S. George, and W.L. Green. 1985. Disturbance of diving ducks by boaters on a migrational staging area. Wildlife Society Bulletin 13:290-296.

Kosin, I.L. 1958. Effect of simulated airplane sounds on the reproductive functions of the male domestic chicken. Journal of Applied Physiology 12:217-220.

Kou, W.W. 2010. Direct seismic indicators of gas hydrates in the Walker Ridge and Green Canyon Areas, deepwater Gulf of Mexico. American Association of Petroleum Geologists, Search and Discovery Article #80112. Internet website: http://www.searchanddiscovery.com/documents/2010/80112kou/ndx_kou.pdf. Posted October 22, 2010.

Krapu, G.L., J.L. Eldridge, C.L. Gratto-Trevor, and D.A. Buhl. 2006. Fat dynamics of Arctic-nesting sandpipers during spring in mid-continental North America. Auk 123:323-334.

Krivor, M.C., J. de Bry, N.J. Linville, and D.J. Wells. In press. Archival investigations for potential colonial-era shipwrecks in ultra-deep water in the Gulf of Mexico. U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEMRE 2011-004. 158 pp.

Kuhn, N.L., I.A. Mendelssohn, and D.J. Reed. 1999. Altered hydrology effects on Louisiana salt marsh function. Wetlands 19:3.

Kushmaro, A., G. Henning, D.K. Hofmann, and Y. Benayahu. 1997. Metamorphosis of *Heteroxenia fuscescens* Plaunlae (Cnidaria: Octocorallia) is inhibited by crude oil: A novel short term toxicity bioassay. Marine Environmental Research 43(4):295-302.

LA 1 Coalition. 2010a. LA 1 Coalition continues aggressive efforts to fund phase 2 of highway project in the wake of Tiger 2 grant results. Press Release. Internet website: http://la1coalition.org/images/Oct21_10LA1NewsRelease.pdf. Accessed December 3, 2010.

LA 1 Coalition. 2010b. Facts & figures: LA Highway 1. Internet website: http://www.la1coalition.org/facts.html#4. Accessed May 5, 2011.

LA Bucket Brigade. 2011. Self-reported health and economic impact survey: An analysis of the *Deepwater Horizon* spill disaster in seven coastal Louisiana parishes. March 3, 2011. http://www.labucketbrigade.org/article.php?id=718. Accessed July 19, 2011.

LaCoast.gov. 2010a. CWPPRA restoration projects. Internet website. http://www.lacoast.gov/projects/list.asp. Accessed December 13, 2010.

LaCoast.gov. 2010b. Coastal wetland planning, protection, and restoration act, summary of wetland benefit for priority list. Internet website: http://www.lacoast.gov/reports/wva/CWPPRA%20project%20benefits%202010-03-22.pdf. Posted March 22, 2010. Accessed May 24, 2010.

LaCoast.gov. 2011. Atchafalaya Basin: Summary of basin plan. Internet website: http://lacoast.gov/new/About/Basin_data/at/Default.aspx. Accessed January 28, 2011.

Lack, D.L. 1968. Ecological adaptations for breeding in birds. London: Methuen. 409 pp.

LaDeau, S.L., A.M. Kilpatrick, and P.P. Marra. 2007. West Nile virus emergence and large-scale declines of North American bird populations. Nature 447:710-714 and Supplementary Information, 10 pp.

Lambert, G., D.B. Peakall, B.J.R. Philogene, and F.R. Engelhardt. 1982. Effect of oil and oil dispersant mixtures on the basal metabolic rate of ducks. Bulletin of Environmental Contamination and Toxicology 29:520-524.

Lange, R. 1985. A 100-ton experimental oil spill at Halten Bank, off Norway. In: Proceedings, 1985 Oil Spill Conference, February 25-28, 1985, Los Angeles, CA. Washington, DC: American Petroleum Institute.

Lange, J.L., D.A. Schwartz, B.N. Doebbeling, J.M. Heller, and P.S. Thorne. 2002. Exposures to the Kuwait oil fires and their association with asthma and bronchitis among gulf war veterans. Environmental Health Perspectives 110(11):1141-1146.

LeBlanc, D.J. 1985. Environmental and construction techniques involved with the installation of a gas pipeline across Timbalier Island, Louisiana. In: Proceedings, Sixth Annual Gulf of Mexico Information Transfer Meeting, October 22-24, 1985. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 86-0073. Pp. 203-205.

Lee, M.R. and T.C. Blanchard. 2010. Health impacts of *Deepwater Horizon* oil disaster on coastal Louisiana residents. Louisiana State University, Department of Sociology, Baton Rouge, LA.

Lee, D.S. and M.L. Moser. 1998. Importance des Sargasses pelagiques pour la recherché alimentaire des oiseaux marins. El Pitirre 11(3):111-112.

Leighton, F.A. 1993. The toxicity of petroleum oils to birds. Environmental Reviews 1:92-103.

Lewis, J.B. 1971. Effect of crude oil and an oil-spill dispersant on reef corals. Marine Pollution Bulletin 2:59-62.

Lewis, A. and D. Aurand. 1997. Putting dispersants to work: Overcoming obstacles. 1997 International Oil Spill Conference. API 4652A. Technical Report IOSC-004.

LGL Ecological Research Associates, Inc. and Texas A&M University. 1986. Gulf of Mexico continental slope study: Annual report, year 2. Volume II: Primary volume. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Office, Metairie, LA. OCS Study MMS 86-0090. 220 pp.

Lin, Q. and I.A. Mendelssohn. 1996. A comparative investigation of the effects of South Louisiana Crude on the vegetation of fresh, brackish and salt marshes. Marine Pollution Bulletin 32:202-209.

Lirman, D., G. Deangelo, J. Serafy, A. Hazra, D. Smith Hazra, J. Herlan, J. Lou, S. Bellmund, J. Wang, and R. Clausing. 2008. Seasonal changes in the abundance and distribution of submerged aquatic vegetation in a highly managed coastal lagoon. Hydrobiologia 596:105-120.

Lissner, A.L., G.L. Taghon, D.R. Diener, S.C. Schroeter, and J.D. Dixon. 1991. Recolonization of deep-water hard-substrate communities: Potential impacts from oil and gas development. Ecological Implications 1(3):258-267.

Littler, D.S. and M.M. Littler. 2000. Caribbean reef plants; an identification guide to the reef plants of the Caribbean, Bahamas, Florida and Gulf of Mexico. OffShore Graphics Inc., Florida. Pp. 280-290.

Liu, K-B. and M.L. Fearn. 2000. Holocene history of catastrophic hurricane landfalls along the Gulf of Mexico coast reconstructed from coastal lake and marsh sediments. In: Nig, Z.H. and K.K. Abdollahi, eds. Current stresses and potential vulnerabilities: Implications of global change for the Gulf Coast region of the United States. Baton Rouge, LA: Franklin Press.

Llacuna, S., A. Gorriz, M. Durfort, and J. Nadal. 1993. Effects of air pollution on passerine birds and small mammals. Archives of Environmental Contamination and Toxicology 24:59-66.

Lohr, K. 2010. Louisiana Gulf Coast businesses lament losses. National Public Radio. October 13, 2010. Internet website: http://www.npr.org/templates/story/story.php?storyId=130537922. Accessed November 12, 2010.

Long, B.F. and J.H. Vandermuelen. 1983. Geomorphological impact of cleanup of an oiled salt marsh (Ile Grande, France). In: Proceedings, 1983 Oil Spill Conference, February 28-March 3, 1983, San Antonio, TX. Washington, DC: American Petroleum Institute. Pp. 501-505.

Longley, W.L., ed. 1994. Freshwater inflows to Texas bays and estuaries: Ecological relationships and methods for determination of needs. Texas Water Development Board and Texas Parks and Wildlife Department, Austin, TX. 386 pp.

Loren C. Scott & Associates. 2008. The economic impacts of Port Fourchon on the national and Houma MSA economies. 31 pp. Internet website: http://www.portfourchon.com/site100-01/1001757/docs/port_fourchon_economic_impact_study.pdf.

Louisiana Coastal Wetlands Conservation and Restoration Task Force. 2006. The 2006 evaluation report to the U.S. Congress on the effectiveness of Coastal Wetlands Planning, Protection and Restoration Act projects. Submitted by the Chairman of the Louisiana Coastal Wetlands Conservation and Restoration Task Force, U.S. Dept. of the Army, Corps of Engineers, New Orleans District, New Orleans, LA. 73 pp. Internet website: http://lacoast.gov/reports/program/CWPPRA%202006%20Evaluation%20Report.pdf.

Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority. 1998. Coast 2050: Toward a sustainable coastal Louisiana. Baton Rouge, LA: Louisiana Dept. of Natural Resources. Internet website: http://www.coast2050.gov/2050reports.htm.

Louisiana Dept. of Environmental Quality. 2004. Louisiana environmental inventory report, 2nd annual edition, April 2004. Baton Rouge, LA. 92 pp.

Louisiana Dept. of Natural Resources. 2009. Louisiana is proud to be a hub of industry. 6 pp. Internet website: http://dnr.louisiana.gov/assets/docs/hub-of-business_brochure.pdf. Accessed January 23, 2011.

Louisiana Dept. of Natural Resources. 2010. Production information. SONRIS lite. Internet website: http://sonris-www.dnr.state.la.us/www_root/sonris_portal_1.htm. Accessed October 6, 2010.

Louisiana Dept. of Wildlife and Fisheries. 2008a. The impact of Hurricane Gustav on the fisheries resources of Louisiana: Preliminary report. September 8, 2008. 4 pp.

Louisiana Dept. of Wildlife and Fisheries. 2008b. The impact of Hurricane Ike on the fisheries resources of Louisiana: Preliminary report. October 2, 2008. 5 pp.

Louisiana Dept. of Wildlife and Fisheries. 2010. Oyster stock assessment report of the public oyster areas in Louisiana. Oyster Data Report Series No. 16. July, 2010.

Louisiana Mid-Continent Oil and Gas Association. 2010. Impact of President Obama's order halting work on 33 exploratory wells in the deepwater Gulf of Mexico. Internet website: http://www.lmoga.com/Economic%20Impacts%20of%20Gulf%20Moratorium.pdf. Accessed July 7, 2010.

Louisiana Universities Marine Consortium (LUMCON). 2008. Dead zone again rivals record size. Press Release, July 28, 2008. Internet website: http://www.gulfhypoxia.net/. Accessed May 4, 2009.

Louisiana Universities Marine Consortium (LUMCON). 2009. Gulf of Mexico dead zone surprisingly small in area, but severe. Press Release, July 24, 2009. Internet website: http://www.gulfhypoxia.net/Research/Shelfwide%20Cruises/2009/Files/Press_Release.pdf/. Accessed August 24, 2009.

Louisiana Universities Marine Consortium (LUMCON). 2010a. 2010 Dead zone—one of the largest ever. LUMCON News. Internet website: http://www.lumcon.edu/Information/news/default.asp?XMLFilename=201008021451.xml. Accessed August 10, 2010.

Louisiana Universities Marine Consortium (LUMCON). 2010b. 2010 Dead zone area extends to lower Texas coast. LUMCON News. Internet website: http://www.gulfhypoxia.net/News/default.asp?XMLFilename=201008110954.xml. Accessed November 15, 2010.

Loya, Y. 1975. Possible effects of water pollution on the community structure of Red Sea corals. Marine Biology 29:177-185.

Loya, Y. 1976a. Effects of water turbidity and sedimentation on the community structure of Puerto Rican corals. Bulletin of Marine Science 26(4):450-466.

Loya, Y. 1976b. Recolonization of Red Sea corals affected by natural catastrophes and man-made perturbations. Ecology 57:278-289.

Loya, Y. and B. Rinkevich. 1979. Abortion effect in corals induced by oil pollution. Marine Ecology Progress Series 1:77-80.

Lu, L. and R.S.S. Wu. 2006. A field experimental study on recolonization and succession of macrobenthic infauna in defaunated sediment contaminated with petroleum hydrocarbons. Estuarine, Coastal and Shelf Science 68:627-634.

Lubchenco, J.L., M. McNutt, B. Lehr, M. Sogge, M. Miller, S. Hammond, and W. Conner. 2010. BP *Deepwater Horizon* oil budget: What happened to the oil? Internet website: http://www.noaanews.noaa.gov/stories2010/PDFs/OilBudget_description_%2083final.pdf. Accessed September 8, 2010.

Lugo-Fernandez, A., D.A. Ball, M. Gravois, C. Horrell, and J.B. Irion. 2007. Analysis of the Gulf of Mexico's Veracruz-Havana route of La Flota de la Nueva España. Journal of Maritime Archaeology 2(1):24-47.

Lutcavage, M.E., P. Plotkin, B. Witherington, and P.L. Lutz. 1997. Human impacts on sea turtle survival. In: Lutz, P.L. and J.A. Musick, eds. The biology of sea turtles. Boca Raton, FL: CRC Press, Inc. Pp. 387-409.

Lyons, T.J. and W.D. Scott. 1990. Principles of air pollution meteorology. Boca Raton, FL: CRC Press, Inc. 225 pp.

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

MacDonald, I.R., ed. 1992. Chemosynthetic ecosystems study literature review and data synthesis, northern Gulf of Mexico: Volumes I-III. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 92-0033, 92-0034, and 92-0035. 25, 218, and 263 pp., respectively.

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

MacDonald, I.R., G.S. Boland, J.S. Baker, J.M. Brooks, M.C. Kennicutt II, and R.R. Bidigare. 1989. Gulf of Mexico hydrocarbon seep communities. II. Spatial distribution of seep organisms and hydrocarbons at Bush Hill. Marine Biology 101:235-247.

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

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

MacDonald, I.R., N.L. Guinasso, R. Sassen, J.M. Brooks, S. Lee, and K.T. Scott. 1994. Gas hydrates that breach the sea-floor and intersect with the water column on the continental slope of the Gulf of Mexico. Geology 22:699-702.

MacDonald, I.R., W.W. Schroeder, and J.M. Brooks, eds. 1995. Chemosynthetic ecosystems study: Final report. Volume 2: Technical report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 95-0022. 319 pp.

MacDonald, I.R., J.F. Reilly Jr., W.E. Best, R. Vnkataramaiah, R. Sassen, N.S. Guinasso Jr., and J. Amos. 1996. Remote sensing inventory of active oil seeps and chemosynthetic communities in the northern Gulf of Mexico. In: Schumacher, D. and M.A. Abrams, eds. Hydrocarbon migration and its near-surface expression. American Association of Petroleum Geologists Memoir 66:27-37.

Mackar, R. 2010. NIH to launch Gulf oil spill health study. Environmental Factor: Your online source for NIEHS news. Internet website: http://www.niehs.nih.gov/news/newsletter/2010/october/spotlight-launch.cfm. Accessed October 2010.

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

Magill, K. 2010. Local jobless rate remains lowest in La. Internet website: http://www.houmatoday.com/article/20101123/ARTICLES/101129790. Accessed December 8, 2010.

Maiaro, J.L. 2007. Disturbance effects on nekton communities of seagrasses and bare substrates in Biloxi Marsh, Louisiana. Master's thesis, Louisiana State University, Baton Rouge, LA. 78 pp. Internet website: http://etd.lsu.edu/docs/available/etd-07032007-101237/unrestricted/Maiaro_thesis.pdf.

Mallman, E.P. and M.D. Zoback. 2007. Subsidence in the Louisiana coastal zone due to hydrocarbon production. Proceedings of the 9th International Coastal Symposium, Journal of Coastal Research SI 50:443–449. Gold Coast, Australia. Internet website: http://www.griffith.edu.au/conference/ics2007/pdf/ICS085.pdf.

Malme, C.I., P.W. Smith, and P.R. Miles. 1986. Characterization of geophysical acoustic survey sounds. U.S. Dept. of the Interior, Mineral Management Service, Pacific OCS Region, Los Angeles, CA. OCS Study MMS 86-0032. 92 pp.

Manville II, A.M. 2005. Bird strikes and electrocutions at power lines, communication towers, and wind turbines: State of the art and state of the science—next steps toward mitigation. In: Ralph, C.J. and T.D. Rich, eds. Bird conservation implementation in the Americas: Proceedings of the 3rd International Partners in Flight Conference, 2002. U.S. Dept. of Agriculture, Forest Service, Pacific Southwest Research Station, Albany, CA. Forest Service General Technical Report PSW-GTR-191. Pp. 1051-1064.

Manzella, S., J. Williams, B. Schroeder, and W. Teas. 2001. Juvenile head-started Kemp's ridleys found in floating grass mats. Marine Turtle Newsletter 52:5-6.

Marine Well Containment Company (MWCC). 2010a. New oil spill containment system to protect Gulf of Mexico planned by major oil companies. Press Release, July 21, 2010. Internet website: http://marinewellcontainment.com/press.php?pressid=1. Accessed December 27, 2010.

Marine Well Containment Company (MWCC). 2010b. ExxonMobil announces equipment for industry use through Marine Well Containment Company. Press Release, September 20, 2010. Internet website: http://www.marinewellcontainment.com/pdfs/

MWCC_Early_Response_Equipment_PR_092010_Issued%20092010.pdf. Accessed December 27, 2010.

Marshall, P.A. 2000. Skeletal damage in reef corals: Relating resistance to colony morphology. Marine Ecology Progress Series 200:177-189.

Marszalek, D.S. 1981. Impact of dredging on a subtropical reef community, southeast Florida, USA. In: Proceedings of the Fourth International Coral Reef Symposium. Volume 1. May 18-22, 1981. Manila, Philippines.

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

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

Mason, J. 2010. The economic cost of a moratorium on offshore oil and gas exploration to the Gulf region. Louisiana State University, Baton Rouge, LA.

Massachusetts Technology Collaborative. 2005. A framework for offshore wind energy development in the United States. With the U.S. Dept. of Energy, National Renewable Energy Laboratory, and GE Energy. 30 pp. Internet website: http://www.masstech.org/offshore/final_09_20.pdf.

Matkin, C.O., E.L. Saulitis, G.M. Ellis, P. Olesiuk, and S.D. Rice. 2008. Ongoing population-level impacts on killer whales *Orcinus orca* following the "Exxon Valdez" oil spill in Prince William Sound, Alaska. Marine Ecology Progress Series 356:269-281.

Matthews, T. and B. Cameron, Jr., 2010. OCS regulatory framework for the Gulf of Mexico region. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 2010-019. 24 pp. Internet website: http://www.gomr.boemre.gov/PDFs/2010/2010-019.pdf.

Maze-Foley, K. and K.D. Mullin. 2006. Cetaceans of the oceanic northern Gulf of Mexico: Distributions, group sizes and interspecific associations. J. Cetacean Res. Manage. 8(2):203-213.

McAuliffe, C.D. 1987. Organism exposure to volatile soluble hydrocarbons from crude oil spills—a field and laboratory comparison. In: Proceedings, 1987 Oil Spill Conference . . . April 6-9, 1988, Baltimore, MD. Washington, DC: American Petroleum Institute. Pp. 275-288.

McAuliffe, C.D., A.E. Smalley, R.D. Groover, W.M. Welsh, W.S. Pickle, and G.E. Jones. 1975. Chevron Main Pass Block 41 oil spill: Chemical and biological investigation. In: Proceedings, 1975 Conference on Prevention and Control of Oil Pollution, March 25-27, 1975, San Francisco, CA. Washington, DC: American Petroleum Institute.

McAuliffe, C.D., B.L. Steelman, W.L. Leek, D.E. Fitzgerald, J.P. Ray, and C.D. Baker. 1981a. The 1979 southern California dispersant treated research oil spills. In: Proceedings 1981 Oil Spill Conference . . . March 2-5, 1981, Atlanta, GA. Washington DC: American Petroleum Institute. Pp. 269-282.

McAuliffe, C.D., G.P. Canevari, T.D. Searl, J.C. Johnson, and S.H. Greene. 1981b. The dispersion and weathering of chemically treated crude oils on the sea surface. In: Petroleum and the Marine Environment. Proceedings of Petromar '80. London: Graham and Trotman Ltd.

McCauley, R.D. and R.C. Harrel. 1981. Effects of oil spill cleanup techniques on a salt marsh. In: Proceedings, 1981 Oil Spill Conference . . . March 2-5, 1981, Atlanta, GA. Washington, DC: American Petroleum Institute. Pp. 401-407.

McConnaughey, R.A., K.L. Mier, and C.B. Dew. 2000. An examination of chronic trawling effects on soft-bottom benthos of the eastern Bering Sea. ICES Journal of Marine Science 57:1377-1388.

McCoy, M. and J. Salerno. 2010. Assessing the effects of the Gulf of Mexico oil spill on human health—workshop summary. Institute of Medicine of the National Academies. Pp. 43-74.

McDonald, S.J., K.L. Willett, J. Thomsen, K.B. Beatty, K. Connor, T.R. Narasimhan, C.M. Erikson, and S.H. Safe. 1996. Sublethal detoxification responses to contaminant exposure associated with offshore production platforms. Canadian Journal of Fisheries and Aquatic Science 53:2606-2617.

McGinnis, M.V., L. Fernandez, C. Pomeroy, S. Hitz, and C. Navarro. 2001. The politics, economics, and ecology of decommissioning offshore oil and gas structures. U.S. Dept. of the Interior, Minerals Management Service, Pacific OCS Region, Camarillo, CA. OCS Study MMS 2001-006. 98 pp.

McGrattan, K.B., W.D. Walton, A.D. Putorti Jr., W.H. Twilley, J.A. McElroy, and D.D. Evans. 1995. Smoke plume trajectory from in situ burning of crude oil in Alaska—field experiments. In: Proceedings of the Eighteenth Arctic and Marine Oil spill Program (AMOP) Technical Seminar, Vol. 2, June 14-16, 1995, Edmonton, Alberta, Canada.

McGrail, D. 1982. Water and sediment dynamics at the Flower Garden Banks. In: Norman, R., ed. Environmental studies at the Flower Gardens and selected banks: Northwestern Gulf of Mexico, 1979-1981. Executive summary. Technical Report No. 82-8-T. Pp. 27-29.

McIlgorm, A., H.F. Campbell, and M.J. Rule. 2009. Understanding the economic benefits and costs of controlling marine debris in the APEC region (MRC 02/2007). A report to the Asia-Pacific Economic Cooperation, Marine Resource Conservation Working Group by the National Marine Science Centre (University of New England and Southern Cross University). Coffs Harbour, NSW, Australia. APEC#209-MR-01.3. 95 pp.

McKeithen, M.A. 2007. Testimony to the Committee on Energy and Natural Resources: Hearing on oil and gas resources on the outer continental shelf and areas available for leasing in the Gulf of Mexico, January 25, 2007. Louisiana Dept. of Natural Resources, Office of Mineral Resources. Internet website: http://energy.senate.gov/public/_files/MarjoriesTestimonyFinal2.doc. Accessed February 16, 2011.

McLaughlin, S.L. 1995. Roots, relics, and recovery: What went wrong with the Abandoned Shipwreck Act of 1987. Columbia-VLA Journal of Law & the Arts 19(3):149-198.

MCS Advanced Subsea Engineering. 2010. Risk analysis of using a surface BOP. Prepared for the U.S. Dept. of the Interior, Minerals Management Service. TA&R Project 640. 113 pp. + apps. Internet website: http://www.boemre.gov/tarprojects/640/aa.pdf.

McTigue, T.A. and R.J. Zimmerman. 1998. Use of infauna by juvenile *Panaeus aztecus* Ives and *Panaeus setiferus* (Linnaeus). Estuaries 21(1):160-175.

Meckel, T.A., U.S. tenBrink, and S.J. Williams. 2006. Current subsidence rates due to compaction of Holocene sediments in southern Louisiana. Geophysical Research Letters Volume 33, L11403. Internet website: http://www.agu.org/pubs/crossref/2006/2006GL026300.shtml.

Melendez, J., J.J. Schubert, and M. Amani. 2006. Risk assessment of surface vs. subsurface BOPs on mobile offshore drilling units. Final project report prepared for the U.S. Dept. of the Interior, Minerals Management Service under the MMS/OTRC Cooperative Research Agreement 1435-01-04-CA-35515. TA&R Project 540. 103 pp. Internet website: http://www.boemre.gov/tarprojects/540/aa.pdf.

Meltzer, D.J., D.K. Grayson, G. Ardila, A.W. Barker, D.F. Dincauze, C.V. Hanes, F. Mina, L. Nunez, and D.J. Stanford. 1997. On the Pleistocene antiquity of Monte Verde, Chile. American Antiquity 62(4):659-663.

Memphis State University. 1971. Effects of noise on wildlife and other animals. Prepared for the U.S. Environmental Protection Agency, Office of Noise Abatement and Control, Washington, DC, under contract number 68-04-0024.

Mendelssohn, I.A. and M.W. Hester. 1988. Texaco USA: Coastal vegetation project, Timbalier Island. New Orleans, LA: Texaco USA. 207 pp.

Mendelssohn, I.A., M.W. Hester, C. Sausser, and M. Fishel. 1990. The effect of a Louisiana crude oil discharge from a pipeline break on the vegetation of a southeast Louisiana brackish marsh. Oil and Chemical Pollution 7:1-15.

Mendelssohn, I.A., M.W. Hester, and J.M. Hill. 1993. Effects of oil spills on coastal wetlands and their recovery. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 93-0045. 46 pp.

Menzies, R.J., R.Y. George, and G.T. Rowe. 1973. Abyssal environment and ecology of the world oceans. Wiley-Interscience. 488 pp.

Meo, S.A. 2009. Effect of duration of exposure to polluted air environment on lung function in subjects exposed to crude oil spill into sea water. International Journal of Occupational Medicine and Environmental Health 22(1):35-41.

Meylan, A.B. and M. Donnelly. 1999. Status justification for listing the hawksbill turtle (*Eretmochelys imbricata*) as critically endangered on the 1996 IUCN Red List of threatened animals. Chelonian Conservation and Biology 3(2):200-204.

Meylan, A. and D. Ehrenfeld. 2000. Conservation of marine turtles. In: Klemens, M.K., ed. Turtle conservation. Washington, DC: Smithsonian Institution Press. Pp. 96-125.

Michel, J. 1992. Chapter 2. Oil behavior and toxicity. In: Hayes, M.O., R. Hoff, J. Michel, D. Scholz, and G. Shigenaka. An introduction to coastal habitats and biological resources for oil spill response. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Office of Response and Restoration. NOAA Report No. HMRAD 92-4. Pp. 2-1 through 2-9. Internet website: http://response.restoration.noaa.gov/book_shelf/678_Chapter2.pdf.

Michot, T.C., C.W. Jeske, J.C. Mazourek, W.G. Vermillion, R.S. Kemmerer, and D. Baker. 2003. Atlas and census of wading bird and seabird nesting colonies in South Louisiana, 2001. Barataria-Terrebonne National Estuary Program Report No. 32. Thibodaux, LA. 93 pp.

Mikuska, T., J.A. Kushlan, and S. Hartley. 1998. Key areas for wintering North American herons. Colonial Waterbirds 21:125-134.

Miller, B.K. and W.R. Fontenot. 2001. Birds of the Gulf Coast. Louisiana University Press, Baton Rouge. 132 pp.

Mills, M. 1992. Alaska sport fishing in the aftermath of the *Exxon Valdez* oil spill. Special Report to the Alaska Dept. of Fish and Game Sport Fish Division. 182 pp.

Mississippi Press. 2007. Sees salt dome as worst disaster since Katrina. News article. Internet website: http://www.gulflive.com/opinion/mississippipress/index.ssf?/base/opinion/119538457290590.xml. Accessed November 19, 2007.

Mitchell, R. and I. Chet. 1975. Bacterial attack of corals in polluted seawater. Microbial Ecology 2:227-233.

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

Mitsch, W.J. and J.G. Gosselink. 2007. Wetlands. Hoboken, NY: John Wiley and Sons.

Montagna, P.A. and D.E. Harper, Jr. 1996. Benthic infaunal long-term response to offshore production platforms in the Gulf of Mexico. Canadian Journal of Fisheries and Aquatic Science 53:2567-2588.

Montagna, P.A. and J. Li. 1997. Modeling contaminant effects on deposit feeding nematodes near Gulf of Mexico production platforms. Ecological Modeling 98:151-162.

Moore, S.F. 1976. Offshore oil spills and the marine environment. Technology Review 61-67.

Moore, J.J. 2006. State of the marine environment in SW Wales, 10 years after the *Sea Empress* oil spill. Prepared for Countryside Council for Wales. Marine Monitoring Report No. 21.

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

Moore, S.F. and R.L. Dwyer. 1974. Effects of oil on marine organisms: A critical assessment of published data. Water Research 8:819-827.

Moridis, G.J., T.S. Collett, R. Boswell, M. Kurihara, M.T. Reagan, C. Koh, and E.D. Sloan. 2008. Toward production from gas hydrates: Current status, assessment of resources, and simulation-based evaluation of technology and potential. Society of Petroleum Engineers. Unconventional Reservoirs Conference, Keystone, CO, February 10-12, 2008. 43 pp. Internet website: http://www.netl.doe.gov/technologies/oil-gas/publications/Hydrates/reports/G308_SPE114163_Feb08.pdf.

Morita A., Y. Kusaka, Y. Deguchi, A. Moriuchi, Y. Nakanaga, M. Iki, S. Miyazaki, and K. Kawahara. 1999. Acute health problems among the people engaged in the cleanup of the Nakhodka oil spill. Environmental Research 91:185-194.

Morrison, R.I.G. 1984. Migration systems of some New World shorebirds. In: Burger, J. and B.L. Olla, eds. Shorebirds: Migration and foraging behavior. Behavior of marine animals. Current Perspectives in Research 6:125-206.

Morrison, R.I.G., R.E. Gill, Jr., B.A. Harrington, S. Skagen, G.W. Page, C.L. Gratto-Trevor, and S.M. Haig. 2000. Population estimates of Nearctic shorebirds. Waterbirds 23:337-352.

Morrison, R.I.G., R.E. Gill, Jr., B.A. Harrington, S. Skagen, G.W. Page, C.L. Gratto-Trevor, and S.M. Haig. 2001. Estimates of shorebird populations in North America. Canadian Wildlife Service Occasional Paper No. 104, Ottawa, Ontario.

Morrison, R.I.G., B.J. McCaffery, R.E. Gill, S.K. Skagen, S.L. Jones, G.W. Page, C.L. Gratto-Trevor, and B.A. Andres. 2006. Population estimates of North American shorebirds. Wader Study Group Bulletin 111:67-85.

Morton, R.A. 1982. Effects of coastal structures on shoreline stabilization and land loss—the Texas experience. In: Boesch, D.F., ed. Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options. Washington, DC: U.S. Dept. of the Interior, Fish and Wildlife Service, Biological Services Program. FWS/OBS-82/59.

Morton, R.A. 2003. An overview of coastal land loss: With emphasis on the southeastern United States. U.S. Dept. of the Interior, Geological Survey. Open-File Report 03-337.

Morton, R.A., N. Buster, and M. Krohn. 2002. Subsurface controls on historical subsidence rates and associated wetland loss in south-central Louisiana. Transactions Gulf Coast Association of Geological Societies 52:767-778.

Morton R.A., T.L. Miller, and L.J. Moore. 2004. Historical shoreline changes along the US Gulf of Mexico: A summary of recent shoreline. U.S. Dept. of the Interior, Geological Survey. Open File-Report 2004-1089. Internet website: http://pubs.usgs.gov/of/2004/1043/ofr-2004-1043.pdf. Accessed February 2011.

Morton, R.A., J.C. Bernier, J.A. Barras, and N.F. Ferina. 2005. Rapid subsidence and historical wetland loss in the Mississippi Delta plain: Likely causes and future implications. U.S. Dept. of the Interior, Geological Survey. Open-File Report 2005-1216. 116 pp. Internet website: http://pubs.usgs.gov/of/2005/1216/ofr-2005-1216.pdf.

Mosier, A.E. 1998. The impact of coastal armoring structures on sea turtle nesting behavior at three beaches on the East Coast of Florida. Unpublished Master's thesis, University of South Florida, St. Petersburg, FL. 112 pp.

Moulton, D.W., T.E. Dahl, and D.M. Dall. 1997. Texas coastal wetlands. Status and trends mid 1955 to early 1990's. U.S. Dept. of the Interior, Fish and Wildlife Service, Southwest Region.

Muller-Karger, F.E., F. Vukovich, R. Leben, B. Nababan, C. Hu, and D. Myhre. 2001. Surface circulation and the transport of the Loop Current into the northeastern Gulf of Mexico: Final report.

U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2001-102. 39 pp.

Mullin, K.D. and G.L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico, 1996-2001. Marine Mammal Science 20:787-807.

Mullin, K.D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships; Chapter 4. In: Davis, R.W., W.E. Evans, and B. Würsig, eds. Cetaceans, sea turtles and birds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. U.S. Dept. of the Interior, Geologic Survey, Biological Resources Division, USGS/BRD/CR-1999-005 and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-003. 364 pp.

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

Murray, S.P. and J. Donley. 1996. Mississippi River plume hydrography: Second annual report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 96-0022. 175 pp.

Murtaugh, J. 2010. Short-term spill impacts leave both winners and losers. Internet website: http://blog.al.com/press-register-business/2010/11/short_term_spill_impacts_leave.html. Published November 14, 2010. Accessed June 14, 2011.

Musick, J.A. and C.J. Limpus. 1997. Habitat utilization and migration in juvenile sea turtles. In: Lutz, P.L. and J.A. Musick, eds. The biology of sea turtles. Boca Raton, FL: CRC Press. Pp. 137-163.

Nalco. 2010. Oil dispersant expert testimony. Internet website. http://www.nalco.com/news-and-events/4259.htm. Accessed December 27, 2010.

National Association of Corrosion Engineers (NACE). 2003. Standard material requirements—methods for sulfide stress cracking and stress corrosion cracking resistance in sour oilfield environments. National Association of Corrosion Engineers. ANSI/NACE MR1075-2003. 44 pp. Internet website: http://www.techstreet.com/cgi-bin/detail?doc_no=NACE%7CMR0175_2003&product_id=1082002.

National Geographic Society. 1999. Field guide to the birds of North America, third edition. Washington, DC: National Geographic. 480 pp.

National Research Council (NRC). 1983. Drilling discharges in the marine environment. Panel on Assessment of Fates and Effects of Drilling Fluids and Cuttings in the Marine Environment. Marine Board, Commission on Engineering and Technical Systems, National Research Council. Washington, DC: National Academy Press. Pp. 18-21.

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

National Research Council (NRC). 1989. Using oil spill dispersants on the sea. Washington, DC: National Academy Press. 335 pp.

National Research Council (NRC). 1990. Decline of the sea turtles: Causes and prevention. Committee on Sea Turtle Conservation. Washington, DC: National Academy Press. 280 pp.

National Research Council (NRC). 2002. Effects of trawling & dredging on seafloor habitat. Washington, DC: National Academy Press. 136 pp.

National Research Council (NRC). 2003. Oil in the sea III: Inputs, fates, and effects (Committee on Oil in the Sea: J.N. Coleman, J. Baker, C. Cooper, M. Fingas, G. Hunt, K. Kvenvolden, J. McDowell, J. Michel, K. Michel, J. Phinney, N. Rabalais, L. Roesner, and R.B. Spies). Washington, DC: National Academy Press. 265 pp.

National Research Council (NRC). 2005. Oil spill dispersants: Efficacy and effects. Washington, DC: National Academy Press. 377 pp.

National Research Council (NRC). 2006. Review of recreational fisheries survey methods. Washington, DC: National Academy Press. 202 pp.

National Response Team. 2010. Oil spill response strategies for coastal marshes during the *Deepwater Horizon* MC252 spill. 10 pp. Internet website: http://www.nrt.org/Production/NRT/NRTWeb.nsf/AllAttachmentsByTitle/SA-1061NRT_Marsh_Cleanup_Options_DWH.06032010.pdf/$File/NRT_marsh_cleanup_overview_6-15.pdf?OpenElement. Accessed December 23, 2010.

National Wetlands Inventory Group. 1985. Status and trends of wetlands and deepwater habitats in the conterminous United States, 1950's to 1970's. Trans. N. Am. Wildl. Nat. Resour. Conf. 50:440-448.

Natural Resources Defense Council. 2010. Gulf Coast seafood consumption survey. Internet website: http://docs.nrdc.org/health/files/hea_10120702a.pdf. 7 pp.

NaturalGas.org. 2010a. Offshore drilling. Internet website. http://www.naturalgas.org/naturalgas/extraction_offshore.asp. Accessed December 21, 2010.

NaturalGas.org. 2010b. Background. Internet website: http://www.naturalgas.org/overview/background.asp. Accessed August 25, 2010.

Navarro, K., S. Janssen, T. Nordbrock, and G. Solomon. 2011. Health alert: Disease clusters spotlight the need to protect people from toxic chemicals. Natural Resources Defense Council and National Disease Clusters Alliance. 28 pp. Internet website: http://www.nrdc.org/health/diseaseclusters/files/diseaseclusters_issuepaper.pdf. Accessed July 19, 2011.

Neal Adams Firefighters Inc. 1991. Joint industry program for floating vessel blowout control. Prepared for the U.S. Dept. of the Interior, Minerals Management Service. TA&R Project 150. Internet website: http://www.boemre.gov/tarprojects/150/150AA.pdf.

Neff, J.M. 1990. Composition and fate of petroleum and spill-treating agents in the marine environment. In: Geraci, J.R. and D.J. St. Aubin, eds. Sea mammals and oil: Confronting the risks. San Diego, CA: Academic Press, Inc. Pp. 1-33.

Neff, J.M. 2005. Composition, environmental fates, and biological effects of water based drilling muds and cuttings discharged to the marine environment: A synthesis and annotated bibliography. Prepared for the Petroleum Environmental Research Forum and American Petroleum Institute. Duxbury, MA: Battelle. 83 pp. Internet website: http://www.perf.org/pdf/APIPERFreport.pdf.

Neff, J.M. and T.C. Sauer, Jr. 1991. Review: Findings of the American Petroleum Institute study on produced waters. In: Geo-Marine, Inc. Proceedings: Eleventh Annual Gulf of Mexico Information Transfer Meeting. November, 1990. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 91-0040. 524 pp.

Neff, J.M., T.C. Sauer, and N. Maciolek. 1989. Fate and effects of produced water discharges in nearshore marine waters. Prepared for the American Petroleum Institute, Washington, DC.

Neff, J.M., S. McKelvie, and R.C. Ayers, Jr. 2000. Environmental impacts of synthetic-based drilling fluids. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-064. 118 pp.

Nelson, H.F. and E.E. Bray. 1970. Stratigraphy and history of the Holocene sediments in the Sabine-High Island Area, Gulf of Mexico. In: Morgam, J.P., ed. Deltaic sedimentation; modern and ancient. Special Publn. No. 15. Tulsa, OK: SEPM.

Nelson, D.L. and M.M. Cox. 2008. Lehringer principles of biochemistry, fifth edition. W.H. Freeman. 1,100 pp.

Netto, S.A., F. Gallucci, and G. Fonseca. 2009. Deep-sea meiofauna response to synthetic-based drilling mud discharge off SE Brazil. Deep-Sea Research II 56:41-49.

Newby, R. 2007. Texas shoreline change from GLO LIDAR: Elevation change in Jefferson County from 2001-2005. The Texas General Land Office, Austin, TX.

Newell, R.C., L.J. Seiderer, and D.R. Hitchcock. 1998. The impact of dredging works in coastal waters: A review of the sensitivity to disturbance and subsequent recovery of biological resources on the seabed. Oceanography and Marine Biology: An Annual Review 36:127-178.

Newman, J.R. 1977. Sensitivity of the hose martin (*Delichon urbica*) to fluoride emissions. Fluoride 10:73-76.

Newman, J.R. 1980. Effects of air emissions on wildlife resources. U.S. Dept. of the Interior, Fish and Wildlife Service, Biological Services Program, National Power Plant Team. FWS/OBS-80/40.1. 32 pp.

Newman, S.H., A. Chmura, K. Converse, A.M. Kilpatrick, N. Patel, E. Lammers, and P. Daszak. 2007. Aquatic bird disease and mortality as an indicator of changing ecosystem health. Marine Ecology Progress Series 352:299-309.

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

Nicol, J.A.C., W.H. Donahue, R.T. Wang, and K. Winters. 1977. Chemical composition and effects of water extracts of petroleum and eggs of the sand dollar *Melitta quinquiesperforata*. Marine Biology 40:309-316.

Nisbet, I.C.T. 2000. Disturbance, habituation, and management of waterbird colonies. Waterbirds 23:312-332.

Nolan, B. 2010. Family business knocked to its knees by oil spill, moratorium. Internet website: http://www.nola.com/news/gulf-oil-spill/index.ssf/2010/09/family_business_knocked_to_its.html. Accessed December 12, 2010.

Nolan, B. and A. Good. 2010. Moratorium in wake of Gulf oil spill idles much more than rigs, workers. Internet website: http://www.nola.com/news/gulf-oil-spill/index.ssf/2010/07/moratorium_in_wake_of_gulf_oil.html. Accessed July 6, 2010.

Norris, F.H., S.P. Stevens, B. Pfefferbaum, K.F. Wyche, and R. L. Pfefferbaum. 2008. Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness. American Journal of Community Psychology 41:127-150.

Nowlin, W.D., Jr. 1972. Winter circulation patterns and property distributions. In: Capurro, L.R.A. and J.L. Reid, eds. Contributions on the physical oceanography of the Gulf of Mexico. Texas A&M University Oceanographic Studies, Vol. 2. Houston, TX: Gulf Publishing Co. Pp. 3-51.

Nowlin, W.D., Jr., A.E. Jochens, R.O. Reid, and S.F. DiMarco. 1998. Texas-Louisiana shelf circulation and transport processes study: Synthesis report. Volume I: Technical report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 98-0035. 502 pp.

Nudds, T.D. 1983. Niche dynamics and organization of waterfowl guilds in variable environments. Ecology 64:319-330.

Nudds, T.D. 1992. Patterns in breeding waterfowl communities. In: Afton, A.D., M.G. Anderson, C.D. Ankney, D.H. Johnson, J.A. Kadlec, and G.L. Krapu, eds. Ecology and management of breeding waterfowl. University of Minnesota Press, Minneapolis. Pp. 540-547.

OBIS-SEAMAP. 2009. State of the World's Sea Turtles (SWOT): Nesting sites. Internet website: http://seamap.env.duke.edu/swot. Accessed July 12, 2011.

Ocean Conservancy. 2011. Tracking trash: 25 years of action for the ocean. 43 pp. Internet website: http://act.oceanconservancy.org/pdf/Marine_Debris_2011_Report_OC.pdf.

Odess, D. 2010. Official communication. Teleconference regarding Section 106 in relation to response to the oil spill.

offshoreWIND.biz. 2010. Japan plans to build 1,000MW offshore wind power by 2020. Internet website: http://www.offshorewind.biz/2010/05/10/japan-plans-to-build-1000mw-offshore-wind-power-by-2020/. Posted May 10, 2010. Accessed March 24, 2011.

Ogren, L.H. 1989. Distribution of juvenile and sub-adult Kemp's ridley sea turtle: Preliminary results from 1984-1987 surveys. In: Caillouet, C.W. and A.M. Landry, eds. First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation and Management, Texas A&M University; Galveston, TX, October 1-4, 1985. TAMU-SG-89-105. Pp. 116-123.

O'Hara, P.D. and L.A. Morandin. 2010. Effects of sheens associated with offshore oil and gas development on the feather microstructure of pelagic seabirds. Marine Pollution Bulletin 60:672-678.

Oil and Gas Journal. 2009. BP finds oil in multiple Lower Tertiary reservoirs. Internet website: http://www.ogfj.com/index/article-display/5015598529/articles/oil-gas-financial-journal/volume-6/Issue_10/Upstream_News/BP_finds_oil_in_multiple_Lower_Tertiary_reservoirs.html. Posted October 1, 2009. Accessed January 11, 2011.

Oil Spill Commission. 2011a. Response/clean-up technology research & development and the BP *Deepwater Horizon* oil spill. Staff Working Paper No. 7. National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. Originally released November 22, 2010; updated January 11, 2011. 28 pp. Internet website: http://www.oilspillcommission.gov/sites/default/files/documents/Updated%20Response%20RD%20Working%20Paper.pdf. Accessed February 11, 2011.

Oil Spill Commission. 2011b. Stopping the spill: The five-month effort to kill the Macondo well. Staff Working Paper No. 6. National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. Internet website: http://www.oilspillcommission.gov/sites/default/files/documents/Updated%20Containment%20Working%20Paper.pdf. Posted November 22, 2010. Updated January 11, 2011.

Oil Spill Commission. 2011c. Deepwater – The Gulf oil disaster and the future of offshore drilling. Final report to the President. Released January 11, 2011. Internet website: http://www.oilspillcommission.gov/final-report. Accessed March 10, 2011.

Oil Spill Commission. 2011d. The use of surface and subsea dispersants during the BP Deepwater Horizon oil spill. Staff Working Paper No. 4., Updated January 11, 2011. Internet website: http://www.oilspillcommission.gov/resources#staff-working-papers. Accessed March 10, 2011.

O'Keefe, D.J. and G.A. Young. 1984. Handbook on the environmental effects of underwater explosives. U.S. Dept. of the Navy, Naval Surface Warfare Center, Dahlgren, VA, and Silver Spring, MD. NSWC TR 83-240.

Okuyama, H., Y. Majima, A.M. Dannenberg, Jr., M. Suga, B.G. Bang, and F.B. Bang. 1979. Quantitative histological changes produced in the tracheal mucosa of young chickens by the inhalation of sulfur dioxide in low concentrations. Journal of Environmental Science and Health C13:267-300.

Olsen, K.M. and H. Larsson. 1995. Terns of Europe and North America. Princeton, NJ: Princeton University Press. 175 pp.

Olsen, K.M. and H. Larsson. 1997. Skuas and jaegers. New Haven, CT: Yale University Press. 190 pp.

Onuf, C.P. 1994. Seagrasses, dredging and light in Laguna Madre, Texas, U.S.A. Estuarine Coastal Shelf Science 39:75-91.

Onuf, C.P. 1996. Biomass patterns in seagrass meadows of the Laguna Madre, Texas. Bulletin of Marine Science 58(2):404-420.

Operational Science Advisory Team (OSAT). 2010. Summary report for sub-sea and sub-surface oil and dispersant detection: sampling and monitoring. Prepared for Paul F. Zunkuft, RADM, U.S. Coast Guard. Federal On-Scene Coordinator. Deepwater Horizon MC 252. December 17, 2010.

Operational Science Advisory Team (OSAT-2). 2011. Summary report for fate and effects of remnant oil in the beach environment. Operational Science Team (OSAT-2), Gulf Coast Incident Management Team. Prepared for Lincoln H. Stroh, CAPT, U.S. Coast Guard, Federal On-Scene Coordinator, Deepwater Horizon MC 252. February 10, 2011. 35 pp. Internet website: http://www.dep.state.fl.us/deepwaterhorizon/files2/osat_2_report__10feb.pdf.

Orth, R.J., T.J.B. Carruthers, W.C. Dennison, C.M. Duarte, J.W. Fourqurean, K.L. Heck, Jr., A.R. Hughes, G.A. Kendrick, W.J. Kenworthy, S. Olyarnik, F.T. Short, M. Waycott, and S.L. Williams. 2006. A global crisis for seagrass ecosystems. BioScience 56(12):987-996.

Osenberg, C.W., R.J. Schmitt, S.J. Holbrook, and D. Canestro. 1992. Spatial scale of ecological effects associated with and open coast discharge of produced water. In: Ray, J.P. and F.R. Englehardt, eds. Produced water: Technological/environmental issues and solutions. New York, NY: Plenum Press. Pp. 387-402.

Oxford Economics. 2010. Potential impact of the Gulf oil spill on tourism. Prepared for the U.S. Travel Association. 27 pp. Internet website: http://www.ustravel.org/sites/default/files/page/2009/11/Gulf_Oil_Spill_Analysis_Oxford_Economics_710.pdf.

Oynes, C. 2006. Deepwater expansion continues in the Gulf of Mexico. Pipeline & Gas Journal 231(6):58.

Pack, W. 2010. Oil spill may benefit Texas. My San Antonio Business. Internet website: http://www.mysanantonio.com/default/article/Oil-spill-may-benefit-Texas-794644.php. Accessed May 25, 2010.

Palinkas, L.A., A.J. Russell, M.A. Downs, and J.S. Petterson. 1992. Ethnic-differences in stress, coping, and depressive symptoms after the *Exxon Valdez* oil-spill. Journal of Nervous and Mental Disease 180:287-295.

Palka, D. and M. Johnson, eds. 2007. Cooperative research to study dive patterns of sperm whales in the Atlantic Ocean. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2007-033. 49 pp.

Parker, P.L., G.P. Pfeiffer, R.E. Casey, C.S. Giam, J.S. Holland, E.T. Park, B.J. Presley, W.M. Sackett, N.P. Smith, C. Van Baalen, and D.E. Wohlschlang. 1975. Environmental assessment of the south Texas outer continental shelf. Chemical and biological survey component. Report to the U.S. Dept. of the Interior, Bureau of Land Management. Contract no. 08550-CT5-17.

Parker, R.O., Jr., D.R. Colby, and T.P. Willis. 1983. Estimated amount of reef habitat on a portion of the U.S. South Atlantic and Gulf of Mexico continental shelf. Bulletin of Marine Science 33:935-940.

Parnell, J.F., D.G. Ainley, H. Blokpoel, G. Cain, T.W. Custer, J.L. Dusi, S. Kress, J.A. Kushlan, W.E. Southern, L.E. Stenzel, and B.C. Thompson. 1988. Colonial waterbird management in North America. Journal of the Colonial Waterbird Society 11:129-169.

Parr, A.E. 1939. Quantitative observations on pelagic Sargassum vegetation of the western North Atlantic. Bull. Bingham Oceanog. Coll. 6:1-94

Parsons, J.J. 1972. The hawksbill turtle and the tortoise shell trade. In: Études de géographie tropicale offertes a Pierre Gourou. Paris, France: Mouton. Pp. 45-60.

Parsons, K.C. 1994. The Arthur Kill oil spills: Biological effects in birds. In: Burger, J., ed. Before and after an oil spill: The Arthur Kill. New Brunswick, NJ: Rutgers University Press. Pp. 215-237.

Parsons, G. and A. Kang. 2007. Valuing beach closures on the Padre Island National Seashore. University of Delaware, Graduate College of Marine Studies. U.S. Dept. of Commerce, NOAA Grant Number NA04NOS4190063. Project Number 06-090. 31 pp.

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

Patin, S.A. 1999. Environmental impact of the offshore oil and gas industry. East Northpoint, NY: EcoMonitor Publishing. Pp. 425.

Patrick, S.R., D.R. Patrick, and S.W. Fardo. 1993. Energy conservation guidebook. Lilburn, GA: The Fairmont Press, Inc. 471 pp. Internet website: http://books.google.com/books?id=f45IIzt4DCIC&pg=PA143&lpg=PA143&dq=ship,+%22discharge+water+temperature%22&source=bl&ots=CEHy0wpaMz&sig=BZam0pB-2mDwo4vO5zGM9jBsQWY&hl=en&ei=nMEpTYnqJsSBlAf_-7joAQ&sa=X&oi=book_result&ct=result&resnum=5&ved=0CC0Q6AEwBA#v=onepage&q&f=false. Accessed January 10, 2011.

Pattengill, C.V. 1998. The structure and persistence of reef fish assemblages of the Flower Garden Banks National Marine Sanctuary. Ph.D. Thesis, Texas A&M University, College Station, TX.

Paull, C.K., B. Hecker, R. Commeau, R.P Freeman-Lynde, C. Neumann, W.P. Corso, S. Golubic, J.E. Hook, E. Sikes, and J. Curry. 1984. Biological communities at the Florida Escarpment resemble hydrothermal vent taxa. Science 226:965-967.

PCCI Marine and Environmental Engineering. 1999. Oil spill containment, remote sensing and tracking for deepwater blowouts: status of existing and emerging technologies. Report prepared for the U.S. Dept. of the Interior, Minerals Management Service. TA&R Project 311. 66 pp. + apps. Internet website: http://www.boemre.gov/tarprojects/311/311AA.pdf.

Peakall, D.B., P.G. Wells, and D. Mackay. 1987. A hazard assessment of chemically dispersed oil spills and seabirds. Marine Environmental Research 22:91-106.

Peakall, D.B., R.J. Norstrom, D.A. Jeffrey, and F.A. Leighton. 1989. Induction of hepatic mixed function oxidases in the herring gull (*Larus argentatus*) by Prudhoe Bay crude oil and its fractions. Comparative Biochemistry and Physiology 94C:461-463.

Peake, D., G. Fargion, K. Mullen, and R. Pitman. 1995. Seabirds of the northwestern and central Gulf of Mexico. In: Abstracts of the Joint Meeting of the Wilson Ornithological Society and Virginia Society of Ornithology, Virginia, 4-7 May, 1995.

Pearson, C.E., D.B. Kelley, R.A. Weinstein, and S.W. Gagliano. 1986. Archaeological investigations on the outer continental shelf: A study within the Sabine River valley, offshore Louisiana and Texas. U.S. Dept. of the Interior, Minerals Management Service, Reston, VA. OCS Study MMS 86-0119. 314 pp.

Pearson, C.E., S.R. James, Jr., M.C. Krivor, S.D. El Darragi, and L. Cunningham. 2003. Refining and revising the Gulf of Mexico outer continental shelf region high-probability model for historic shipwrecks: Final report. Volume I-III. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2003-060, 2003-061, and 2003-062. 13, 338, and 138 pp., respectively.

Peele, R.H., J.I. Snead, and W. Feng. 2002. Outer continental shelf pipelines crossing the Louisiana coastal zone: A geographic information system approach. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico Region OCS Study, New Orleans LA. MMS 2002-038. 24 pp.

Penland, S., L. Wayne, L.D. Britsch, S.J. Williams, A.D. Beall, and V. Caridas Butterworth. 2001a. Geomorphic classification of coastal land loss between 1932 and 1990 in the Mississippi River Delta Plain, southeastern Louisiana. U.S. Dept. of the Interior, Geological Survey, Coastal and Marine Geology Program, Woods Hole Field Center, Woods Hole, MA. Open-File Report 00-417.

Penland, S., L. Wayne, L.D. Britsch, S.J. Williams, A.D. Beall, and V. Caridas Butterworth. 2001b. Process classification of coastal land loss between 1932 and 1990 in the Mississippi River Delta Plain, southeastern Louisiana. U.S. Dept. of the Interior, Geological Survey, Coastal and Marine Geology Program, Woods Hole Field Center, Woods Hole, MA. Open-File Report 00-418.

Penn State. 2010. Scientists discover dying corals, creatures near Gulf oil spill site. Press Release, November 5, 2010. Internet website: http://live.psu.edu/story/49703. Accessed November 30, 2010.

Pequegnat, W.E. 1983. The ecological communities of the continental slope and adjacent regimes of the northern Gulf of Mexico. Prepared by TerEco Corp. for the U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. 398 pp.

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

Perez, C., A. Velando, I. Munilla, M. Lopez-Alonzo, and D. Oro. 2008. Monitoring polycyclic aromatic hydrocarbon pollution in the marine environment after the *Prestige* oil spill by means of seabird blood analysis. Environmental Science and Technology 42:707-713.

Perez, C., I. Munilla, M. Lopez-Alonso, and A. Velando. 2010. Sublethal effects on seabirds after the *Prestige* oil-spill are mirrored in sexual signals. Biological Letters 6:33-35.

Perkins, S. 2010. Scour power, big storms shift coastal erosion into overdrive. Science News Magazine. 178(5):14. Internet website: http://www.sciencenews.org/view/feature/id/62040/title/Scour_power. Accessed December 2010.

Peters, E.C., P.A. Meyers, P.P. Yevich, and N.J. Blake. 1981. Bioaccumulation and histopathological effects of oil on a stony coral. Marine Pollution Bulletin 12(0):333-339.

Peters, E.C., N.J. Gassman, J.C. Firman, R.H. Richmond, and E.A. Power. 1997. Ecotoxicology of tropical marine ecosystems. Environmental Toxicology and Chemistry 16(1):12-40.

Peterson, C.H., M.C. Kennicutt II., R.H. Green, P. Montagna, D.E. Harper, Jr., E.N. Powell, and P.F. Roscigno. 1996. Ecological consequences of environmental perturbations associated with offshore hydrocarbon production: A perspective on long-term exposures in the Gulf of Mexico. Canadian Journal of Fisheries and Aquatic Science 53:2637-2654.

Pezeshki, S.R., R.D. Delaune, J.A. Nyman, R.R. Lessard, and G.P. Canevari. 1995. Removing oil and saving oiled marsh grass using shoreline cleaner (Publication No. 4620). International Oil Spill Conference. Washington, DC: American Petroleum Institute. Pp. 203-209.

Pezeshki, S.R., M.W. Hester, Q. Lin, and J.A. Nyman. 2000. The effects of oil spill and cleanup on dominant U.S. Gulf Coast marsh macrophytes: A review. Environmental Pollution 108:129-139.

Pipelines International. 2010. Getting the job done in swamp, marsh and wetland terrain. December 2010. Vol. 006, pp. 34-35. Internet website: http://pipelinesinternational.com/pdfs/PIN_Dec10_web.pdf.

Poirier, O.A. and G.A. Thiel. 1941. Deposition of free oil by sediments settling in sea water. Bulletin of the American Association of Petroleum Geologists 25(12):2170-2180.

Poirrier, M.A. 2007. Statewide summary for Louisiana. In: Handley, D.A., D. Altsman, and R. DeMay, eds. Seagrass status and trends in the northern Gulf of Mexico: 1940-2002. U.S. Dept. of the Interior, Geological Survey Scientific Investigations Report 2006-5287 and U.S. Environmental Protection Agency 855-R-04-003. 61 pp. Internet website: http://pubs.usgs.gov/sir/2006/5287/.

Pond, S. and G.L. Pickard. 1983. Introductory dynamical oceanography, 2nd ed. New York, NY: Pergamon Press. 329 pp.

Powell, E.N. 1995. Evidence for temporal change at seeps. In: MacDonald, I.R., W.W. Schroeder, and J.M. Brooks, eds. Chemosynthetic ecosystems study: Final report. Volume 2: Technical report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 95-0022. Pp. 8.1-8.65.

Powell, P., P. Szaniszlo, W.E. Pequegnat, C. Venn, C.S. Giam, P.N. Boothe, B.J. Presley, J.R. Schwarz, S. Alexander, R.W. Flint, N.N. Rabalais, J.S. Holland, R. Yoshiyama, and D.E. Wohlschlang. 1980. Chapter Five: Benthic biota of the south Texas shelf. In: Flint, R.W. and N.N. Rabalais, eds. Environmental studies, south Texas outer continental shelf, 1975-1977. Volume I: Ecosystem description. U.S. Dept. of the Interior, Bureau of Land Management, Washington, DC. Contract no. AA551-CT8-51.

Poysa, H. 1983. Morphology-mediated niche organization in a guild of dabbling ducks. Ornis Scandinavica 14:317-326.

Precht, W.E. and R.B. Aronson. 2004. Climate flickers and range shifts of reef corals. Frontiers in Ecology and the Environment 2:307-314.

Precht, W.F., R.B. Aronson, K.J.P. Deslarzes, M.L. Robbart, T.J.T. Murdoch, A. Gelber, D.J. Evans, B. Gearheart, and B. Zimmer. 2006. Long-term monitoring at the East and West Flower Garden Banks, 2002-2003: Final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2006-035.

Precht, W.F., R.B. Aronson, K.J.P. Deslarzes, M.L. Robbart, D.J. Evans, B. Zimmer, and L. Duncan. 2008. Long-term Monitoring at the East and West Flower Garden Banks, 2004-2005: Interim report. Volume I: Technical report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, Louisiana. OCS Study MMS 2008-027. 123 pp.

Prentki, R.T., C. Smith, O. Johansen, P. Daling, M. Moldestad, K. Skognes, and M. Reed. 2004. The MMS/SINTEF oil weathering model, further development and applications. Review version of paper presented at International Marine Environmental Modeling Seminar (IMEMS), Washington, DC, October 2004. Internet website: http://alaska.boemre.gov/reports/2005rpts/2005_020/Final%20Report/Appendix%20E/prentki_OWM_Alaska.pdf.

Price, W.A. 1958. Sedimentology and quaternary geomorphology of south Texas, supplementary to field trip manual, Sedimentology of south Texas": Corpus Christi Geological Society spring field trip 1958. Gulf Coast Association of Geological Societies Transactions 8(1958):41-75.

Pritchard, P.C.H. 1997. Evolution, phylogeny, and current status. In: Lutz, P.L. and J.A. Musivk, eds. The biology of sea turtles. Boca Raton, FL: CRC Press. Pp. 1-28.

Puder, M.G. and J.A. Veil. 2006. Offsite commercial disposal of oil and gas exploration and production waste: Availability, options, and costs. Argonne National Laboratory, Environmental Science Division. Internet website: http://www.evs.anl.gov/pub/doc/ANL-EVS-R-06-5.pdf.

Pulich, W., Jr. and C. Onuf. 2007. Statewide summary for Texas. In: Handley, D.A., D. Altsman, and R. DeMay, eds. Seagrass status and trends in the northern Gulf of Mexico: 1940-2002. Scientific Investigations Report 2006-5287. U.S. Environmental Protection Agency 855-R-04-003. Pp. 7-16. Internet website: http://pubs.usgs.gov/sir/2006/5287/.

Pulsipher, A.G., O.O. Iledare, R.H. Baumann, D.E. Dismukes, and D.V. Mesyanzhinov. 1998. Environmental and safety risks of an expanding role for independents on the Gulf of Mexico OCS. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 98-0021. 39 pp.

Rabalais, N.N. 1990. Biological communities of the south Texas continental shelf. American Zoologist 30:77-87.

Rabalais, N.N., R.E. Turner, and W.J. Wiseman, Jr. 2002. Gulf of Mexico hypoxia, A.K.A. "The Dead Zone." Annual Review of Ecological Systems 33:235-263.

Railroad Commission of Texas. 2009. Self-evaluation report. Submitted to the Sunset Commission, September 2009. 215 pp. Internet website: http://www.rrc.state.tx.us/about/divisions/RRCSelfEvaluationReport2009.pdf.

Railroad Commission of Texas. 2010. Oil production and well counts (1935-2009). Internet website: http://www.rrc.state.tx.us/data/production/oilwellcounts.php. Posted March 9, 2010. Accessed October 12, 2010.

Ramseur, J.L. 2010. Oil spill in U.S. coastal waters: Background, governance, and issues for Congress. Congressional Research Service. Report for Congress 7-57, RL33705. April 30, 2010.

Rappole, J.H. 2006. A guide to the birds of the southeastern states: Florida, Georgia, Alabama, and Mississippi. University Press of Florida, Gainesville.

Rasmussen, E. 2008. Distance to the horizon, calculator. Erick's Blog. Internet website. http://www.erik-rasmussen.com/blog/2008/03/25/distance-to-the-horizon/. Posted March 25, 2008. Accessed December 30, 2010.

Ravishankara, A.R. and J. Goldman. 2010. Air chemistry in the Gulf of Mexico oil spill area, NOAA WP-3D Airborne Chemical Laboratory Flights of 8 and 10 June 2010. Internet website: http://www.esrl.noaa.gov/csd/tropchem/2010gulf/NOAA_P3_Gulf_Mission_Report_final.pdf.

Ray, J.P. 1998. Findings of the Offshore Operators Committee produced water bioaccumulation study. In: SPE International Conference on Health, Safety, and Environment in Oil and Gas Exploration and Production. June 7-10, 1998. Caracas, Venezuela. Society of Petroleum Engineers, Inc.

Redden, J. 2009. Port Fourchon thrives despite the economy. Offshore Magazine. March 1, 2009. Internet website: http://www.offshore-mag.com/index/article-display/357201/articles/offshore/supplements/port-of-fourchon/articles/port-fourchon-thrives-despite-the-economy.html. Accessed December 3, 2010.

Rees, M.A. 2010. Paleoindian and early archaic. In: Reese, M.A., ed. Archaeology of Louisiana. Baton Rouge, LA: Louisiana State University Press. Pp. 34-62.

Regg, J.B., S. Atkins, B. Hauser, J. Hennessey, B. Kruse, J. Lowenhaupt, B. Smith, and A. White. 2000. Deepwater development: A reference document for the deepwater environmental assessment, Gulf of Mexico OCS (1998 through 2007). U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 2000-015. 94 pp.

Reible, D. 2010. After the oil is no longer leaking. The University of Texas, Austin. Environ. Sci. Technol. 44(15):5685–5686.

Reimer, A.A. 1975. Effects of crude oil on corals. Marine Pollution Bulletin 6(3):39-43.

RestoreTheGulf.gov. 2010a. Tar balls along Texas coast are from *Deepwater Horizon*; how they arrived unclear. July 5, 2010. Internet website: http://www.restorethegulf.gov/release/2010/07/05/tar-balls-along-texas-coast-are-deepwater-horizon-how-they-arrived-unclear. Accessed May 31, 2011.

RestoreTheGulf.gov. 2010b. Consolidated Fish and Wildlife collection report—Nov. 2, 2010. Internet website: http://www.restorethegulf.gov/release/2010/11/02/consolidated-fish-and-wildlife-collection-report-nov-2-2010. Accessed June 29, 2011.

RestoreTheGulf.gov. 2010c. Shoreline treatment recommendation report. 27 pp. Internet website: http://www.restorethegulf.gov/release/2010/09/09/shoreline-treatment-recommendation-report. Posted June 10, 2010. Accessed June 15, 2011.

RestoreTheGulf.gov. 2010d. Operations and ongoing response—July 06, 2010. Internet website: http://www.restorethegulf.gov/release/2010/07/06/operations-and-ongoing-response-july-06-2010. Accessed July 9, 2010.

RestoreTheGulf.gov. 2011. Language documents. Internet website: http://www.restorethegulf.gov/search/apachesolr_search/language%20documents. Accessed June 27, 2011.

Rezak, R. and T.J. Bright. 1979. Northwestern Gulf of Mexico topographic features study. Executive summary of the final report. U.S. Dept. of the Interior, Bureau of Land Management, New Orleans OCS Office, New Orleans, Louisiana. Study no. 1979-14.

Rezak, R. and T.J. Bright. 1981. Northern Gulf of Mexico topographic features study: Final report to the U.S. Dept. of the Interior, Bureau of Land Management, Contract No. AA551-CT8-35. 5 vols.

Rezak, R., T.J. Bright, and D.W. McGrail. 1983. Reefs and banks of the northwestern Gulf of Mexico: Their geological, biological, and physical dynamics. Final Technical Report No. 83-1-T.

Rezak, R., T.J. Bright, and D.W. McGrail. 1985. Reefs and banks of the northwestern Gulf of Mexico: Their geological, biological, and physical dynamics. New York, NY: Wiley and Sons. 259 pp.

Rezak, R., S.R. Gittings, and T.J. Bright. 1990. Biotic assemblages and ecological controls on reefs and banks of the northwest Gulf of Mexico. American Zoologist 30:23-35.

Rhodes, D.C. 1974. Organism-sediment relations on the muddy sea floor. Oceanography and Marine Biology: An Annual Review 12:263-300.

Rhodes, D.C. and J.D. Germano. 1982. Characterization of organism-sediment relations using sediment profile imaging: An efficient method of remote ecological monitoring of the seafloor (Remots™ System). Marine Ecology Progress Series 8:115-128.

Rhodes, R.C., J.D. Thompson, and A.J. Wallcraft. 1989. Buoys-calibrated winds over the Gulf of Mexico. J. Atmos. and Ocean. Technology 6(4):608-623.

Rice, S.A. and C.L. Hunter. 1992. Effects of suspended sediment and burial on Scleractinian corals from west central Florida patch reefs. Bulletin of Marine Science 51(3):429-442.

Richards, W.J. 1990. List of the fishes in the western central Atlantic and the status of early life history stage information. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-SEFC-267. 88 pp.

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

Ridgway, S.H. and D. Carder. 2001. Assessing hearing and sound production in cetacean species not available for behavioral audiograms: Experience with *Physeter, Kogia, and Eschrichtius*. Aquatic Mammals 27:267-276.

Rigzone. 2010. Rig report: Offshore rig fleet by region. Internet website: http://www.rigzone.com/data/. Accessed December 20, 2010.

Rinkevich, B. and Y. Loya. 1977. Harmful effects of chronic oil pollution on a Red Sea Scleractinian coral population. In: Taylor, D.L., ed. Proceedings, Third International Coral Reef Symposium. Volume 2: Geology. Miami, FL. May, 1977. Pp. 585-591.

Rinkevich, B. and Y. Loya. 1983. Response of zooxanthellae photosynthesis to low concentrations of petroleum hydrocarbons. Bulletin of the Institute of Oceanography and Fisheries 109-115.

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

Robbart, M.L., R.B. Aronson, K.J.P. Deslarzes, W.F. Precht, L. Duncan, B. Zimmer, and T. DeMunda. 2009. Post-hurricane assessment of sensitive habitats of the Flower Garden Banks vicinity. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2009-032. 160 pp.

Roberts, H.H. and T.W. Neurauter. 1990. Direct observations of a large active mud vent on the Louisiana continental slope. Association of Petroleum Geologists Bulletin 74:1508.

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

Rocke, T.E., T.M. Yuill, and R.D. Hinsdill. 1984. Oil and related toxicant effects on mallard immune defenses. Environmental Research 33:343-352.

Rogers. C.S. 1990. Responses of coral reefs and reef organisms to sedimentation. Marine Ecology Progress Series 62:185-202.

Rogers, C.S. and V.H. Garrison. 2001. Ten years after the crime: Lasting effects of damage from a cruise ship anchor on a coral reef in St. John, U.S. Virgin Islands. Bulletin of Marine Science 69(2):793-803.

Rooker, J.R., S.A. Holt, M.A. Soto, and G.J. Holt. 1998. Postsettlement patterns of habitat use by Sciaenid fishes in subtropical seagrass meadows. Estuaries 21(2):318-327.

Roosenburg, W.M. 1994. Nesting habitat requirements of the diamondback terrapin: A geographic comparison. Wetland Journal 6(2):8-11.

Roosenburg, W.M., K.L. Haley, and S. McGuire. 1999. Habitat selection and movements of the diamondback terrapin, *Malaclemys terrapin*, in a Maryland estuary. Chelonian Conservation and Biology 3:425-429.

Rosman, I., G.S. Boland, and J.S. Baker. 1987. Epifaunal aggregations of Vesicomyidae on the continental slope off Louisiana. Deep-Sea Res. 34:1811-1820.

Roth, A.F. and D.M. Baltz. 2009. Short-term effects of an oil spill on marsh-edge fishes and decapod crustaceans. Estuaries and Coasts 32:565-572.

Rowe, G.T. and M.C. Kennicutt II. 2001. Deepwater program: Northern Gulf of Mexico continental slope benthic habitat and ecology. Year I: Interim report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2001-091. 166 pp.

Rowe, G.T. and M.C. Kennicutt II, eds. 2009. Northern Gulf of Mexico continental slope habitats and benthic ecology study: Final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2009-039. 456 pp.

Rowe, G. and D.W. Menzel. 1971. Quantitative benthic samples from the deep Gulf of Mexico with some comments on the measurements of deep-sea biomass. Bulletin of Marine Science 21(2):556-566.

Roy, K.J. and S.V. Smith. 1971. Sedimentation and coral reef development in turbid water: Fanning Lagoon. Pacific Science 25:234-248.

Rozas, L.P. 1992. Comparison of nekton habitats associated with pipeline canals and natural channels in Louisiana salt marshes. Wetlands 12(2):136-146.

Rozas, L.P. and W.E. Odum. 1988. Occupation of submerged aquatic vegetation by fishes: Testing the roles of food and refuge. Oecologia 77:101-106.

Runcie, J., C. Macinnis-Ng, and P. Ralph. 2004. The toxic effects of petrochemical on seagrasses. Literature review. For Australian Maritime Safety Authority, Institute for Water and Environmental Resource Management, Sydney, Australia. 20 pp. Internet website: http://www.amsa.gov.au/marine_environment_protection/national_plan/Contingency_Plans_and_Management/Research_Development_and_Technology/Toxic_Effects_Seagrasses.pdf.

Russell, R.W. 2005. Interactions between migrating birds and offshore oil and gas platforms in the northern Gulf of Mexico: Final report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2005-009. 327 pp.

Russo, M. 1992. Variations in late archaic subsistence and settlement patterning in peninsular Florida. In: Jeter, M., ed. Southeastern Archaeological Conference: Abstracts of the forty-ninth annual meeting, Little Rock, AR.

Rützler, K. and W. Sterrer. 1970. Oil pollution damage observed in tropical communities along the Atlantic seaboard of Panama. BioScience 20(4):222-224.

Ryan, P.G. 1988. Effects of ingested plastic on seabird feeding: Evidence from chickens. Marine Pollution Bulletin 19(3):125-128.

Ryan, P.G. 1990. The effects of ingested plastic and other marine debris on seabirds. In: Shomura, R.S. and M.L. Godfrey, eds. Proceedings of the Second International Conference on Marine Debris, April 2-7, 1989, Honolulu, HI. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-NOAA-TM-NMFS-SWFSC-154. Pp. 623-634.

S.L. Ross Environmental Research Ltd.. 1997. Fate and behavior of deepwater subsea oil well blowouts in the Gulf of Mexico. Prepared for the U.S. Dept. of the Interior, Minerals Management Service. 27 pp. Internet website: http://www.boemre.gov/tarprojects/287/287AA.PDF.

S.L. Ross Environmental Research Ltd. 2000. Technology assessment of the use of dispersants on spills from drilling and production facilities in the Gulf of Mexico outer continental shelf. Prepared for the U.S. Dept. of the Interior, Minerals Management Service, Engineering and Research Branch, Herndon, VA. 19 pp. Internet website: http://www.boemre.gov/tarprojects/349/349AB.pdf.

Sadiq, M. and J.C. McCain. 1993. The Gulf War aftermath: An environmental tragedy. Dordrecht, The Netherlands: Kluwer Academic Publishers.

Sager, W. 1997. Geophysical detection and characterization of seep community sites. In: MacDonald, I.R., ed. 1998. Stability and change in Gulf of Mexico chemosynthetic communities: Interim report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 98-0034. Pp. 49-60.

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

Sanders, H.L., J.F. Grassle, G.R. Hamson, L.S. Morse, S. Garner-Price, and C.C. Jones. 1980. Anatomy of an oil spill: Long-term effects from the grounding of the barge Florida off West Falmouth, Massachusetts. Journal of Marine Research 38:265-380.

Santos, M.F.L., P.C. Lana, J. Silva, J.G. Fachel, and F.H. Pulgati. 2009. Effects of non-aqueous fluids cuttings discharge from exploratory drilling activities on the deep-sea macrobenthic communities. Deep-Sea Research II 56:32-40.

Sargent, F.J., T.J. Leary, D.W. Crewz, and C.R. Kruer. 1995. Scarring of Florida's seagrasses: Assessment and management options. FRMI TR-1, Florida Marine Research Institute, St. Petersburg, FL. 37 pp. + app.

Sassen, R. 1998. Origins of hydrocarbons and community stability. In: MacDonald, I.R., ed. Stability and change in Gulf of Mexico chemosynthetic communities: Interim report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 98-00034. Pp. 71-76.

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

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

Sathiakumar, N. 2010. Short-term physical effects: Oil spills. Presentation, School of Public Health, University of Alabama at Birmingham. http://www.iom.edu/~/media/Files/Activity%20Files/PublicHealth/OilSpillHealth/NaliniSathiakumar-6-22-1110am.pdf.

Saunders, J., A. Thurman, and R.T. Saucier. 1992. Preceramic(?) mound complexes in northeastern Louisiana. In: Jeter, M.D., ed. Southeastern Archaeological Conference: Abstracts of the Forty-Ninth Annual Meeting, Little Rock, AR.

Sayre, A. 2010. Forecast: Louisiana will have slow job growth. Internet website: http://www.businessweek.com/ap/financialnews/D9IMCA800.htm. Accessed December 12, 2010.

Scaife, W.W., R.E. Turner, and R. Costanza. 1983. Coastal Louisiana recent land loss and canals impacts. Environmental Management 7(5):433-442.

Schaum, J., M. Cohen, S. Perry, R. Artz, R. Draxler, J.B. Frithsen, D. Heist, M. Lorber, and L. Phillips. 2010. Screening level assessment of risks due to dioxin emissions from burning oil from the BP *Deepwater Horizon* Gulf of Mexico spill. 21 pp. Internet website: http://www.epa.gov/research/dioxin/docs/OilScreen25.pdf. Accessed April 13, 2011.

Schiro, A.J., D. Fertl, L.P. May, G.T. Regan, and A. Amos. 1998. West Indian manatee (*Trichechus manatus*) occurrence in U.S. waters west of Florida. Presentation, World Marine Mammal Conference, 20-24 January, Monaco.

Schlager, W. 1981. The paradox of drowned reefs and carbonate platforms. Geological Society of America Bulletin 92(4):197-211. Internet website: http://bulletin.geoscienceworld.org/cgi/content/abstract/92/4/197.

Schmahl, G.P. 2011. Official communication. Email regarding post-Deepwater Horizon research conducted at the Flower Garden Banks. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration. May 24, 2011.

Schmahl, G.P. and E.L. Hickerson. 2006. McGrail Bank, a deep tropical coral reef community in the northwestern Gulf of Mexico. In: Proceedings of 10th International Coral Reef Symposium. June 28-July 2, 2006, Okinawa, Japan.

Schmidt, K. 2010a. Despite fears following spill, local jobless rate holds steady. Internet website: http://www.reefrelieffounders.com/drilling/2010/09/25/daily-comet-despite-fears-following-spill-local-jobless-rate-holds-steady/. Accessed December 12, 2010.

Schmidt, K. 2010b. Still no employment impact from spill, drilling uncertainty. Internet website: http://www.dailycomet.com/article/20101028/ARTICLES/101029226. Accessed December 10, 2010.

Schofield, P.J. 2009. Geographic extent and chronology of the invasion of the non-native lionfish (*Pterois volitans* [Linneaus 1758] and *P. miles* [Bennett 1828]) in the western North Atlantic and Caribbean Sea. Aquatic Invasions 4(3):473-479.

Scholz, D.K., J.H. Kucklick, R.G. Pond, A.H. Walker, A. Bostrom, and P. Fischbeck. 1999. Fate of spilled oil in marine waters: Where does it go? What does it do? How do dispersants affect it? An information booklet for decision-makers. American Petroleum Institute Publication Number 4691, 43 pp. Internet website: http://www.cleancaribbean.org/ccc_doc/pdf/API_Fate_of_Spilled_Oil.pdf.

Schroeder, D.M. and M.S. Love. 2004. Ecological and political issues surrounding decommissioning of offshore oil facilities in the southern California Bight. Ocean and Coastal Management 47:21-48.

Schummer, M.L. and W.R. Eddleman. 2003. Effects of disturbance on activity and energy budgets of migrating waterbirds in south-central Oklahoma. Journal of Wildlife Management 67:789-795.

Schwartz, F.J. 1988. Aggregations of young hatchling loggerhead sea turtles in the Sargassum off North Carolina. Marine Turtle Newsletter 42: 9-10

Schwartz, A. 2010. China beats U.S. to first offshore wind farm. Internet website: http://www.fastcompany.com/1687492/china-beats-us-to-first-offshore-wind-farm. Posted September 8, 2010. Accessed March 23, 2011.

Scott-Denton, E. 2009. Official communication. Incidental seabird bycatch in fisheries in the Gulf of Mexico. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

Seba, E. 2010. Update 1—Texas waterway to fully reopen to ships in a week. Reuters. January 29, 2010. Internet website: http://www.reuters.com/article/idUSN2912414520100129?type=marketsNews. Accessed November 26, 2010.

Sen Gupta, B.K., M.K. Lobegeier, and L.E. Smith. 2009. Foraminiferal communities of bathyal hydrocarbon seeps, northern Gulf of Mexico: A taxonomic, ecologic, and geologic study. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2009-013. 380 pp.

Seni, S.J. and M.P.A. Jackson. 1983. Evolution of salt structures, east Texas diapir province, Part 2: Patterns and rates of halokinesis. The American Association of Petroleum Geologists Bulletin 67(8):1245-1274.

Shaffer, G.P., J.W. Day, S. Mack, G.P. Kemp, I. van Heerden, M.A. Poirrier, K.A.Westphal, D. FitzGerald, A. Milanes, C.A. Morris, R. Bea, and P.S. Penland. 2009. The MRGO navigation project: A massive human-induced environmental, economic, and storm disaster. Journal of Coastal Research 54:206-224.

Shafir, S., J. Van Rijn, and B. Rinkevich. 2007. Short and long term toxicity of crude oil and oil dispersants to two representative coral species. Environmental Science and Technology 41:5571-5574.

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

Sharp, J.M. and S.G. Appan. 1982. The cumulative ecological effects of normal offshore petroleum operations contrasted with those resulting from continental shelf oil spills. Philosophical Transactions of the Royal Society of London. B: Biological Sciences 297:309-322.

Sharp, J.M. and D.W. Hill. 1995. Land subsidence along the northeastern Texas Gulf Coast: Effects of deep hydrocarbon production. Environmental Geology 25(3):181-191. Internet website: http://www.springerlink.com/content/t5072854ukl2r262/.

Sheavly, S.B. 2007. National marine debris monitoring program: Final program report, data analysis and summary. Prepared for the U.S. Environmental Protection Agency by Ocean Conservancy. Grant Number X83053401-02. 76 pp.

Shigenaka, G. 2001. Toxicity of oil to reef-building corals: A spill response perspective. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Seattle, WA. NOAA Technical Memorandum NOS OR&R 8. 95 pp. Internet website: http://response.restoration.noaa.gov/book_shelf/1_coral_tox.pdf.

Shinn, E.A., J.H. Hudson, D.M. Robbin, and C.K. Lee. 1980. Drilling mud plumes from offshore drilling operations: Implications for coral survival. The R&D Program for OCS Oil and Gas Operations. U.S. Dept. of the Interior, Geological Survey, Fisher Island Station, Miami Beach, FL.

Short, F.T., R.G. Coles, and C. Pergent-Martini. 2001. Global seagrass distribution. In: Short, F.T. and R.G. Coles, eds. 2001. Global seagrass research methods. Amsterdam, The Netherlands: Elsevier Science B.V. Pp 5-6, 20.

Sibley, D.A. 2000. The Sibley guide to birds. National Audubon Society, Knopf, NY. 544 pp.

Siegesmund, P., J. Kruse, J. Prozzi, R. Alsup, and R. Harrison. 2008. Guide to the economic value of Texas ports. Center for Transportation Research, The University of Texas at Austin. Internet website: http://www.utexas.edu/research/ctr/pdf_reports/0_5538_P1.pdf. Accessed November 30, 2010.

Singh, T. 2010. China starts construction on world's biggest offshore wind farm. Internet website: http://inhabitat.com/china-starts-construction-on-worlds-biggest-offshore-wind-farm/. Posted October 25, 2010. Accessed March 24, 2011.

Skagen, S.K. and F.L. Knopf. 1993. Toward conservation of midcontinental shorebird migrations. Conservation Biology 7:533-541.

Skagen, S.K., D.A. Granfors, and C.P. Melcher. 2008. On determining the significance of ephemeral continental wetlands to North American migratory shorebirds. Auk 125:20-29.

Smith, M.F., ed. 1984. Ecological characterization atlas of coastal Alabama: Map narrative. U.S. Dept. of the Interior, Fish and Wildlife Service FWS/OBS-82/46 and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 84-0052. 189 pp.

Smultea, M.A. and B. Würsig. 1995. Behavioral reactions of bottlenose dolphins to the *Mega Borg* oil spill, Gulf of Mexico 1990. Aquatic Mammals 21:171-181.

Snedden, G.A. In preparation. Forcing functions governing salt transport processes in coastal navigation canals and connectivity to surrounding wetland landscapes in south Louisiana using Houma navigation canal as a surrogate. U.S. Dept. of the Interior, Geological Survey, National Wetlands Research Center, Baton Rouge, LA.

Source Strategies Inc. 2010. Texas hotel performance report: Third quarter data tables: By metro, by metro by county.

South Atlantic Fishery Management Council. 2002. Fishery management plan for pelagic Sargassum habitat of the South Atlantic Region, including a final environmental impact statement, initial regulatory flexibility analysis, regulatory impact review, & social impact assessment/fishery impact statement: Second revised final. South Atlantic Fishery Management Council, Charleston, SC.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene, Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas, and P. Tyack. 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. Aquatic Mammals 33:411-521.

Southwest Research Institute. 1981. Ecological investigations of petroleum production platforms in the central Gulf of Mexico. Submitted to the U.S. Dept. of the Interior, Bureau of Land Management, New Orleans OCS Office, New Orleans, LA. Contract no. AA551-CT8-17.

Spalding, E.A. and M.W. Hester. 2007. Effects of hydrology and salinity on oligohaline plant species productivity: Implications of relative sea-level rise. Estuaries and Coasts 30(2):214-225.

St. Aubin, D.J. and V. Lounsbury. 1990. Oil effects on manatees: Evaluating the risks. Chapter 11. In: Geraci, J.R. and D.J. St. Aubin, eds. Sea mammals and oil: Confronting the risks. San Diego, CA: Academic Press, Inc. Pp. 241-251.

Stadelman, W.J. 1958. The effects of sounds of varying intensity on hatchability of chicken eggs. Poultry Science 37:166-169.

State of Louisiana. 2007. Integrated ecosystem restoration and hurricane protection: Louisiana's comprehensive master plan for a sustainable coast. Coastal Protection and Restoration Authority of Louisiana, Baton Rouge, LA. Internet website: http://www.lacpra.org/index.cfm?md=pagebuilder&tmp=home&nid=24&pnid=0&pid=28&fmid=0&catid=0&elid=0. Accessed April 7, 2011.

Stehn, T. 2007. Official communication. Captive and wild whooping crane population sizes in 2007. Wildlife Biologist, U.S. Dept. of the Interior, Fish and Wildlife Service, Aransas National Wildlife Refuge, TX.

Steidl, R.J. and B.F. Powell. 2006. Assessing the effects of human activities on wildlife. George Wright Forum 23:50-58.

Stephens, B.P. 2009. Basement controls on subsurface geologic patterns and coastal geomorphology across the northern Gulf of Mexico: Implications for subsidence studies and coastal restoration. Transactions Gulf Coast Association of Geological Societies 59:729-751. Internet website: http://www.searchanddiscovery.net/abstracts/html/2009/gcags/abstracts/stephens.htm.

Stephens, B.P. 2010a. Basement controls on subsurface geologic patterns and near-surface geology across the northern Gulf of Mexico: A deeper perspective on coastal Louisiana. American Association of Petroleum Geologists, Annual Conference and Exhibition, April 11-14, 2010, New Orleans, LA. Search and Discovery Article #30129. Internet website: http://www.searchanddiscovery.net/documents/2010/30129stephens/ndx_stephens.pdf.

Stephens, B.P. 2010b. Basement controls on subsurface geologic patterns and coastal geomorphology across the northern Gulf of Mexico: Implications for subsidence studies and coastal restoration. Adapted from the presentation given to New Orleans Geological Society, July 14, 2010.

Stephenson, R. 1997. Effects of oil and other surface-active organic pollutants on aquatic birds. Environmental Conservation 24:121-129.

Stephenson, R. and C.A. Andrews. 1997. The effect of water surface tension on feather wetability in aquatic birds. Canadian Journal of Zoology 74:288-294.

Steyn, P. 2010. *Exxon Valdez* oil spill. Answers.com. Internet website: http://www.answers.com/topic/exxon-valdez-oil-spill. Accessed November 23, 2010.

Stone, R.B. 1974. A brief history of artificial reef activities in the United States. In: Proceedings: Artificial Reef Conference, Houston, TX. Pp. 24-27.

Stone, G.W. 2001. Wave climate and bottom boundary layer dynamics with implications for offshore sand mining and barrier island replenishment in south-central Louisiana. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-053. 90 pp.

Stone, R.B., W. Pratt, R.O. Parker, and G. Davis. 1979. A comparison of fish populations on an artificial and natural reef in the Florida Keys. Mar. Fish. Rev. 41(9):1-24.

Stoner, A.W. 1983. Pelagic Sargassum: Evidence for a major decrease in biomass. Deep-Sea Research Part A. Oceanographic Research Papers 30(4):469-474.

Stout, J.P, M.G. Lelong, J.L. Borom, and M.T. Powers. 1981. Wetland habitat of the Alabama coastal area. Part II: An inventory of wetland habitats south of the battleship parkway. Alabama Coastal Area Board, Technical Publication CAB-81-01.

Stright, M.J., E.M. Lear, and J.F. Bennett. 1999. Spatial data analysis of artifacts redeposited by coastal erosion: A case study of McFaddin Beach, Texas. U.S. Dept. of the Interior, Minerals Management Service, Herndon, VA. OCS Study MMS 99-0068. 2 vols.

Sturges, W., E. Chassignet, and T. Ezer. 2004. Strong mid-depth currents and a deep cyclonic gyre in the Gulf of Mexico: Final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS-2004-040. 89 pp.

Stutzenbaker, C.D. and M.W. Weller. 1989. The Texas coast. In: Smith, L.M., R.L. Pederson, and R.K. Kaminski, eds. Habitat management for migrating and wintering waterfowl in North America. Lubbock, TX: Texas Tech. University Press. Pp. 385-405.

Suchanek, T.H. 1993. Oil impacts on marine invertebrate populations and communities. American Zoologist 33:510-523.

Swanson, C., F.D. McCay, S. Subbayya, J. Rowe, P. Hall, and T. Isaji. 2003. Modeling dredging-induced suspended sediment and the environmental effects in Mt. Hope Bay and the Taunton River for the proposed Weaver's Cove Energy, LLC, Liquefied Natural Gas Import Terminal. Prepared by Applied Science Associates for Weaver's Cove Energy, LLC.

Swenson, E.M. and R.E. Turner. 1987. Spoil banks: Effects on a coastal marsh water-level regime. Estuarine Coastal Shelf Science 24:599-609.

Swift, T.L. and S.J. Hannon. 2010. Critical thresholds associated with habitat loss: A review of the concepts, evidence, and applications. Biological Reviews 85:35-53.

Systems Applications International, Sonoma Technology, Inc., Earth Tech, Alpine Geophysics, and A.T. Kearney. 1995. Gulf of Mexico air quality study: Final report. Volumes I-III. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 95-0038, 95-0039, and 95-0040. 650, 214, and 190 pp., respectively.

Szaro, R.C., P.H. Albers, and N.C. Coon. 1978a. Petroleum: effects on mallard egg hatchability. Journal of Wildlife Management 42:404-406.

Szaro, R.C., M.P. Dieter, G.H. Heinz, and J.F. Ferrell. 1978b. Effects of chronic ingestion of south Louisiana crude oil on mallard ducklings. Environmental Research 17:426-436.

Tan, L., M. Belanger, and C. Witthich. 2008. Revisiting the correlation between estimated seabird mortality and oil spill size. Journal of Marine Animals and Their Ecology 3:20-26.

Taylor, H.A., M.A. Rasheed, and R. Thomas. 2006. Port Curtis post oil spill seagrass assessment, Gladstone-2006. DPI&F Information Series QI06046 (DPI&F, Cairns). 19 pp. Internet website: http://www.seagrasswatch.org/Info_centre/Publications/pdf/meg/GladstonePostOilSpillReport2006_Final.pdf.

Teal, J.M. and R.W. Howarth. 1984. Oil spill studies: A review of ecological effects. Environmental Management 8:27-44.

Teal, J.M., J.W. Farrington, K.A. Burns, J.J. Stegeman, B.W. Tripp, B. Woodin, and C. Phinney. 1992. The West Falmouth oil spill after 20 years: Fate of fuel oil compounds and effects on animals. Marine Pollution Bulletin 24(12):607-614.

Teas, W.G. 1994. Marine turtle stranding trends, 1986-1993. In: Bjorndal, K.A., A.B. Bolten, D.A. Johnson, and P.J. Eliazar, comps. Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-SEFSC-351. Pp. 293-295.

Telesnicki, G.J. and W.M. Goldberg. 1995. Effects of turbidity on the photosynthesis and respiration of two south Florida reef coral species. Bulletin of Marine Science 57(2):527-539.

Teo, S.L.H, A. Boustany, H. Dewar, M.J.W. Stokesbury, K.C. Weng, S. Beemer, A.C. Seitz, C.J. Farwell, E.D. Prince, and B.A. Block. 2007. Annual migrations, diving behavior, and thermal biology of Atlantic bluefin tuna, *Thunnus thynnus*, on their Gulf of Mexico breeding grounds. Marine Biology 151:1-18.

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

Teslik, L.H. and C. Menegatti. 2010. Oil spill will hurt U.S. economy, but not big enough to cause recession. *The Washington Post*. Internet website: http://www.washingtonpost.com/wp-dyn/content/article/2010/07/01/AR2010070105311_pf.html. Accessed July 3, 2010.

Tetrahedron, Inc. 1996. Reliability of blowout preventers tested under fourteen and seven days time interval. Study report prepared for the U.S. Dept. of the Interior, Minerals Management Service. TA&R Project 253. 33 pp. Internet website: http://www.boemre.gov/tarprojects/253/AA.PDF.

Texas General Land Office. 2007. The Texas Coastal Erosion Response Program in 2007: Highlights and a look forward. Presented by Lorrie Council, P.G., Coastal Protection Division.

Texas General Land Office. 2010. Energy land and lease inventory system. Internet website: http://www.glo.state.tx.us/energy/ellis.html. Accessed October 12, 2010.

Texas General Land Office. 2011. Resource management codes: Texas State-owned submerged lands. Internet website: http://www.glo.texas.gov/cf/map-search/index.html. Accessed July 19, 2011.

Texas Historical Commission. 2010. Marine stewards. Internet website: http://www.thc.state.tx.us/stewards/stwmarine.shtml. Accessed August 31, 2010.

Texas Parks and Wildlife Department. 1990. Texas colonial waterbird census summary. Texas Parks and Wildlife Department and the Texas Colonial Waterbird Society, Special Administrative Report.

Texas Parks and Wildlife Department. 1999. Seagrass conservation plan for Texas. Texas Parks and Wildlife, Resource Protection Division, Austin, TX. 79 pp. Internet website: http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_bk_r0400_0041.pdf.

Texas Parks and Wildlife Department. 2003. Texas coastal wetland types. Website authors: Jacob, J.S., D. Moulton, and R.A. Lopez. Internet website: http://www.texaswetlands.org/index.htm. Accessed September 29, 2010.

Texas Parks and Wildlife Department. 2008. Biologist assesses Ike impacts to coastal ecosystems. Texas Parks and Wildlife News Release. October 1, 2008. Internet website: http://www.tpwd.state.tx.us/newsmedia/releases/?req=20081001b. Accessed December 2010.

Texas Parks and Wildlife Department. 2009. Galveston Bay oyster reef restoration gets underway. News Release. September 17, 2009. Internet website: http://www.tpwd.state.tx.us/newsmedia/releases/?req=20090917b&nrtype=all&nrspan=&nrsearch=. Accessed August 6, 2010.

Texas Parks and Wildlife Department. 2010a. Catch rate by minor bay application. Internet website: http://www.tpwd.state.tx.us/landwater/land/maps/gis/ris/catch_rate/index.phtml. Accessed December 15, 2010.

Texas Parks and Wildlife Department. 2010b. Artificial reefs interactive mapping. Internet website: http://gis-apps.tpwd.state.tx.us/ris.net/ArtificialReefs/. Accessed February 15, 2011.

Texas Parks and Wildlife Department. 2010c. 2010-2011 Texas fishing and hunting regulations: Summary of recreational fishing regulations. Internet website: http://www.tpwd.state.tx.us/publications/annual/. Accessed February 15, 2011.

Texas Parks and Wildlife Department. 2010d. The great Texas coastal birding trail. Brochure. Austin, TX. PWD BK W7000-1092. 12 pp.

Texas State Government Homepage. n.d. Texas in focus: South Texas demographics. Internet website: http://www.window.state.tx.us/specialrpt/tif/southtexas/demographics.html. Accessed January 14, 2011.

Thatcher, C.A., S.B. Hartley, and S.A. Wilson. 2011. Bank erosion of navigation canals in the western and central Gulf of Mexico. U.S. Dept. of the Interior, Geological Survey, National Wetlands Resource Center, Open-File Report 2010-1017 and U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA, OCS Study BOEMRE 2010-039. 32 pp. + 2 apps. Internet website: http://pubs.usgs.gov/of/2010/1017_p/pdf/OF10-1017.pdf.

The Encyclopedia of Earth. 2008. Gulf of Mexico large marine ecosystem. Internet website: http://www.eoearth.org/article/Gulf_of_Mexico_large_marine_ecosystem?topic=49522. Updated December 28, 2010. Accessed January 11, 2011.

The Greater Lafourche Port Commission (TGLPC). 2010a. Map of waterfront property available at Port Fourchon. Internet website: http://www.portfourchon.com/site100-01/1001757/docs/2010_7_1_waterfront.pdf. Accessed December 2, 2010.

The Greater Lafourche Port Commission (TGLPC). 2010b. Map of non-waterfront property available at Port Fourchon. Internet website: http://www.portfourchon.com/site100-01/1001757/docs/2010_7_1_nonwaterfront.pdf. Accessed December 3, 2010.

The Greater Lafourche Port Commission (TGLPC). 2010c. Port Fourchon north expansion. Internet website: http://www.portfourchon.com/explore.cfm/northernexpansion/. Accessed December 3, 2010.

The Greater Lafourche Port Commission (TGLPC). 2010d. South Lafourche airport in "excellent condition": Many improvements since Port Commission acquisition. Internet website: http://www.portfourchon.com/explore.cfm/20100222airptrev/. Accessed December 3, 2010.

The Heinz Center. 2010. Evaluation of erosion hazards. Prepared for the Federal Emergency Management Agency. Contract EMW-97-CO-0375. 205 pp.

The Louis Berger Group, Inc. 2004. OCS-related infrastructure in the Gulf of Mexico fact book. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2004-027. 249 pp.

The Oil Drum. 2009. USA Gulf of Mexico oil production forecast update. Internet website: http://www.theoildrum.com/node/5081. Posted February 9, 2009. Accessed January 4, 2011.

The White House. 2010. Establishing the Gulf Coast Ecosystem Restoration Task Force. Office of the Press Secretary, Executive Order, October 5, 2010. Internet website: http://www.whitehouse.gov/the-press-office/2010/10/05/executive-order-gulf-coast-ecosystem-restoration-task-force.

Thistle, D. 1981. Natural physical disturbances and communities of marine soft bottoms. Marine Ecology Progress Series 6:223-228.

Thorhaug, A. 1988. Dispersed oil effects on mangroves, seagrasses, and corals in the wider Caribbean. Proceedings of the 6th International Coral Reef Symposium, Australia 2:337-339.

Thorhaug, A., J. Marcus, and F. Booker. 1986. Oil and dispersed oil on subtropical and tropical seagrasses in laboratory studies. Marine Pollution Bulletin 17:357-631.

Tiner, R.W. 1984. Wetlands of the United States: Current status and recent trends. U.S. Dept. of the Interior, Fish and Wildlife Service, Newton Corner, MA. vii + 59 pp.

Tkalich, P. and E.S. Chan. 2002. Vertical mixing of oil droplets by breaking waves. Marine Pollution Bulletin 44:1219-1229.

Tokotch, B. 2010. Oil and coral fact sheet. 3 pp. Internet website: http://sero.nmfs.noaa.gov/sf/deepwater_horizon/Oil-CoralOnePage.pdf. Accessed December 6, 2010.

Tolbert, C.M. 1995. Oil and gas development and coastal income inequality: Case studies at the place level. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 94-0052. 75 pp.

Tolbert, C.M. and M. Sizer. 1996. U.S. commuting zones and labor market areas: 1990 update. U.S. Dept. of Agriculture, Economic Research Service, Rural Economy Division. Staff Paper No. AGES-9614.

Toll Road News. 2009. LA1 bridge to Gulf oil & gas is tolling. Internet website: http://tollroadsnews.com/node/4305. Accessed December 3, 2010.

Torres, J.L. 2001. Impacts of sedimentation on the growth rates of *Montastraea annularis* in southwest Puerto Rico. Bulletin of Marine Science 69(2):631-637.

Torres, R., M. Chiappone, F. Geraldes, Y. Rodriguez, and M. Vega. 2001. Sedimentation as an important environmental influence on Dominican Republic reefs. Bulletin of Marine Science 69(2):805-818.

Trapido, E.J. 2010. Health and the *Deepwater Horizon* Gulf oil spill. JSOST *Deepwater Horizon* Oil Spill Principal Investigator (PI) Conference, October 5-6, 2010, St. Petersburg, FL.

Trefry, J.H. 1981. A review of existing knowledge on trace metals in the Gulf of Mexico. In: Proceedings of a symposium on environmental research needs in the Gulf of Mexico (GOMEX). Volume II-B. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Environmental Research Laboratory. Pp. 225-259.

Trefry, J.H. and J.P. Smith. 2003. Forms of mercury in drilling fluid barite and their fate in the marine environment: A review and synthesis. In: Proceedings of the SPE/EPA/DOE Exploration and Production Environmental Conference, March 10-12, 2003, San Antonio, TX. Paper SPE 80571-MS. 10 pp.

Trefry, J.H., K.L. Naito, R.P. Trocine, and S. Metz. 1995. Distribution and bioaccumulation of heavy metals from produced water discharges to the Gulf of Mexico. Water Science and Technology 32(2):31-36.

Trefry, J.H., R.P. Trocine, M.L. McElvaine, R.D. Rember, and L. Hawkins. 2003. Concentrations of total mercury and methylmercury in sediment adjacent to offshore drilling sites. In: Proceedings of the SPE/EPA/DOE Exploration and Production Environmental Conference, March 10-12, 2003, San Antonio, TX. Paper SPE 80569-MS. 12 pp.

Trivelpiece, W.Z., R.G. Butler, D.S. Miller, and D.B. Peakall. 1984. Reduced survival of chicks on oil-dosed adult Leach's storm-petrels. Condor 86:81-82.

Tuler, S., T. Webler, K. Dow, and F. Lord. 2009. Human dimensions impacts of oil spills: Brief summaries of human impacts of oil and oil spill response efforts. Social and Environmental Research

Institute. Project funded by the Coastal Response Research Center. Internet website: http://www.seri-us.org/projects/HDOil.html.

Tuler, S., T. Weber, R. Lord, and K. Dow. 2010. A case study into the human dimensions of the DM-932 oil spill in New Orleans. Greenfield MA: Social and Environmental Research Institute. 32 pp.

Tunnell, J.W., Jr. 1981. Sebree Bank: Observations derived from scuba dive during a Bureau of Land Management sponsored cruise during August 24-27, 1981. In: Dokken, Q., R. Lehman, J. Prouty, C. Adams, and C. Beaver. 1993. A preliminary survey of Sebree Bank (Gulf of Mexico, Port Mansfield, TX), August 23-27, 1993. Texas A&M University, Center for Coastal Studies, Corpus Christi, TX. Center for Coastal Studies Technical Report No. TAMU-CC-9305-CCS. 13 pp.

Tunnell, J.W., Jr., Q.R. Dokken, M.E. Kindinger, and L.C. Thebeau. 1981. Effects of the *Ixtoc I* oil spill on the intertidal and subtidal infaunal populations along lower Texas coast barrier island beaches. In: Proceedings 1981 Oil Spill Conference, March 2-5, Atlanta, GA. Washington DC: American Petroleum Institute. Pp. 467-475.

Turner, R.E. and D.R. Cahoon. 1988. Causes of wetland loss in the coastal Central Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 87-0119 (Volume I: Executive Summary), 87-0120 (Volume II: Technical Narrative), and 87-0121 (Volume III: Appendices). 32, 400, and 122 pp., respectively.

Turner, R.E., R. Costanza, and W. Scaife. 1982. Canals and wetland erosion rates in coastal Louisiana. In: Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options. U.S. Dept. of the Interior, Fish and Wildlife Service, Office of Biological Services. FWS/OBS 82/59.

Turner, R.E., J.M. Lee, and C. Neill. 1994. Backfilling canals to restore wetlands: Empirical results in coastal Louisiana. Wetlands Ecology and Management 3(1):63-78.

Tuttle, J.R. and A.J. Combe III. 1981. Flow regime and sediment load affected by alterations of the Mississippi River. In: Cross, R.D. and Williams, D.L., eds. Proceedings, National Symposium: Freshwater Inflow Estuaries. U.S. Dept. of the Interior, Fish and Wildlife Service, Office of Biological Services. FWS/OBS-81/104. Pp. 334-348. Internet website: http://www.gomr.boemre.gov/PI/PDFImages/ESPIS/3/3779.pdf.

United Louisiana Vietnamese American Fisherfolks. 2010. Loss of subsistence use claim framework & template for Louisiana Vietnamese American fisherfolks & other Louisiana fisherfolks. Internet website: http://www.mqvncdc.org/event_page.php?id=38. Accessed March 28, 2011.

United Nations Environment Programme. 2009. Marine litter: A global challenge. Nairobi, Kenya: United Nations Environmental Programme. 232 pp. Internet website: http://www.unep.org/pdf/unep_marine_litter-a_global_challenge.pdf.

Upton, H.F. 2010. Commercial fishery disaster assistance. Congressional Research Service. Report for Congress. RL 34209. Internet website: http://www.fas.org/sgp/crs/misc/RL34209.pdf.

U.S. Congress, Office of Technology Assessment. 1990. Coping with an oiled sea: an analysis of oil spill response technologies, OTA-BP-O-63, Washington, DC: U.S. Government Printing Office. 70 pp. Internet website: http://www.fas.org/ota/reports/9011.pdf. Accessed December 27, 2010.

U.S. Dept. of Agriculture. Economic Research Service. 2004. County typology codes. Internet website: http://www.ers.usda.gov/Data/TypologyCodes/. Accessed September 20, 2010.

U.S. Dept. of Commerce. 2010. Estimating the economic effect of the deepwater drilling moratorium on the Gulf Coast economy: Inter-agency report, September 16, 2010. Report presented at the Department of Commerce Testimony—111th Congress by Rebecca Blank, Under Secretary for Economic Affairs, U.S. Dept. of Commerce. 25 pp. Internet website: http://www.commerce.gov/sites/default/files/documents/2010/november/blank091610_report.pdf. Accessed December 12, 2010.

U.S. Dept. of Commerce. Census Bureau. 2003. Language use and English-speaking ability: 2000; Census 2000 brief. 11 pp. Internet website: http://www.census.gov/prod/2003pubs/c2kbr-29.pdf.

U.S. Dept. of Commerce. National Aeronautics and Space Administration. 2003. SeaWiFS Project—detailed description. Internet website: http://oceancolor.gsfc.nasa.gov/SeaWiFS/BACKGROUND/SEAWIFS_970_BROCHURE.html. Updated July 30, 2003. Accessed January 11, 2011.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2007a. Report to Congress on the impact of Hurricanes Katrina, Rita, and Wilma on commercial and recreational fishery habitat of Alabama, Florida, Louisiana, Mississippi, and Texas. July 2007. 191 pp. + apps. Internet website: http://www.nmfs.noaa.gov/msa2007/docs/HurricaneImpactsHabitat_080707_1200.pdf. Accessed December 30, 2010.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2007b. Endangered Species Act Section 7 consultation on the effects of the five-year outer continental shelf oil and gas leasing program (2007-2012) in the Central and Western Planning Areas of the Gulf of Mexico. Biological Opinion. June 29. F/SER/2006/02611. 127 pp.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2010a. Essential fish habitat; a marine fish habitat conservation mandate for Federal agencies. South Atlantic Region. Internet website: http://sero.nmfs.noaa.gov/hcd/pdfs/efhdocs/sa_guide_2010.pdf.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2010b. Final recovery plan for the sperm whale (*Physeter macrocephalus*). U.S. Dept. of Commerce, National Marine Fisheries Service, Silver Spring, MD. 165 pp.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2010c. Report to Congress: Status of fisheries of the United States. 20 pp. Internet website: http://www.nmfs.noaa.gov/sfa/statusoffisheries/sos_full28_press.pdf.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2010d. Information and databases on fisheries landings. Internet website (latest data for 2009): http://www.st.nmfs.gov/st1/commercial/landings/annual_landings.html.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2010e. Fisheries economics of the U.S. Internet website: http://www.st.nmfs.noaa.gov/st5/publication/fisheries_economics_2008.html. Accessed December 28, 2010.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2011a. 2010-2011 cetacean unusual mortality event in northern Gulf of Mexico. Internet website: http://www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico2010.htm. Accessed June 29, 2011.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2011b. Dolphins and whales and the Gulf of Mexico oil spill. Internet website: http://www.nmfs.noaa.gov/pr/health/oilspill/mammals.htm. Accessed June 29, 2011.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2011c. Sea turtles and the Gulf of Mexico oil spill. Internet website: http://www.nmfs.noaa.gov/pr/health/oilspill/turtles.htm. Accessed June 30, 2011.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2011d. Deepwater Horizon MC252: Documented sea turtles in northern Gulf of Mexico from 4/30/1-0/18/10. Internet website: http://www.nmfs.noaa.gov/pr/images/oilspill/turtles2010.jpg. Accessed June 30, 2011.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2011e. Sea turtle strandings in the Gulf of Mexico. Internet website: http://www.nmfs.noaa.gov/pr/species/turtles/gulfofmexico.htm. Accessed July 11, 2011.

U.S. Dept. of Commerce. National Marine Fisheries Service. 2011f. Status of stocks: 2010 report on the status of U.S. fisheries. Annual report to Congress on the status of U.S. fisheries. 21 pp. Internet website: http://www.nmfs.noaa.gov/stories/2011/07/docs/report.pdf.

U.S. Dept. of Commerce. National Marine Fisheries Service and U.S. Dept. of the Interior, Fish and Wildlife Service. 2007a. Leatherback sea turtle (*Dermochelys coriacea*); 5-year review: Summary and evaluation. U.S. Dept. of Commerce, National Marine Fisheries Service, Silver Spring, MD, and U.S. Dept. of the Interior, Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Service Field Office, Jacksonville, FL. 79 pp. Internet website: http://www.fws.gov/northflorida/seaTurtles/2007-Reviews/2007-leatherback-turtle-5-year-review-final.pdf.

U.S. Dept. of Commerce. National Marine Fisheries Service and U.S. Dept. of the Interior, Fish and Wildlife Service. 2007b. Green sea turtle (*Chelonia mydas*); 5-year review: Summary and evaluation. U.S. Dept. of Commerce, National Marine Fisheries Service, Silver Spring, MD, and U.S. Dept. of the Interior, Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Service Field Office, Jacksonville, FL. 102 pp. Internet website: http://www.fws.gov/northflorida/SeaTurtles/2007-Reviews/2007-green-turtle-5-year-review-final.pdf.

U.S. Dept. of Commerce. National Marine Fisheries Service and U.S. Dept. of the Interior, Fish and Wildlife Service. 2007c. Hawksbill sea turtle (*Eretmochelys imbricata*); 5-year review: Summary and evaluation. U.S. Dept. of Commerce, National Marine Fisheries Service, Silver Spring, MD, and U.S. Dept. of the Interior, Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Service Field Office, Jacksonville, FL. 90 pp. Internet website: http://www.fws.gov/northflorida/SeaTurtles/2007-Reviews/2007-hawksbill-turtle-5-year-review-final.pdf.

U.S. Dept. of Commerce. National Marine Fisheries Service and U.S. Dept. of the Interior, Fish and Wildlife Service. 2007d. Kemp's ridley sea turtle (*Lepidochelys kempii*); 5-year review: Summary and evaluation. U.S. Dept. of Commerce, National Marine Fisheries Service, Silver Spring, MD, and U.S. Dept. of the Interior, Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Service Field Office, Jacksonville, FL. 50 pp. Internet website: http://www.fws.gov/northflorida/SeaTurtles/2007-Reviews/2007-Kemps-ridley-turtle-5-year-review-final.pdf.

U.S. Dept. of Commerce. National Marine Fisheries Service and U.S. Dept. of the Interior, Fish and Wildlife Service. 2007e. Loggerhead sea turtle (*Caretta caretta*); 5-year review: Summary and evaluation. U.S. Dept. of Commerce, National Marine Fisheries Service, Silver Spring, MD, and U.S. Dept. of the Interior, Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Service Field Office, Jacksonville, FL. 65 pp. Internet website: http://www.fws.gov/northflorida/SeaTurtles/2007-Reviews/2007-Loggerhead-turtle-5-year-review-final.pdf.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2000. Shoreline assessment manual, third edition. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Office of Response and Restoration, Seattle, WA. HAZMAT Report 2000-1. 120 pp. Internet website: http://www.fws.gov/contaminants/FWS_OSCP_05/fwscontingencyappendices/N-Manuals-Response-Assessment/ShorelineAssessment_NOAA.pdf. Accessed February 13, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2005. NOAA attributes recent increase in hurricane activity to naturally occurring multi-decadal climate variability. *NOAA Magazine*. November 29, 2005. Internet website: http://www.magazine.noaa.gov/stories/mag184.htm.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration**.** 2006. NOAA fact sheet, small diesel spills (500-5000 gallons) (Office of Response and Restoration). November 2006. Internet website: http://response.restoration.noaa.gov/book_shelf/974_diesel.pdf.

U.S. Dept. of Commerce. National Oceanic Atmospheric Administration. 2007. National Artificial Reef Plan: Guidelines for siting, construction, development, and assessment of artificial reefs. Internet website: http://www.nmfs.noaa.gov/sfa/PartnershipsCommunications/recfish/NARPREVISION_3_07_07_FINAL.pdf.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2008a. The Gulf of Mexico at a glance. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Washington, DC. 34 pp. Internet website: http://gulfofmexicoalliance.org/pdfs/gulf_glance_1008.pdf. Accessed February 27, 2009.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2008b. Interagency report on marine debris sources, impacts, strategies, and recommendations. Interagency Marine Debris Coordinating Committee, Silver Spring, MD. 62 pp.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2008c. NOAA responds to New Orleans barge collision oil spill. Internet website: http://www.noaanews.noaa.gov/stories2008/20080724_oilspill.html. Accessed November 26, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2009. Final: Amendment 1 to the consolidated Atlantic highly migratory species fishery management plan; essential fish habitat. U.S. Dept. of the Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Sustainable Fisheries, Highly Migratory Species Management Division, Silver Spring, MD. xiii + 395 pp. Internet website: http://www.nmfs.noaa.gov/sfa/hms/EFH/Final/FEIS_Amendment_Total.pdf.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010a. Using booms in response to oil spills. National Ocean Service. 4 pp. Internet website: http://sero.nmfs.noaa.gov/sf/deepwater_horizon/NOAA_boom_fact_sheet.pdf. Last revised May 10, 2010. Accessed December 27, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010b. Environmental Response Management Application (ERMA). 2010c. Potential oiling footprint, NOAA/NESDIS (RADARSAT-2 ScanSAR). NESDIS Anomaly Analysis 17-May-10 11:36 CDT. Cumulative Aquatracka fluorometry results, Deepwater Horizon Response. Internet website: http://gomex.erma.noaa.gov/. Accessed April 4, 2011.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010c. Tarballs from *Deepwater Horizon* found on Bolivar and Galveston Island. *Gulf of Mexico News*. July 5, 2010. Internet website: http://coastalmanagement.noaa.gov/news/gomexnews.html. Accessed May 31, 2011.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010d. Archive of hurricane seasons (2005, 2007, 2008, 2010). National Hurricane Center, Miami, FL. Internet website: http://www.nhc.noaa.gov.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010e. Flower Gardens National Marine Sanctuary species list. Internet website: http://flowergarden.noaa.gov/document_library/science/recdivingspecieslist.pdf. Accessed September 16, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010f. Corals that are Candidates for Listing Under the ESA. NOAA Fisheries Office of Protected Resources Web Page. Internet website: http://www.nmfs.noaa.gov/pr/species/invertebrates/corals.htm. Accessed December 1, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010g. Oil spill resources. Sanctuary Impacts. Flower Garden Banks National Marine Sanctuary website. Internet website: http://flowergarden.noaa.gov/education/oilspill.html. Accessed October 8, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010h. Flower Gardens National Marine Sanctuary draft management plan. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Silver Spring, MD.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010i. Approximate oil locations from April 27, 2010 to May 1, 2010, including forecast for May 2 (map). Internet website: http://response.restoration.noaa.gov/book_shelf/1893_TM-2010-04-30-2145.pdf. Accessed June 29, 2011.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010j. Environmental Response Management Application (ERMA). Internet website: http://gomex.erma.noaa.gov. Accessed October 14, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010k. Resources related to Environmental Sensitivity Index (ESI) maps. Internet website: http://response.restoration.noaa.gov/resource_resourcetopic.php?RECORD_KEY(resourcetopics)=resourcetopic_id&resourcetopic_id(resourcetopics)=37. Accessed December 3, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010l. NOAA ship *Thomas Jefferson* June 15-27 mission summary. Internet website: http://www.noaa.gov/sciencemissions/PDFs/thomas_jefferson_cruise_%20recap_july2_2010.pdf. Accessed September 8, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2011a. Potential oiling footprint – NOAA/NESDIS (RADARSAT-2 ScanSAR). April 2010 to August 2010. Internet website: http://gomex.erma.noaa.gov/erma.html#x=-88.38501&y=29.16176&z=6&layers=9651+9655+9657+9506+9447+9413+9309+9203+9095+8981+8816+8747+8666+8592+8523+8332+8236+8152+8058+7961+7849+7768+7685+7585+7531+7473+7252+7162+7157+6914+6807+6764+6583+6548+6564+6484+6372+6268+6272+6214+6197+6174+6060+5895+5771+5675+5600+5482+5430+5336+5258+5200+5147+5073+5021+4944+4880+4686+4585+4509+4435+4354+4264+4164+4065+3976+3906+3580+3494+3399+3295+3203+3101+3009+2915+2835+2751+2647+2574+2512+2362+2439+2361+2312+2311+2266+2244+2213+2127+2230+2073+2058+2066+1966+1984+1965+1953+1820+1876+1827+1785+8920+1550+1530+1584+1582+1515+1454+1467+1453+1417+1404+1345+1330+1329+1309+1328+1248+1267+1171+1202+1164+1165+1144+1126+1125+1084+1115+1129+1053+1013+1005+1004+968+928+837+836+789+739+653+639+637+576+567+555+551+546+507+504+492+473+365+5723. Accessed April 7, 2011.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2011b. Threats to marine turtles: Threats in the marine environment. Internet website: http://www.nmfs.noaa.gov/pr/species/turtles/threats.htm. Accessed June 12, 2011.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2011c. Endangered species listing for Atlantic bluefin tuna not warranted. http://www.noaanews.noaa.gov/stories2011/20110527_bluefintuna.html. Posted May 27, 2011. Accessed June 9, 2011.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2011d. 2010-2011 cetacean unusual mortality event in northern Gulf of Mexico. Internet website: http://www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico2010.htm. Updated July 6, 2011. Accessed July 12, 2011.

U.S. Dept. of Energy. 2010. Creating an offshore wind industry in the United States: A strategic work plan for the United States Department of Energy, fiscal years 2011 – 2015. U.S. Dept. of Energy, Office of Energy Efficiency and Renewable Energy, Wind & Water Power Program. September 2, 2010. Internet website: http://www.windpoweringamerica.gov/pdfs/offshore/offshore_wind_strategic_plan.pdf.

U.S. Dept. of Energy. Energy Information Administration. 2006. Natural gas processing: The crucial link between natural gas production and its transportation to market. U.S. Dept. of Energy, Energy Information Administration, Office of Oil and Gas, Washington DC, January 2006.

U.S. Dept. of Energy. Energy Information Administration. 2010a. Crude and petroleum products explained, use of oil. Internet website: http://tonto.eia.doe.gov/energyexplained/index.cfm?page=oil_use. Last updated March 1, 2010. Accessed March 30, 2010.

U.S. Dept. of Energy. Energy Information Administration. 2010b. Crude and petroleum products explained, oil imports and exports. Internet website: http://tonto.eia.doe.gov/energyexplained/index.cfm?page=oil_imports. Last updated February 23, 2010. Accessed March 30, 2010.

U.S. Dept. of Energy. Energy Information Administration. 2010c. Natural gas consumption by end use. Internet website: http://tonto.eia.doe.gov/dnav/ng/ng_cons_sum_dcu_nus_a.htm. Last updated March 29, 2010. Accessed March 30, 2010.

U.S. Dept. of Energy. Energy Information Administration. 2010d. Table browser. Table 5a. U.S. natural gas supply, consumption and inventories, and Table 4a. U.S. crude oil and liquid fuel supply, consumption, and inventories. Internet websites: Table 4a: http://www.eia.doe.gov/emeu/steo/pub/cf_tables/steotables.cfm?tableNumber=9. Table 5a: http://www.eia.doe.gov/emeu/steo/pub/cf_tables/steotables.cfm?tableNumber=15. Posted December 7, 2010. Accessed January 4, 2011.

U.S. Dept. of Energy. Energy Information Administration. 2010e. Short-term energy outlook. Internet website: http://www.eia.doe.gov/emeu/steo/pub/contents.html. Posted December 7, 2010. Accessed January 4, 2011.

U.S. Dept. of Energy. Energy Information Administration. 2011a. Natural gas consumption by end use. Internet website: http://tonto.eia.doe.gov/dnav/ng/ng_cons_sum_dcu_nus_a.htm. Last updated March 29, 2011. Accessed April 26, 2011.

U.S. Dept. of Energy. Energy Information Administration. 2011b. Short-term energy and summer fuels outlook. Internet website: http://www.eia.gov/emeu/steo/pub/contents.html#US_Crude_Oil_And_Liquids_Fuels. Posted April 12, 2011. Accessed April 27, 2011.

U.S. Dept. of Homeland Security. Coast Guard. 2010a. Polluting incidents in and around U.S. waters. A spill/release compendium: 1969-2008. Office of Investigations & Compliance Analysis (CG-545), Washington DC. Internet website: http://www.safety4sea.com/admin/images/media/pdf/2010.09.01-Spill_Compendium.pdf. Accessed December 23, 2010.

U.S. Dept. of Homeland Security. Coast Guard. 2010b. Ballast water management. Internet website: http://www.uscg.mil/hq/cg5/cg522/cg5224/bwm.asp. Accessed October 28, 2010.

U.S. Dept. of Homeland Security. Coast Guard. 2010c. *Deepwater Horizon* response daily report, period 175. October 12, 2010. Coast Guard Unified Area Command.

U.S. Dept. of Homeland Security. Federal Emergency Management Agency. 2008. Hurricane Ike preliminary recovery assessment. Internet website: http://www.fema.gov/pdf/hazard/hurricane/2008/ike/impact_report.pdf.

U.S. Dept. of Labor. Bureau of Labor Statistics. 2010a. Quarterly census of employment and wages for 2001-2009. Internet website: http://www.bls.gov/cew/. Accessed December 1, 2010.

U.S. Dept. of Labor. Bureau of Labor Statistics. 2010b. Fact sheet: Employment in the oil and gas well drilling industry. Internet website: http://www.bls.gov/cew/oil_gas_drilling.htm. Accessed July 1, 2010.

U.S. Dept. of Labor. Occupational Safety and Health Administration. 2010. Keeping workers safe during oil spill response and cleanup operations: Gulf oil response and heat. Internet website: http://www.osha.gov/oilspills/heatstress.html. Accessed January 12, 2011.

U.S. Dept. of the Army. Corps of Engineers. 1992. Planning assistance to States program, Section 22 report, inlets along the Texas Gulf Coast. Galveston District, Southwestern Division, August 1992. 56 pp. Internet website: http://cirp.usace.army.mil/pubs/archive/Inlets_Along_TX_Gulf_Coast.pdf.

U.S. Dept. of the Army. Corps of Engineers. 2002. Diamondback terrapin (*Malaclemys terrapin* (spp)). Internet website: http://el.erdc.usace.army.mil/tessp/profile.cfm?Type=Freshwater%20Turtles&Name=Diamondback%20Terrapin&View=Species. Accessed October 18, 2010.

U.S. Dept. of the Army. Corps of Engineers. 2004a. Louisiana coastal area (LCA): Ecosystem restoration study. Volume I, LCA Study—main report. U.S. Dept. of the Army, Corps of Engineers, New Orleans District, New Orleans, LA. Internet website: http://www.lca.gov/Library/ProductList.aspx?ProdType=0&folder=1125. Accessed March 18, 2011.

U.S. Dept. of the Army. Corps of Engineers. 2004b. Barataria-Plaquemines barrier island complex project CWPPRA project Fed No/BA-38 Pass La Mer to Chaland Pass and Pelican Island: Environmental assessment. New Orleans District, New Orleans, LA. 89 pp. + apps. Internet website: http://lacoast.gov/reports/env/BA-38ea304.pdf.

U.S. Dept. of the Army. Corps of Engineers. 2008. Maintenance dredging and disposal of dredged materials Mississippi and Louisiana portions of the Gulf Intracoastal Waterway federally authorized navigation project: Draft environmental assessment, January 2008. Mobile District Office, Mobile, AL. 232 pp. Internet website: http://www.sam.usace.army.mil/pd/EAs/GIWW_DRAFTEAforPUBLIC(2)jj.pdf

U.S. Dept. of the Army. Corps of Engineers, 2009a. Louisiana coastal protection and restoration (LACPR): Final technical report. Programmatic cumulative effects analysis appendix. U.S. Dept. of the Army, Corps of Engineers, New Orleans District, Mississippi Valley Division. 49 pp. with annexes. Internet website: http://lacpr.usace.army.mil/FinalReport/Vol%20IV/Programmatic%20Cumulative%20Effects%20Analysis.pdf.

U.S. Dept. of the Army. Corps of Engineers. 2009b. Louisiana coastal protection and restoration (LACPR): Final technical report. U.S. Dept. of the Army, Corps of Engineers, New Orleans District, Mississippi Valley Division. 265 pp. with attachments. Internet website: http://lacpr.usace.army.mil/default.aspx?p=LACPR_Final_Technical_Report.

U.S. Dept. of the Army. Corps of Engineers. 2009c. Corps hurricane response. Task Force Hope Status Report Newsletter. December 14, 2009. 8 pp. Internet website: http://www.mvn.usace.army.mil/hps2/pdf/Dec_14_2009.pdf.

U.S. Dept. of the Army. Corps of Engineers. 2010. Draft supplemental environmental assessment for the beach erosion control and storm damage reduction project, Panama City Beach, Bay County. Mobile District, Planning and Environmental Division, Environmental Resources Branch, Coastal Environment Team. 27 pp.

U.S. Dept. of the Army. Corps of Engineers. 2011a. Amount of dredged material ocean disposed by year in cubic yards by single district. Internet website: http://el.erdc.usace.army.mil/odd/. Stated as current through 2008. Accessed January 27, 2011.

U.S. Dept. of the Army. Corps of Engineers. 2011b. United States of America ocean dumping report for calendar year 2008 dredged material. Headquarters, Washington DC. Internet website: http://el.erdc.usace.army.mil/odd/file.htm. Stated as current through 2008. Accessed January 27, 2011.

U.S. Dept. of the Interior. 2010. Increased safety measures for energy development on the outer continental shelf, May 27, 2010. U.S. Dept. of the Interior, Washington, DC. 44 pp. Internet website: http://www.doi.gov/deepwaterhorizon/loader.cfm?csModule=security/getfile&PageID=33598.

U.S. Dept. of the Interior. Bureau of Land Management. 1982. *Ixtoc I* oil spill economic impact study. U.S. Dept. of the Interior, Bureau of Land Management, New Orleans OCS Office, New Orleans, LA. Study no. 1982-33.

U.S. Dept. of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement. 2010a. Modifications to suspension of deepwater drilling operations: Environmental assessment and finding of no significant impact (October 12, 2010). U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Herndon, VA. 43 pp. Internet website: http://www.boemre.gov/eppd/PDF/EAModificationsSuspension10122010.pdf.

U.S. Dept. of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement. 2010b. Fact sheet: The workplace safety rule on safety and environmental management systems (SEMS). U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA. 2 pp. Internet website: http://www.doi.gov/news/pressreleases/loader.cfm?csModule=security/getfile&PageID=45791.

U.S. Dept. of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement. 2010c. Technical Information Management System (TIMS). Accessed September 13, 2010.

U.S. Dept. of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement. 2010d. BOEMRE issues guidance for deepwater drillers to comply with strengthened safety and environmental standards. Press Release and Document. December 13, 2010. 18 pp. Internet website: http://www.boemre.gov/ooc/press/2010/press1213.htm. Accessed December 27, 2010.

U.S. Dept. of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement. 2010e. Loss of well control—statistics and summaries 2006-2010. Internet website: http://www.boemre.gov/incidents/blowouts.htm. Updated November 19, 2010. Accessed December 15, 2010.

U.S. Dept. of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement. 2010f. BOEMRE website incident statistics and summaries 1996-2010. Internet website: http://www.boemre.gov/incidents/IncidentStatisticsSummaries.htm. Specifically accessed the page Gulf of Mexico Region Spills ≥ 50 Barrels (2,100 gallons)—2007: http://www.boemre.gov/incidents/SigPoll2007.htm. Accessed November 11, 2010.

U.S. Dept. of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement. 2010g. BOEMRE website incident statistics and summaries 1996-2010. Internet websites: http://www.boemre.gov/incidents/IncidentStatisticsSummaries.htm. Specifically accessed the page Gulf of Mexico Region Spills ≥ 50 Barrels (2,100 gallons)—2008: http://www.boemre.gov/incidents/SigPoll2008.htm. Accessed November 30, 2010.

U.S. Dept. of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement. 2010h. Questions, answers, and related resources. Internet website: http://www.gomr.boemre.gov/homepg/offshore/egom/faq.html. Accessed October 5, 2010.

U.S. Dept. of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement. 2010i. Summary OCS spills of 50 barrels (2,100 gallons) and greater, calendar year 1964-2009. Internet website: http://www.boemre.gov/incidents/spills1964-1995.htm. Accessed November 24, 2010.

U.S. Dept. of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement. 2010j. Federal and academic scientists return from deep-sea research cruise in Gulf of Mexico: Scientists observe damage to deep-sea corals. Press Release. November 4, 2010. Internet website: http://www.boemre.gov/ooc/press/2010/press1104a.htm. Accessed November 24, 2010.

U.S. Dept. of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement. 2011. Combined leasing report: June 1, 2011. Internet website: http://www.boemre.gov/ld/PDFs/LeaseStatsJune2011.pdf. Accessed July 5, 2011.

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

U.S. Dept. of the Interior. Fish and Wildlife Service. 2003. Recovery plan for the Great Lakes, piping plover (*Charadrius melodious*). U.S. Dept. of the Interior, Fish and Wildlife Service, Great Lakes – Big Rivers Region. 141 pp.

U.S. Dept. of the Interior. Fish and Wildlife Service. 2007. Endangered Species Act Section 7 consultation on the effects of the five-year outer continental shelf oil and gas leasing program (2007-2012) in the Central and Western Planning Areas of the Gulf of Mexico. Biological Opinion. September 14.

U.S. Dept. of the Interior. Fish and Wildlife Service. 2010. Species report. Chapter 4. Internet website: http://ecos.fws.gov/tess_public/SpeciesReport.do. Accessed on August 30, 2010.

U.S. Dept. of the Interior. Fish and Wildlife Service. 2011. Deepwater Horizon bird impact data from the DOI-ERDC NRDA database 12 May 2011. 6 pp. Internet website: http://www.fws.gov/home/dhoilspill/pdfs/Bird%20Data%20Species%20Spreadsheet%2005122011.pdf. Accessed July 11, 2011.

U.S. Dept. of the Interior. Fish and Wildlife Service and U.S. Dept. of Commerce, Census Bureau. 2006. 2006 national survey of fishing, hunting, and wildlife-associated recreation. FHW/06-NAT. 174 pp.

U.S. Dept. of the Interior. Geological Survey. 1988. Report to Congress: Coastal barrier resource system. Recommendations for additions to or deletions from the Coastal Barrier Resource System. Vol. 18, Louisiana.

U.S. Dept. of the Interior. Geological Survey. 2010a. Summary of the water cycle. Internet website: http://ga.water.usgs.gov/edu/watercyclesummary.html. Accessed October 4, 2010.

U.S. Dept. of the Interior. Geological Survey. 2010b. NAS—nonindigenous aquatic species. *Pterois volitans/miles*. Internet website: http://nas.er.usgs.gov/queries/collectioninfo.aspx?NoCache=8%2F11%2F2009+10%3A53%3A53+AM&SpeciesID=963&State=&County=&HUCNumber=. Accessed October 18, 2010.

U.S. Dept. of the Interior. Minerals Management Service. 1984. Port Arthur and Bouma Bank quads, sheets I-VIII. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Map MMS 84-0003.

U.S. Dept. of the Interior. Minerals Management Service. 1987. Programmatic environmental assessment: Structure removal activities, Central and Western Gulf of Mexico Planning Areas. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 87-0002. 84 pp.

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

U.S. Dept. of the Interior. Minerals Management Service. 2000. Gulf of Mexico deepwater operations and activities: Environmental assessment. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2000-001. 264 pp. Internet website: http://www.gomr.boemre.gov/PDFs/2000/2000-001.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2001a. Proposed use of floating production, storage, and offloading systems on the Gulf of Mexico outer continental shelf, Western and Central Planning Areas—final environmental impact statement. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2000-090. 782 pp. Internet website: http://www.gomr.boemre.gov/PDFs/2000/2000-090.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2001b. Outer continental shelf oil & gas leasing program: 2002-2007—draft environmental impact statement, October 2001. 2 vols. U.S. Dept. of the Interior, Minerals Management Service, Herndon, VA. OCS EIS/EA MMS 2001-079.

U.S. Dept. of the Interior. Minerals Management Service. 2002. Gulf of Mexico OCS oil and gas lease sales: 2003-2007; Central Planning Area Sales 185, 190, 194, 198, and 201; Western Planning Area Sales 187, 192, 196, and 200—draft environmental impact statement. 2 vols. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2002-015.

U.S. Dept. of the Interior. Minerals Management Service. 2005. Structure-removal operations on the Gulf of Mexico outer continental shelf—programmatic environmental assessment. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2005-013.

U.S. Dept. of Interior. Minerals Management Service. 2006a. Planning area resources addendum to assessment of undiscovered technically recoverable oil and gas resources of the Nation's outer continental shelf, 2006. MMS Fact Sheet RED-2006-02, July 2006. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico Region, New Orleans, LA. 2 pp. Internet website: http://www.boemre.gov/revaldiv/PDFs/NA2006BrochurePlanningAreaInsert.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2006b. Deepwater Gulf of Mexico 2006: America's expanding frontier. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 2006-022. 144 pp. Internet website: http://www.gomr.boemre.gov/homepg/whatsnew/techann/2006/2006-022.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2007a. Outer continental shelf oil and gas leasing program: 2007-2012—final environmental impact statement. Volumes I-II. U.S. Dept. of the Interior, Minerals Management Service, Washington, DC. OCS EIS/EA MMS 2007-003. Internet website: http://www.BOEMRE.gov/5-year/PDFs/MMSProposedFinalProgram2007-2012.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2007b. Gulf of Mexico OCS oil and gas lease sales: 2007-2012; Western Planning Area Sales 204, 207, 210, 215, and 218; Central Planning Area Sales 205, 206, 208, 213, 216, and 222—final environmental impact statement. 2 vols. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2007-018. Internet website: http://www.gomr.BOEMRE.gov/PDFs/2007/2007-018-Vol1.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2007c. Proposed final program: Outer continental shelf oil and gas leasing program, 2007-2012 (April 2007). U.S. Dept. of the Interior, Minerals Management Service, Herndon, VA. 146 pp. Internet website: http://www.boemre.gov/5-year/PDFs/MMSProposedFinalProgram2007-2012.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2007d. Gulf of Mexico OCS oil and gas scenario examination: Pipeline landfalls. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 2007-053. 8 pp. Internet website: http://www.gomr.mms.gov/PDFs/2007/2007-053.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2007e. Final programmatic environmental impact statement for alternative energy development and production and alternate use of facilities on the outer continental shelf. U.S. Dept. of the Interior, Minerals Management Service, Herndon, VA. OCS EIS/EA 2007-046.

U.S. Dept. of the Interior. Minerals Management Service. 2007f. NTL No. 2007-G03: Marine trash and debris awareness and elimination. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. Internet website: http://www.gomr.boemre.gov/homepg/regulate/regs/ntls/2007NTLs/07-g03.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2007g. Gulf of Mexico OCS oil and gas scenario examination: Exploration and development activity. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 2007-052. 14 pp.

U.S. Dept. of the Interior. Minerals Management Service. 2008a. Gulf of Mexico OCS oil and gas lease sales: 2009-2012; Central Planning Area Sales 208, 213, 216, and 222; Western Planning Area Sales 210, 215, and 218—final supplemental environmental impact statement. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2008-041.

U.S. Dept. of the Interior. Minerals Management Service. 2008b. Preliminary evaluation of in-place gas hydrate resources: Gulf of Mexico outer continental shelf. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 2008-004. Internet website: http://www.mms.gov/revaldiv/GasHydrateFiles/MMS2008-004.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2008c. NTL No. 2008-G05: Shallow hazards program. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. Internet website: http://www.gomr.boemre.gov/homepg/regulate/regs/ntls/2008NTLs/08-g05.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2009a. Petroleum spills from Federal outer continental shelf oil and gas facilities caused by major hurricanes, 2002 to 2008: Lili (2002), Ivan (2004), Katrina (2005), Rita (2005), Gustav (2008) and Ike (2008). September 24, 2009. Internet website: http://www.boemre.gov/incidents/PDFs/Hurricanes2002to2008.pdf. Accessed March 18, 2011.

U.S. Dept. of the Interior. Minerals Management Service. 2009b. NTL No. 2009-G39: Biologically-sensitive underwater features and areas. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. Internet website: http://www.gomr.boemre.gov/homepg/regulate/regs/ntls/2009NTLs/09-G39.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2009c. NTL No. 2009-G40: Deepwater benthic communities. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. Internet website: http://www.gomr.boemre.gov/homepg/regulate/regs/ntls/2009NTLs/09-G40.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2009d. Rigs to reefs policy addendum: Enhanced reviewing and approval guidelines in response to the post-Hurricane Katrina regulatory environment. Related document, OCS Report MMS 2000-073. Internet website: http://www.gomr.boemre.gov/homepg/regulate/environ/rigs-to-reefs/Rigs-to-Reefs-Policy-Addendum.pdf.

U.S. Dept. of the Interior. Minerals Management Service. 2009e. NTL 2009-G35: Sub-seabed disposal and offshore storage of solid wastes. Internet website: http://www.gomr.boemre.gov/homepg/regulate/regs/ntls/2009NTLs/09-G35.pdf.

U.S. Dept. of the Interior. National Park Service. 2005. November 2005 archeology e-gram. Internet website: http://www.nps.gov/archeology/pubs/egrams/0511.pdf. Accessed July 20, 2010.

U.S. Dept. of the Interior. National Park Service. 2008. Padre Island National Seashore: The 2008 sea turtle nesting season. Internet website: http://www.nps.gov/pais/naturescience/2008-season.htm. Accessed February 16, 2011.

U.S. Dept. of the Interior. National Park Service. 2009. Sea turtle recovery project (turtle nesting). Internet website: http://www.nps.gov/pais/naturescience/strp.htm. Accessed February 18, 2011.

U.S. Dept. of the Interior. National Park Service. 2010. Padre Island National Seashore: Current sea turtle nesting season; sea turtle nesting in Texas. Internet website: http://www.nps.gov/pais/naturescience/current-season.htm. Accessed February 16, 2011.

U.S. Dept. of the Interior. National Park Service. 2011. Padre Island National Seashore: Sea turtle recovery project; international efforts to save Kemp's ridley. Internet website: http://www.nps.gov/pais/naturescience/strp.htm. Accessed February 16, 2011.

U.S. Dept. of the Interior. Office of Public Affairs. 2010a. Salazar calls for new safety measures for offshore oil and gas operations; orders six month moratorium on deepwater drilling. May 27, 2010. Internet website: http://www.boemre.gov/ooc/press/2010/press0527.htm. Accessed November 16, 2010.

U.S. Dept. of the Interior. Office of Public Affairs. 2010b. Readout of BOEMRE Director Bromwich's meeting with shallow water drilling coalition. September 14, 2010. Internet website: http://www.boemre.gov/ooc/press/2010/press0914.htm. Accessed November 16, 2010.

U.S. Dept. of Transportation. 2010. Gulf Coast ports surrounding the deepwater horizon oil spill. June 2010. Research and Innovative Technology Administration. Internet website: http://www.bts.gov/publications/bts_fact_sheets/2010_001/pdf/entire.pdf. Accessed August 31, 2010.

U.S. Dept. of Transportation. Coast Guard. 2003. Final environmental impact statement for the Port Pelican LLC deepwater port license application. Commandant, U.S. Dept. of Transportation, Coast Guard, Washington, DC.

U.S. Dept. of Transportation. Federal Highway Administration. 2004. Louisiana 1 improvements: Golden Meadow to Port Fourchon. Revised Record of Decision. Internet website: http://www.dotd.state.la.us/press/LA1_ROD_Addm.pdf. Accessed November 19, 2010.

U.S. Dept. of Transportation. National Transportation Safety Board. 1998. Safety recommendation M-98-124. Internet website: http://www.ntsb.gov/Recs/letters/1998/M98_124.pdf. Accessed October 2003.

U.S. Dept. of Transportation. Maritime Administration (MARAD). 2009. Vessel calls snapshot, 2009. 10 pp. Internet website: http://www.marad.dot.gov/documents/Vessel_Calls_at_US_Ports_Snapshot.pdf.

U.S. Dept. of Transportation. Maritime Administration (MARAD). 2010. Deepwater port licensing program: Pending applications. Internet website: http://www.marad.dot.gov/ports_landing_page/deepwater_port_licensing/dwp_planned_ports/dwp_planned_ports.htm. Accessed September 30, 2010.

U.S. Dept. of Transportation. Maritime Administration (MARAD). 2011. Cruise summary tables: North American cruises by departure port. Internet website: http://www.marad.dot.gov/documents/north_america_cruise_summary_data.xls. Accessed July 8, 2011.

U.S. Environmental Protection Agency. 2000. Sector notebook project: Oil and gas extraction. 51 pp. Internet website: http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/oilgaspt1.pdf.

U.S. Environmental Protection Agency. 2001. Coastal condition report. EPA-620/R-01/005. Internet website: http://www.epa.gov/owow/oceans/nccr/downloads.html. Accessed August 24, 2009.

U.S. Environmental Protection Agency. 2002. Exemption of oil and gas exploration and production wastes from federal hazardous waste regulations. U.S. Environmental Protection Agency, Office of Solid Wastes, Washington, DC. EPA530-K-01-004. 40 pp. Internet website: http://www.epa.gov/osw/nonhaz/industrial/special/oil/oil-gas.pdf.

U.S. Environmental Protection Agency. 2004. Final NPDES general permit for new and existing sources and new dischargers in the offshore subcategory of the oil and gas extraction category for the western portion of the outer continental shelf of the Gulf of Mexico (GMG290000). U.S. Environmental Protection Agency. 117 pp. Internet website: http://www.epa.gov/region6/water/npdes/genpermit/gmg290000finalpermit2004.pdf.

U.S. Environmental Protection Agency. 2005. Coastal condition report II. EPA-620/R-03/002. Internet website: http://www.epa.gov/owow/oceans/nccr/2005/downloads.html/. Accessed August 24, 2009.

U.S. Environmental Protection Agency. 2006. Natural gas processing: The crucial link between natural gas production and its transportation to market. 11 pp. Internet website: http://www.eia.doe.gov/pub/oil_gas/natural_gas/feature_articles/2006/ngprocess/ngprocess.pdf.

U.S. Environmental Protection Agency. 2007a. Region 6 compliance assurance and enforcement, offshore and oil and gas NPDES permits. Internet website: http://www.epa.gov/earth1r6/6en/w/offshore/home.htm. Accessed November 26, 2010.

U.S. Environmental Protection Agency. 2007b. National Estuary Program coastal condition report. U.S. Environmental Protection Agency, Office of Water, Office of Research and Development, Washington DC. EPA-842/B-06/001. Internet website: Accessed February 1, 2008.

U.S. Environmental Protection Agency. 2007c. USEPA Region 6 NPDES OCS general permit no. GMG290000. Internet website: http://www.epa.gov/earth1r6/6en/w/offshore/permit10012007.pdf. Accessed April 28, 2009.

U.S. Environmental Protection Agency. 2007d. NPDES general permit for new and existing sources and new dischargers in the offshore subcategory of the oil and gas extraction category for the western portion of the outer continental shelf of the Gulf of Mexico (GMG290000). U.S. Environmental

Protection Agency. 15 pp. Internet website: http://www.epa.gov/Region06/water/npdes/genpermit/gmg290000fedreg.pdf.

U.S. Environmental Protection Agency. 2008a. Coastal condition report III. EPA/842-R-08-002. Internet website: http://www.epa.gov/nccr/. Accessed February 27, 2009.

U.S. Environmental Protection Agency. 2008b. National Pollutant Discharge Elimination System (NPDES), vessel discharges, final vessel general permit. 5 pp. Internet website: http://cfpub.epa.gov/npdes/home.cfm?program_id=350. Updated December 15, 2008. Accessed April 20, 2009.

U.S. Environmental Protection Agency. 2008c. National list of beaches. Report number EPA-R-08-004.

U.S. Environmental Protection Agency. 2009. Region 4 environmental assessment for the National Pollutant Discharge Elimination System permitting for eastern Gulf of Mexico offshore oil and gas exploration, development and production. Permit 904/P-09-001. 129 pp. Internet website: http://www.epa.gov/region04/water/permits/documents/ea_12_09_09.pdf.

U.S. Environmental Protection Agency. 2010a. Ozone standards, counties violating primary ground-level ozone standard (also see maps), 2006-2008. Internet website: http://www.epa.gov/groundlevelozone/actions.html. Accessed October 5, 2010.

U.S. Environmental Protection Agency. 2010b. Region 4 air permits. Internet website: http://www.epa.gov/region4/air/permits/index.htm. Accessed November 2010.

U.S. Environmental Protection Agency. 2010c. Greenhouse gas reporting program. Internet website: http://www.epa.gov/climatechange/emissions/ghgrulemaking.html. Accessed February 1, 2011.

U.S. Environmental Protection Agency. 2010d. Particulate matter. Internet website: http://www.epa.gov/pm/. Accessed December 2, 2010.

U.S. Environmental Protection Agency. 2010e. Dispersants. Internet website: http://www.epa.gov/bpspill/dispersants-bp.html. Accessed July 9, 2010.

U.S. Environmental Protection Agency. 2010f. Recovered oil, contaminated materials and liquid and solid wastes management directive, Louisiana, June 29, 2010. Internet website: http://www.epa.gov/bpspill/waste/wastemanagementdirective_la.pdf. Accessed August 31, 2010.

U.S. Environmental Protection Agency. 2010g. Recovered oil, contaminated materials and liquid and solid wastes management directive, Mississippi, Alabama, Florida, June 29, 2010. Internet website: http://www.epa.gov/bpspill/waste/wastemanagementdirective_msalfl.pdf. Accessed August 31, 2010.

U.S. Environmental Protection Agency. 2010h. Waste staging and decontamination areas in Alabama, Florida, Louisiana and Mississippi, June 28-October 4. Internet website: http://www.epa.gov/bpspill/data/waste_facility_assessments.pdf. Accessed October 10, 2010.

U.S. Environmental Protection Agency. 2010i. Dispersants toxicity testing – Phase II questions and answers; August 2, 2010. Internet website: http://www.epa.gov/bpspill/dispersants/qanda-phase2.pdf. Accessed January 4, 2011.

U.S. Environmental Protection Agency. 2011a. 8-hour ozone nonattainment area/state/county report. Internet website: http://www.epa.gov/oaqps001/greenbk/gnca.html. Accessed April 2011.

U.S. Environmental Protection Agency. 2011b. General conformity: Regulatory actions. Internet website: http://www.epa.gov/air/genconform/regs.html. Accessed June 12, 2011.

U.S. Environmental Protection Agency and U.S. Dept. of Army, Corps of Engineers. 2003. Ocean Dredged Material Disposal Program: Regional implementation agreement. USEPA Region 6, USACOE Galveston District, USACOE New Orleans District. July 2003. Internet website: http://www.epa.gov/region6/water/ecopro/em/ocean/ria.pdf.

U.S. Government Accountability Office. 2007. Coastal wetlands: Lessons learned from past efforts in Louisiana could help guide future restoration and protection. Government Accountability Office, Washington DC. GAO 08-130. 62 pp. Internet website: http://www.gao.gov/new.items/d08130.pdf.

U.S. House of Representatives. Committee on Energy and Commerce. Subcommittee on Commerce, Trade, and Consumer Protection. 2010. The BP oil spill and the Gulf Coast tourism: Assessing the impact. Internet website: https://hsdl.org/?view&doc=126706&coll=limited.

U.S. Travel Association. 2010. Economic impact of travel and tourism. The Power of Travel Data Center. Internet website: http://poweroftravel.org/statistics.

Valentine, J. 2010. Official communication. Media reports of fisheries closures offsetting population losses from the spill. Senior Marine Scientist & Associate Professor, Dauphin Island Sea Lab and University of South Alabama. November 18, 2010.

Van Zandt, S., W.G. Peacock, D. Henry, H. Grover, and W.E. Highfield. 2010. Social vulnerability and Hurricane Ike: Using social vulnerability mapping to enhance coastal community resilience in Texas. Special permission via email correspondence working paper from the Hazard Reduction & Recovery Center, Texas A&M University.

Vandermuelen, J.H. 1982. Some conclusions regarding long-term effects of some major oil spills. Philosophical Transactions of the Royal Society of London. Series B, Biological Communities and Ecosystems 297(1087):335-351.

Vandegrift, K.J., S.H. Sokolow, P. Daszak, and A.M. Kilpatrick. 2010. Ecology of avian influenza viruses in a changing world. Annals of the New York Academy of Sciences 1195:113-128.

Vashcenko, M.A. 1980. Effects of oil pollution on the development of sex cells in sea urchins. Biologische Anstalt Helgoland 297-300.

Veil, J.A., M.G. Puder, D. Elcock, and R.J. Redweik, Jr. 2004. A white paper describing produced water from production of crude oil, natural gas, and coal bed methane. Prepared by Argonne National Laboratory, Argonne, IL, for the U.S. Department of Energy, National Energy Technology Laboratory, Contract W-31-109-Eng-38. 79 pp. Internet website: http://www.ead.anl.gov/pub/dsp_detail.cfm?PubID=1715.

Velando, A., D. Alvarez, J. Mourino, F. Arcos, and A. Barros. 2005a. Population trends and reproductive success of the European shag *Phalacrocorax aristotelis* on the Iberian Peninsula following the *Prestige* oil spill. Journal of Ornithology 146:116-120.

Velando, A., I. Munilla, and P.M. Leyenda. 2005b. Short-term indirect effects of the 'Prestige' oil spill on European shags: Changes in availability of prey. Marine Ecology Progress Series 302:263-274.

Visser, J.M. and G.W. Peterson. 1994. Breeding populations and colony site dynamics of seabirds nesting in Louisiana. Colonial Waterbirds 17:146-152.

Vittor, B.A. 2000. Benthic macroinfauna of the northeastern Gulf of Mexico OCS, near DeSoto Canyon. In: Schroeder, W.W. and C.F. Wood, eds. Physical/Biological Oceanographic Integration Workshop for the DeSoto Canyon and Adjacent Shelf, October 19-21, 1999. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-074. 168 pp.

Wallace, B., J. Kirkley, T. McGuire, D. Austin, and D. Goldfield. 2001. Assessment of historical, social, and economic impacts of OCS development on Gulf Coast communities. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2001-026. 12 pp.

Wang, F.C. 1987. Effects of levee extension on marsh flooding. Journal of Water Resources Planning and Management 113:161-176.

Wang, F.C. 1988. Saltwater intrusion modeling: The role of man-made features. In: Turner, R.E. and D.R. Cahoon, eds. Causes of wetland loss in the coastal central Gulf of Mexico. Volume 2.

U.S. Dept. of the Interior, Minerals Management Service, New Orleans, LA. OCS Study MMS 87-0120. Pp. 71-100.

Wang, P. and T. Roberts. 2010. Ongoing beach cleanup of the BP oil spill—a superficial job, literally. University of South Florida, Dept. of Geology, Coastal Research Laboratory, Tampa, FL.. 15 pp. Internet website: http://news.usf.edu/article/articlefiles/2566-PW%202nd%20Beach%20report.pdf.

Wang, D.W., S.A. Mitchell, W.J. Teague, E. Jarosz, and M.S. Hulbert. 2005. Extreme waves under Hurricane Ivan. Science 3009:896.

Ward, G.A., B. Baca, W. Cyriacks, R.E. Dodge, and A. Knap. 2003. Continuing long-term studies of the TROPICS Panama oil and dispersed oil spill sites. In: Proceedings of the 2003 International Oil Spill Conference, April 2-10, 2003, Vancouver, British Columbia.

Warham, J. 1990. The petrels: Their ecology and breeding systems. San Diego, CA: Academic Press. 440 pp.

Waring, G.T., E. Josephson, K. Maze-Foley, and P.E. Rosel, eds. 2010. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments – 2011. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-NE-219. 598 pp.

Wartzok, D. and D.R. Ketten. 1999. Marine mammal sensory systems. In: Reynolds, J.E. and S.A. Rommel, eds. Biology of marine mammals. Washington, DC: Smithsonian Institution Press. Pp. 117-175.

Waters, M.R., S.L. Forman, T.A. Jennings, L.C. Nordt, S.G. Driese, J.M. Feinberg, J.L. Keene, J. Halligan, A. Lindquist, J. Pierson, C.T. Hallmark, M.B. Collins, and J.E. Wiederhold. 2011. The Buttermilk Creek Complex and the origins of Clovis at the Debra L. Friedkin Site, Texas. Science 331:1599-1603.

Weatherly, G. 2004. Intermediate depth circulation in the Gulf of Mexico: PALACE float results for the Gulf of Mexico between April 1998 and March 2002. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OSC Region, New Orleans, LA. OCS Study MMS-2004-013. 51 pp.

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

Webb, T. 2010. BP oil spill: Failed safety device on *Deepwater Horizon* rig was modified in China. *The Observer*. Internet website: http://www.guardian.co.uk/environment/2010/jul/18/deepwater-horizon-blow-out-preventer-china. Posted July 18, 2010. Accessed September 22, 2010.

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

Webb, J.W., S.K. Alexander, and J.K. Winters. 1985. Effects of autumn application of oil on *Spartina alterniflora* in a Texas salt marsh. Environ. Poll. Series A. 38(4):321-337.

Weinstein, B.L. 2010. The economic and fiscal consequences of the drop in shallow-water drilling permits: Impacts on the Gulf Coast and the Nation. Southern Methodist University, Maguire Energy Institute, Cox School of Business. September 2010. Internet website: http://pressdocs.cox.smu.edu/maguire/Maguire%20Institute%20Shallow%20Water%20Report%209-10.pdf. Accessed November 28, 2010.

Weir, R.D. 1976. Annotated bibliography of bird kills at man-made obstacles: A review of the state of the art and solutions. Canadian Wildlife Service, Ottawa.

Welsh, S.E., M. Inoue, L.J. Rouse, Jr., and E. Weeks. 2009. Observation of the deepwater manifestation of the Loop Current and Loop Current rings in the eastern Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2009-050. 110 pp.

Wells, R.J.D. and J.R. Rooker. 2004. Spatial and temporal habitat use by fishes associated with Sargassum mats in the NW Gulf of Mexico. Bulletin of Marine Science 74:81-99

Wesseling, I., A.J. Uychiacoc, P.M. Aliño, T. Aurin, and J.E. Vermaat. 1999. Damage and recovery of four Philippine corals from short-term sediment burial. Marine Ecology Progress Series 176:11-15.

West Engineering Services, Inc. 2002. Mini shear study. Prepared for the U.S. Dept. of the Interior, Minerals Management Service. TAR Project 455. 16 pp. Internet website: http://www.boemre.gov/tarprojects/455/Final%20Report.pdf.

West Engineering Services, Inc. 2004. Shear ram capability study. Prepared for the U.S. Dept. of the Interior, Minerals Management Service. TAR Project 463. Internet website: http://www.boemre.gov/tarprojects/463/(463)%20West%20Engineering%20Final%20Report.pdf

West Engineering Services, Inc. 2006. Assess the acceptability and safety of using equipment, particularly BOP and wellhead components, at pressures in excess of rated working pressure. Prepared for the U.S. Dept. of the Interior, Minerals Management Service. TAR Project 566. 56 pp. Internet website: http://www.boemre.gov/tarprojects/566/566AA.pdf.

Wheeler, N.M., S.B. Reid, K.J. Craig, J.R. Zielonka, D.R. Stauffer, and S.R. Hanna. 2008. Cumulative increment analysis for the Breton National Wilderness Area. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2008-058.

White, I.C. and J.M. Baker. 1999. The *Sea Empress* oil spill in context. International Conference on the *Sea Empress* Oil Spill, 11-13th February 1998, Cardiff, Wales. 33 pp. Internet website: http://www.itopf.com/uploads/seeec.pdf.

White, W.A., T.R. Calnan, R.A. Morton, R.S. Kimble, T.G. Littleton, J.H. McGowen, H.S. Nance, and K.E. Schmedes. 1986. Submerged lands of Texas, Brownsville-Harlingen area. University of Texas at Austin, Bureau of Economic Geology, Austin, TX.

Whittle, K.J., R. Hardy, P.R. Mackie, and A.S. McGill. 1982. A quantitative assessment of the sources and fate of petroleum compounds in the marine environment. Philosophical Transactions of the Royal Society of London. B. 297:193-218.

Wicker, K.M., R.E. Emmer, D. Roberts, and J. van Beek. 1989. Pipelines, navigation channels, and facilities in sensitive coastal habitats: An analysis of Outer Continental Shelf impacts, Coastal Gulf of Mexico. Volume I: Technical narrative. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 89-0051. 470 pp.

Wiese, F.K., W.A. Montevecchi, G.K. Davoren, F. Huettmann, A.W. Diamond, and J. Linke. 2001. Seabirds at risk around offshore oil platforms in the north-west Atlantic. Marine Pollution Bulletin 42:1285-1290.

WikiHow. 2010. The how to manual. How to calculate the distance to the horizon. Internet website. http://www.wikihow.com/Calculate-the-Distance-to-the-Horizon. Updated September 29, 2010. Accessed December 30, 2010.

Wilber, D.H., W. Brostoff, D.G. Clarke, and G.L. Ray. 2005. Sedimentation: Potential biological effects from dredging operations in estuarine and marine environments. DOER Technical Notes Collection. ERDC TN-DOER-E20. U.S. Dept. of the Army, Engineer Research and Development Center, Vicksburg, MS.

Wilber, D.H., G.L. Ray, D.G. Clarke, and R.J. Diaz. 2008. Responses of benthic infauna to large-scale sediment disturbance in Corpus Christi Bay, Texas. Journal of Experimental Marine Biology and Ecology 365:13-22.

Wilhelm, S.I., G.J. Robertson, P.C. Ryan, and D.C. Schneider. 2007. Comparing an estimate of seabirds at risk to a mortality estimate from the November 2004 *Terra Nova* FPSO oil spill. Marine Pollution Bulletin 54:537-544.

Williams, R., S. Gero, L. Bejder, J. Calambokidis, S. Kraus, D. Lusseau, A. Read, and J. Robbins. 2011. Underestimating the damage: Interpreting cetacean carcass recoveries in the context of the *Deepwater Horizon*/BP Incident. Conservation Letters 0:1-6, doi:10.1111/j.1755-263x2011.00168x.

Wilson, D.L., J.N. Fanjoy, and R.S. Billings. 2004. Gulfwide emission inventory study for the regional haze and ozone modeling efforts: Final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study 2004-072. 273 pp.

Wilson, D.L., R. Billings, R. Oommen, and R. Chang. 2007. Year 2005 Gulfwide emission inventory study. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2007-067. 149 pp.

Wilson, D.L., R. Billings, R. Oommen, B. Lange, J. Marik, S. Mcclutchey, and H. Perez. In press. Year 2008 Gulfwide emission inventory study. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEMRE 2010-045.

Winge, O. 1923. The Sargasso Sea, its boundaries and vegetation. Rep. Dan. Oceanog. Expd, 1908-1910. 3 Misc. Pap. 2:1-34

Wolfe, S.H., J.A. Reidenauer, and D.B. Means. 1988. An ecological characterization of the Florida Panhandle. U.S. Dept. of the Interior, Fish and Wildlife Service Biological Report 88(12) and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 88-0063. 278 pp.

Woods & Poole Economics, Inc. 2006. The 2006 complete economic and demographic data source (CEDDS) on CD-ROM.

Woods & Poole Economics, Inc. 2010. The 2011 complete economic and demographic data source (CEDDS) on CD-ROM.

Wright, D.G. and G.E. Hopky. 1998. Guidelines for the use of explosives in or near Canadian fisheries waters. Canadian Technical Report of Fisheries and Aquatic Sciences 2107.

Wu, S.-Y., B. Yarnal, and A. Fisher. 2002. Vulnerability of coastal communities to sea-level rise: A case study of Cape May County, New Jersey. Climate Research 22:255–270.

Würsig, B., T.A. Jefferson, and D.J. Schmidly. 2000. The marine mammals of the Gulf of Mexico. College Station: Texas A&M University Press. 232 pp.

Wyers, S.C., H.R. Frith, R.E. Dodge, S.R. Smith, A.H. Knap, and T.D. Sleeter. 1986. Behavioral effects of chemically dispersed oil and subsequent recovery in *Diploria strigosa*. Marine Ecology 7:23-42.

Yarwood, G., G. Mansell, M. Jimenez, and S. Lau. 2004. 2000 Gulf-wide emissions inventory—OCS on-shore impacts modeling (Texas), a preliminary look. Prepared for the U.S. Dept. of the Interior, Minerals Management Service, New Orleans, LA. Novato, CA: ENVIRON International Corporation. September 1, 2004.

Yender, R.A. and J. Michel, eds. 2010. Oil spills in coral reefs: Planning and response considerations. Second edition. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Office of Response and Restoration. 82 pp. Internet website: http://response.restoration.noaa.gov/book_shelf/70_coral_full_report.pdf.

Zabala, J., I. Zuberogoitia, J.A. Martinez-Climent, and J. Etxezarreta. 2010. Do long lived seabirds reduce the negative effects of acute pollution on adult survival by skipping breeding? A study with European storm petrels (*Hydrobates pelagicus*) during the "Prestige" oil-spill. Marine Pollution Bulletin 62:109-115.

Zeller, T., Jr. 2010. Drill ban means hard times for rig workers. *The New York Times*. Internet website: http://www.nytimes.com/2010/06/18/business/18rig.html?_r=1. Accessed June 29, 2010.

Zenz House, K., D.P. Schrag, C.F. Harvey, and K.A. Lackner. 2006. Permanent carbon dioxide storage in deep-sea sediments. Proceedings of the National Academy of Sciences 103(33):12291-12295.

Zhang, Z. and D. McConnell. 2011. Rock physics modeling of the gas hydrate and free gas mixed system in Green Canyon 955, Gulf of Mexico, and implications for gas hydrate prospecting. U.S Dept. of Energy, National Energy Technology Laboratory, Fire in the Ice, January 2011. Pp. 15-19. Internet website: http://www.netl.doe.gov/technologies/oil-gas/FutureSupply/MethaneHydrates/newsletter/newsletter.htm. Accessed March 18, 2011.

Zieman, J.C. 1976. The ecological effects of physical damage from motor boats on turtle grass beds in Southern Florida. Aquatic Botany 2:127-139.

Zieman, J.C. 1982. The ecology of the seagrasses of south Florida: A community profile. U.S. Dept. of the Interior, Fish and Wildlife Service. FWS/OBS-82/25. 123 pp.

Zieman, J.C., R. Orth, R.C. Phillips, G. Thayer, and A. Thorhaug. 1984. The effects of oil on seagrass ecosystems. In: Cairns, J., Jr. and A.L. Buikema, Jr., eds. Restoration of habitats impacted by oil spills. Boston, MA: Butterworth Publishers.

Zuberogoitia, I., J.A. Martinez, A. Iraeta, A. Azkona, J. Zabala, B. Jimenez, R. Merino, and G. Gomez. 2006. Short-term effects of the *Prestige* oil spill on the peregrine falcon (*Falco peregrinus*). Marine Pollution Bulletin 52:1176-1181.

CHAPTER 7

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Chapter 8

Glossary

8. GLOSSARY

Acute—Sudden, short term, severe, critical, crucial, intense, but usually of short duration.

Anaerobic—Capable of growing in the absence of molecular oxygen.

Annular preventer—A component of the pressure control system in the BOP that forms a seal in the annular space around any object in the wellbore or upon itself, enabling well control operations to commence.

Anthropogenic—Coming from human sources, relating to the effect of humankind on nature.

API gravity—A standard adopted by the American Petroleum Institute for expressing the specific weight of oil.

Aromatic—Class of organic compounds containing benzene rings or benzenoid structures.

Attainment area—An area that is shown by monitored data or by air-quality modeling calculations to be in compliance with primary and secondary ambient air quality standards established by the USEPA.

Barrel (bbl)—A volumetric unit used in the petroleum industry; equivalent to 42 U.S. gallons or 158.99 liters.

Benthic—On or in the bottom of the sea.

Biological Opinion—The FWS or NMFS evaluation of the impact of a proposed action on endangered and threatened species, in response to formal consultation under Section 7 or the endangered Species Act.

Block—A geographical area portrayed on official BOEMRE protraction diagrams or leasing maps that contains approximately 2,331 ha (9 mi^2).

Blowout—An uncontrolled flow of fluids below the mudline from appurtenances on a wellhead or from a wellbore.

Blowout preventer (BOP)—One of several valves installed at the wellhead to prevent the escape of pressure either in the annular space between the casing and drill pipe or in open hole (i.e., hole with no drill pipe) during drilling completion operations. Blowout preventers on jackup or platform rigs are located at the water's surface; on floating offshore rigs, BOP's are located on the seafloor.

Bottom kill—A wild well-control procedure involving the intersection of an uncontrolled well with a relief well for the purpose of pumping heavy mud or cement into the wild well to stanch the flow of oil or gas (the well control strategy for the Macondo spill deployed in mid-July 2010 that resulted in the successful capping of the well.

Cetacean—Aquatic mammal of the order Cetacea, such as whales, dolphins, and porpoises.

Chemosynthetic—Organisms that obtain their energy from the oxidation of various inorganic compounds rather than from light (photosynthetic).

Cofferdam containment dome—A vertically elongated box structure designed to fit loosely over the Macondo lower marine riser package to capture escaping oil at the surface (an early containment strategy for the Macondo spill deployed in May 2010).

Coastal waters—Waters within the geographical areas defined by each State's Coastal Zone Management Program.

Coastal wetlands—forested and nonforested habitats, mangroves, and marsh islands exposed to tidal activity. These areas directly contribute to the high biological productivity of coastal waters by input of detritus and nutrients, by providing nursery and feeding areas for shellfish and finfish, and by serving as habitat for birds and other animals.

Coastal zone—The coastal waters (including the lands therein and thereunder) and the adjacent shorelands (including the waters therein and thereunder) strongly influenced by each other and in proximity to the shorelines of the several coastal states; the zone includes islands, transitional and intertidal areas, salt marshes, wetlands, and beaches and extends seaward to the outer limit of the United States territorial sea. The zone extends inland from the shorelines only to the extent necessary to control shorelands, the uses of which have a direct and significant impact on the coastal waters. Excluded from the coastal zone are lands the use of which is by law subject to the discretion of or which is held in trust by the Federal Government, its officers, or agents. See also State coastal zone boundaries.

Completion—Conversion of a development well or an exploratory well into a production well.

Condensate—Liquid hydrocarbons produced with natural gas; they are separated from the gas by cooling and various other means. Condensates generally have an API gravity of 50°-120°.

Continental margin—The ocean floor that lies between the shoreline and the abyssal ocean floor, includes the continental shelf, continental slope, and continental rise.

Continental shelf—General term used by geologist to refer to the continental margin province that lies between the shoreline and the abrupt change in slope called the shelf edge, which generally occurs in the Gulf of Mexico at about 200 m water depth. The continental shelf is characterized by a gentle slope (about 0.1°). This is different from the juridicial term used in Article 76 of the Convention on the Law of the Sea (see the definition of Outer Continental Shelf).

Continental slope—The continental margin province that lies between the continental shelf and continental rise, characterized by a steep slope (about 3°-6°).

Critical habitat—Specific areas essential to the conservation of a protected species and that may require special management considerations or protection.

Crude oil—Petroleum in its natural state as it emerges from a well, or after it passes through a gas-oil separator but before refining or distillation. An oily, flammable, bituminous liquid that is essentially a complex mixture of hydrocarbons of different types with small amounts of other substances.

Deferral—Action taken by the Secretary of the Interior at the time of the Area Identification to remove certain areas/blocks from the proposed sale.

Delineation well—A well that is drilled for the purpose of determining the size and/or volume of an oil or gas reservoir.

Demersal—Living at or near the bottom of the sea.

***Deepwater Horizon* (DWH) event—**All actions stemming from the April 20, 2010, explosion and subsequent sinking of the Transocean drillship *Deepwater Horizon*, up to and including the Macondo well kill declaration on September 19, 2010.

Development—Activities that take place following discovery of economically recoverable mineral resources, including geophysical surveying, drilling, platform construction, operation of onshore support facilities, and other activities that are for the purpose of ultimately producing the resources.

Development Operations Coordination Document (DOCD)—A document that must be prepared by the operator and submitted to BOEMRE for approval before any development or production activities are conducted on a lease in the Western Gulf.

Development well—A well drilled to a known producing formation to extract oil or gas; a production well; distinguished from a wildcat or exploratory well and from an offset well.

Direct employment—Consists of those workers involved the primary industries of oil and gas exploration, development, and production operations (Standard Industrial Classification Code 13—Oil and Gas Extraction).

Discharge—Something that is emitted; flow rate of a fluid at a given instant expressed as volume per unit of time.

Dispersant—A suite of chemicals and solvents used to break up an oil slick into small droplets, which increases the surface area of the oil and hastens the processes of weathering and microbial degradation.

Dispersion—A suspension of finely divided particles in a medium.

Drilling mud—A mixture of clay, water or refined oil, and chemical additives pumped continuously downhole through the drill pipe and drill bit, and back up the annulus between the pipe and the walls of the borehole to a surface pit or tank. The mud lubricates and cools the drill bit, lubricates the drill pipe as it turns in the wellbore, carries rock cuttings to the surface, serves to keep the hole from crumbling or collapsing, and provides the weight or hydrostatic head to prevent extraneous fluids from entering the well bore and to downhole pressures; also called drilling fluid.

Economically recoverable resources—An assessment of hydrocarbon potential that takes into account the physical and technological constraints on production and the influence of costs of exploration and development and market price on industry investment in OCS exploration and production.

Effluent—The liquid waste of sewage and industrial processing.

Effluent limitations—Any restriction established by a State or the USEPA on quantities, rates, and concentrations of chemical, physical, biological, and other constituents discharged from point sources into U.S. waters, including schedules of compliance.

Epifaunal—Animals living on the surface of hard substrate.

Essential habitat—Specific areas crucial to the conservation of a species and that may necessitate special considerations.

Estuary—Coastal semienclosed body of water that has a free connection with the open sea and where freshwater meets and mixes with seawater.

Eutrophication—Enrichment of nutrients in the water column by natural or artificial methods accompanied by an increase of respiration, which may create an oxygen deficiency.

Exclusive Economic Zone (EEZ)—The maritime region extending 200 nmi from the baseline of the territorial sea, in which the United States has exclusive rights and jurisdiction over living and nonliving natural resources.

Exploration Plan (EP)—A plan that must be prepared by the operator and submitted to BOEMRE for approval before any exploration or delineation drilling is conducted on a lease in the Western Gulf.

Exploration well—A well drilled in unproven or semi-proven territory to determining whether economic quantities of oil or natural gas deposit are present; exploratory well.

False crawls—Refers to when a female sea turtle crawls up on the beach to nest (perhaps) but does not and returns to the sea without laying eggs.

Field—An accumulation, pool, or group of pools of hydrocarbons in the subsurface. A hydrocarbon field consists of a reservoir in a shape that will trap hydrocarbons and that is covered by an impermeable, sealing rock.

Floating production, storage, and offloading (FPSO) system—A tank vessel used as a production and storage base; produced oil is stored in the hull and periodically offloaded to a shuttle tanker for transport to shore..

Gathering lines—A pipeline system used to bring oil or gas production from a number of separate wells or production facilities to a central trunk pipeline, storage facility, or processing terminal.

Geochemical—Of or relating to the science dealing with the chemical composition of and the actual or possible chemical changes in the crust of the earth.

Geophysical survey—A method of exploration in which geophysical properties and relationships are measured remotely by one or more geophysical methods.

Habitat—A specific type of environment that is occupied by an organism, a population, or a community.

Hermatypic coral—Reef-building corals that produce hard, calcium carbonate skeletons and that possess symbiotic, unicellular algae within their tissues.

Harassment—An intentional or negligent act or omission that creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns that include, but are not limited to, feeding or sheltering.

Hydrocarbons—Any of a large class of organic compounds containing primarily carbon and hydrogen. Hydrocarbon compounds are divided into two broad classes: aromatic and aliphatics. They occur primarily in petroleum, natural gas, coal, and bitumens.

Hypoxia—Depressed levels of dissolved oxygen in water, usually resulting in decreased metabolism.

Incidental take—Takings that result from, but are not the purpose of, carrying out an otherwise lawful activity (e.g., fishing) conducted by a Federal agency or applicant (see Taking).

Indirect employment—Secondary or supporting oil- and gas-related industries, such as the processing of crude oil and gas in refineries, natural gas plants, and petrochemical plants.

Induced employment—Tertiary industries that are created or supported by the expenditures of employees in the primary or secondary industries (direct and indirect employment), including consumer goods and services such as food, clothing, housing, and entertainment.

Infrastructure—The facilities associated with oil and gas development, e.g., refineries, gas processing plants, etc.

Jack-up rig—A barge-like, floating platform with legs at each corner that can be lowered to the sea bottom to raise the platform above the water.

Junk shot—A wild well-control procedure accompanying a top kill that introduces foreign objects into the drilling fluid (such as shredded rope, rubber, or golf balls) and that is designed to clog the openings or partial openings in a nonfunctioning blowout preventer (an early well control strategy for the Macondo spill in May 2010).

Kick—A deviation or imbalance, typically sudden or unexpected, between the downward pressure exerted by the drilling fluid and the upward pressure of in situ formation fluids or gases.

Landfall—The site where a marine pipeline comes to shore.

Lease—Authorization that is issued under Section 8 or maintained under Section 6 of the Outer Continental Shelf Lands Act and that authorizes exploration for, and development and production of, minerals.

Lease sale—The competitive auction of leases granting companies or individuals the right to explore for and develop certain minerals under specified conditions and periods of time.

Lease term—The initial period for oil and gas leases, usually a period of 5, 8, or 10 years depending on water depth or potentially adverse conditions.

Lessee—A party authorized by a lease, or an approved assignment thereof, to explore for and develop and produce the leased deposits in accordance with regulations at 30 CFR 250.

Lower marine riser package—The head assembly of a subsurface well at the point where the riser connects to a blowout preventer.

Macondo—Prospect name given by BP to the Mississippi Canyon Block 252 exploration well that the *Deepwater Horizon* rig was drilling when a blowout occurred on April 20, 2010.

Macondo spill—The name given to the oil spill that resulted from the explosion and sinking of the *Deepwater Horizon* rig from the period between April 24, 2010, when search and recovery vessels on site reported oil at the sea surface until uncontrolled flow from the Macondo well was capped.

Marshes—Persistent, emergent, nonforested wetlands characterized by predominantly cordgrasses, rushes, and cattails.

Military warning area—An area established by the Department of Defense within which military activities take place.

Minerals—As used in this document, minerals include oil, gas, sulphur, and associated resources, and all other minerals authorized by an Act of Congress to be produced from public lands as defined in Section 103 of the Federal Land Policy and Management Act of 1976.

Nepheloid—A layer of water near the bottom that contains significant amounts of suspended sediment.

Nonattainment area—An area that is shown by monitoring data or by air-quality modeling calculations to exceed primary or secondary ambient air quality standards established by the USEPA.

Nonhazardous oil-field wastes (NOW)—Wastes generated by exploration, development, or production of crude oil or natural gas that are exempt from hazardous waste regulation under the Resource Conservation and Recovery Act (*Regulatory Determination for Oil and Gas and Geothermal Exploration, Development and Production Wastes,* dated June 29, 1988, 53 FR 25446; July 6, 1988). These wastes may contain hazardous substances.

Naturally occurring radioactive materials (NORM)—naturally occurring material that emits low levels of radioactivity, originating from processes not associated with the recovery of radioactive material. The radionuclides of concern in NORM are Radium-226, Radium-228, and other isotopes in the radioactive decay chains of uranium and thorium.

Offloading—Unloading liquid cargo, crude oil, or refined petroleum products.

Operational discharge—Any incidental pumping, pouring, emitting, emptying, or dumping of wastes generated during routine offshore drilling and production activities.

Operator—An individual, partnership, firm, or corporation having control or management of operations on a leased area or portion thereof. The operator may be a lessee, designated agent of the lessee, or holder of operating rights under an approved operating agreement.

Organic matter—Material derived from living plants or animals.

Outer Continental Shelf (OCS)—All submerged lands that comprise the continental margin adjacent to the United States and seaward of State offshore lands.

Pelagic—Of or pertaining to the open sea; associated with open water beyond the direct influence of coastal systems.

Penaeids—Chiefly warm water and tropical prawns belonging to the family Penaeidae.

Plankton—Passively floating or weakly motile aquatic plants (phytoplankton) and animals (zooplankton).

Platform—A steel or concrete structure from which offshore development wells are drilled.

Play—A prospective subsurface area for hydrocarbon accumulation that is characterized by a particular structural style or depositional relationship.

Primary production—Organic material produced by photosynthetic or chemosynthetic organisms.

Produced water—Total water discharged from the oil and gas extraction process; production water or production brine.

Production—Activities that take place after the successful completion of any means for the extraction of resources, including bringing the resource to the surface, transferring the produced resource to shore, monitoring operations, and drilling additional wells or workovers.

Province—A spatial entity with common geologic attributes. A province may include a single dominant structural element such as a basin or a fold belt, or a number of contiguous related elements.

Ram—The main component of a blowout preventer designed to shear casing and tools in a wellbore or to seal an empty wellbore. A blind shear ram accomplishes the former and a blind ram the latter.

Recoverable reserves—The portion of the identified hydrocarbon or mineral resource that can be economically extracted under current technological constraints.

Recoverable resource estimate—An assessment of hydrocarbon or mineral resources that takes into account the fact that physical and technological constraints dictate that only a portion of resources can be brought to the surface.

Recreational beaches—Frequently visited, sandy areas along the Gulf of Mexico shorefront that support multiple recreational activities at the land-water interface. Included are National Seashores, State Park and Recreational Areas, county and local parks, urban beachfronts, and private resorts.

Refining—Fractional distillation of petroleum, usually followed by other processing (for example, cracking).

Relief—The difference in elevation between the high and low points of a surface.

Reserves—Proved oil or gas resources.

Rig—A structure used for drilling an oil or gas well.

Riser insertion tube tool—A "straw" and gasket assembly improvised during the Macondo spill response that was designed to siphon oil and gas from the broken riser of the *Deepwater Horizon* lying on the sea bottom (an early recovery strategy for the Macondo spill in May 2010).

Royalty—A share of the minerals produced from a lease paid in either money or "in-kind" to the landowner by the lessee.

Saltwater intrusion—Saltwater invading a body of freshwater.

Sciaenids—Fishes belonging to the croaker family (Sciaenidae).

Seagrass beds—More or less continuous mats of submerged, rooted, marine, flowering vascular plants occurring in shallow tropical and temperate waters. Seagrass beds provide habitat, including breeding and feeding grounds, for adults and/or juveniles of many of the economically important shellfish and finfish.

Sediment—Material that has been transported and deposited by water, wind, glacier, precipitation, or gravity; a mass of deposited material.

Seeps (hydrocarbon)—Gas or oil that reaches the surface along bedding planes, fractures, unconformities, or fault planes.

Sensitive area—An area containing species, populations, communities, or assemblages of living resources, that is susceptible to damage from normal OCS-related activities. Damage includes interference with established ecological relationships.

Shear ram—The component in a BOP that cuts, or shears, through the drill pipe and forms a seal against well pressure. Shear rams are used in floating offshore drilling operations to provide a quick method of moving the rig away from the hole when there is no time to trip the drill stem out of the hole.

Shunting—A method used in offshore oil and gas drilling and production activities where expended cuttings and fluids are discharged through a downpipe, which terminates no more than 10 m from the ocean floor, rather than discharged at the ocean surface.

Shoreline Cleanup and Assessment Team—The on-the-scene responders for post-spill shoreline protection who established priorities, standardized procedures and establish terminology.

Spill of National Significance—Designation by the USEPA Administrator under 40 CFR 300.323 for discharges occurring in the inland zone and the Commandant of the CG for discharges occurring in the coastal zone, authorizing the appointment of a National Incident Commander for spill-response activity.

State coastal zone boundary—The State coastal zone boundaries for each CZMA-affected State are defined at http://coastalmanagement.noaa.gov/mystate/docs/StateCZBoundaries.pdf.

Structure—Any OCS facility that extends from the seafloor to above the waterline; in petroleum geology, any arrangement of rocks that may hold an accumulation of oil or gas.

Subarea—A discrete analysis area.

Subsea isolation device—An emergency disconnection and reconnection assembly for the riser at the seafloor.

Supply vessel—A boat that ferries food, water, fuel, and drilling supplies and equipment to an offshore rig or platform and returns to land with refuse that cannot be disposed of at sea.

Taking—To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect any endangered or threatened species, or to attempt to engage in any such conduct (including actions that induce stress, adversely impact critical habitat, or result in adverse secondary or cumulative impacts). Harassments are the most common form of taking associated with OCS Program activities.

Tension-leg platform (TLP)—A production structure that consists of a buoyant platform tethered to concrete pilings on the seafloor with flexible cable.

Top hat—A short cylindrical sleeve with a tapered apex designed to fit atop of the lower marine riser package and to capture oil and gas from the flowing Macondo well (a functional subsurface recovery strategy for the Macondo spill in June and July, before the well was capped on July 15, 2010).

Top kill—A wild well-control procedure involving the pump-down under pressure of heavy drilling fluid to equalize pressure and to stop the flow of gas and oil exiting a blowout (an early well control strategy for the Macondo spill deployed in May 2010).

Total dissolved solids—The total amount of solids that are dissolved in water.

Total suspended particulate matter—The total amount of suspended solids in water.

Total suspended solids—The total amount of suspended solids in water.

Trunkline—A large-diameter pipeline receiving oil or gas from many smaller tributary gathering lines that serve a large area; common-carrier line; main line.

Turbidity—Reduced water clarity due to the presence of suspended matter.

Unified Area Command—A system of satellite work, coordination, and remediation stations administered by the Unified Incident Commander during a spill of national significance.

Unified Incident Command—Command and coordination center for the National Incident Commander.

Volatile organic compound (VOC)—Any organic compound that is emitted to the atmosphere as a vapor.

Water test areas—Areas within the Eastern Gulf where Department of Defense research, development, and testing of military planes, ships, and weaponry take place.

Weathering (of oil)—The aging of oil due to its exposure to the atmosphere, causing marked alterations in its physical and chemical makeup.

APPENDICES

APPENDIX A

FIGURES AND TABLES

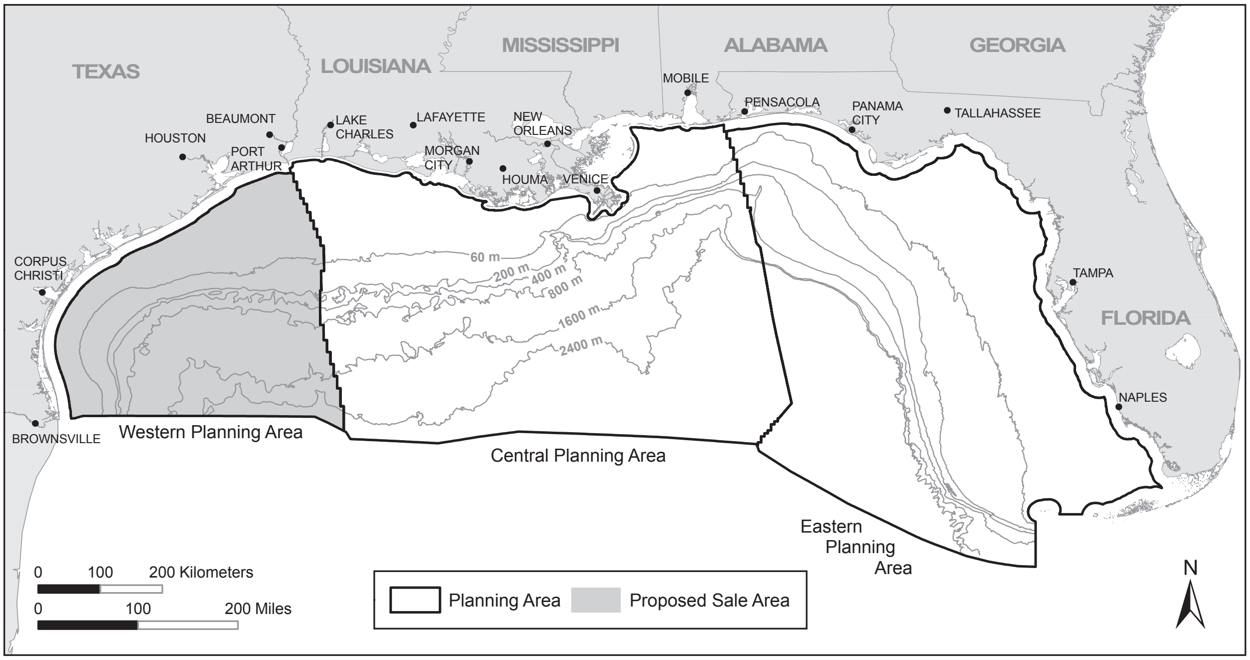

Figure 1-1. Gulf of Mexico Outer Continental Shelf Planning Areas, Proposed Lease Sale Area, and Locations of Major Cities.

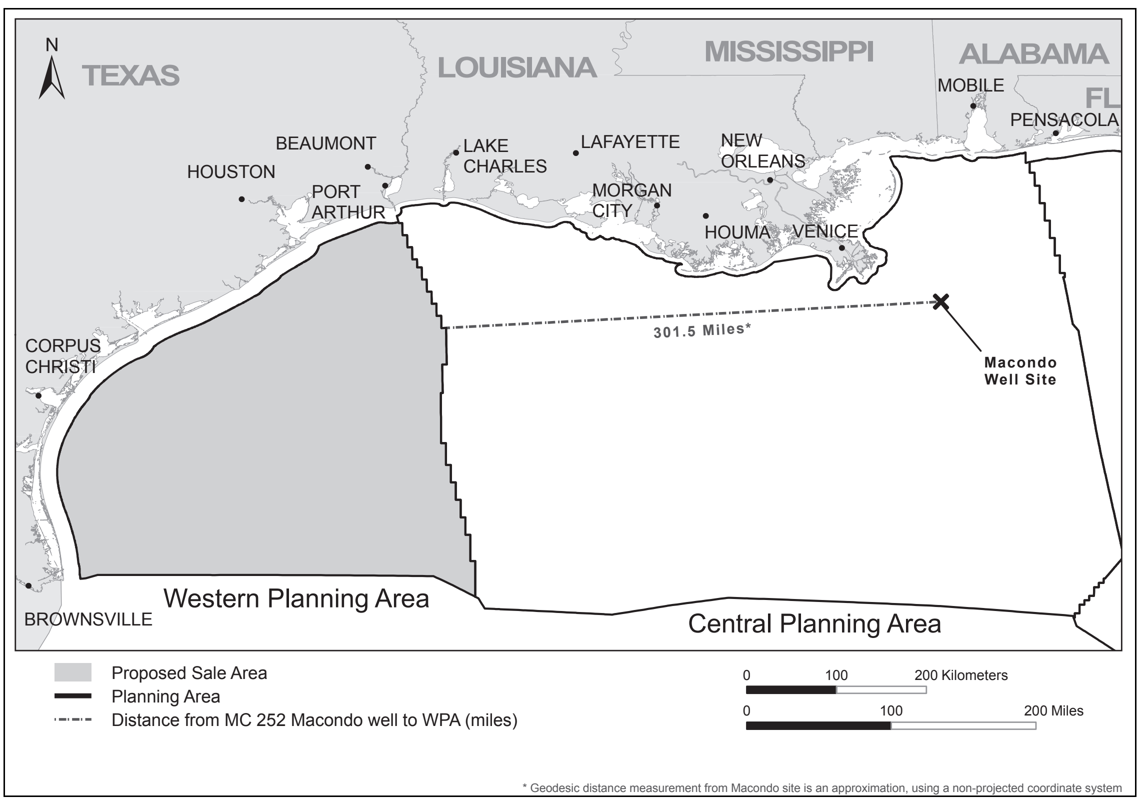

Figure 1-2. Distance from the Macondo Well (Mississippi Canyon Block 252) to the Western Planning Area Boundary.

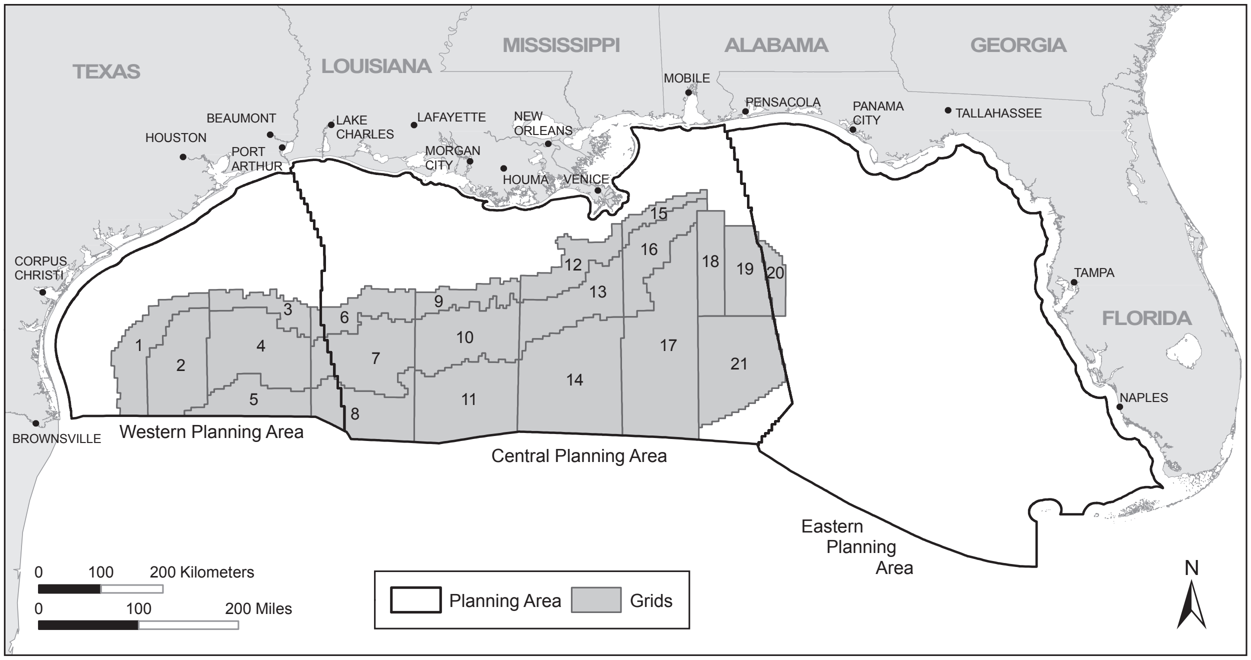

Figure 1-3. Grid Areas of Remotely Operated Vehicle Surveys in Deep Water from NTL 2008-G06.

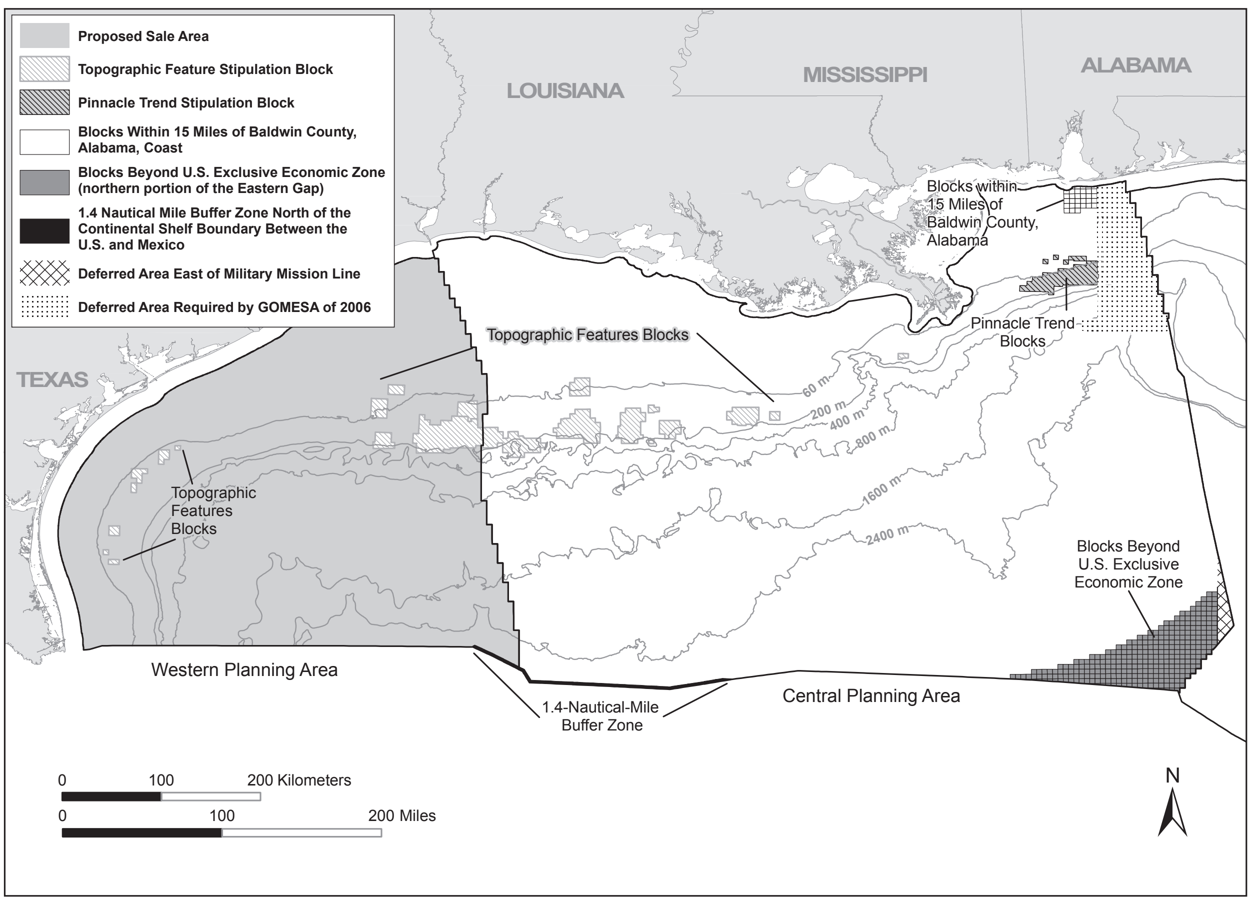

Figure 2-1. Location of Proposed Stipulations and Deferrals.

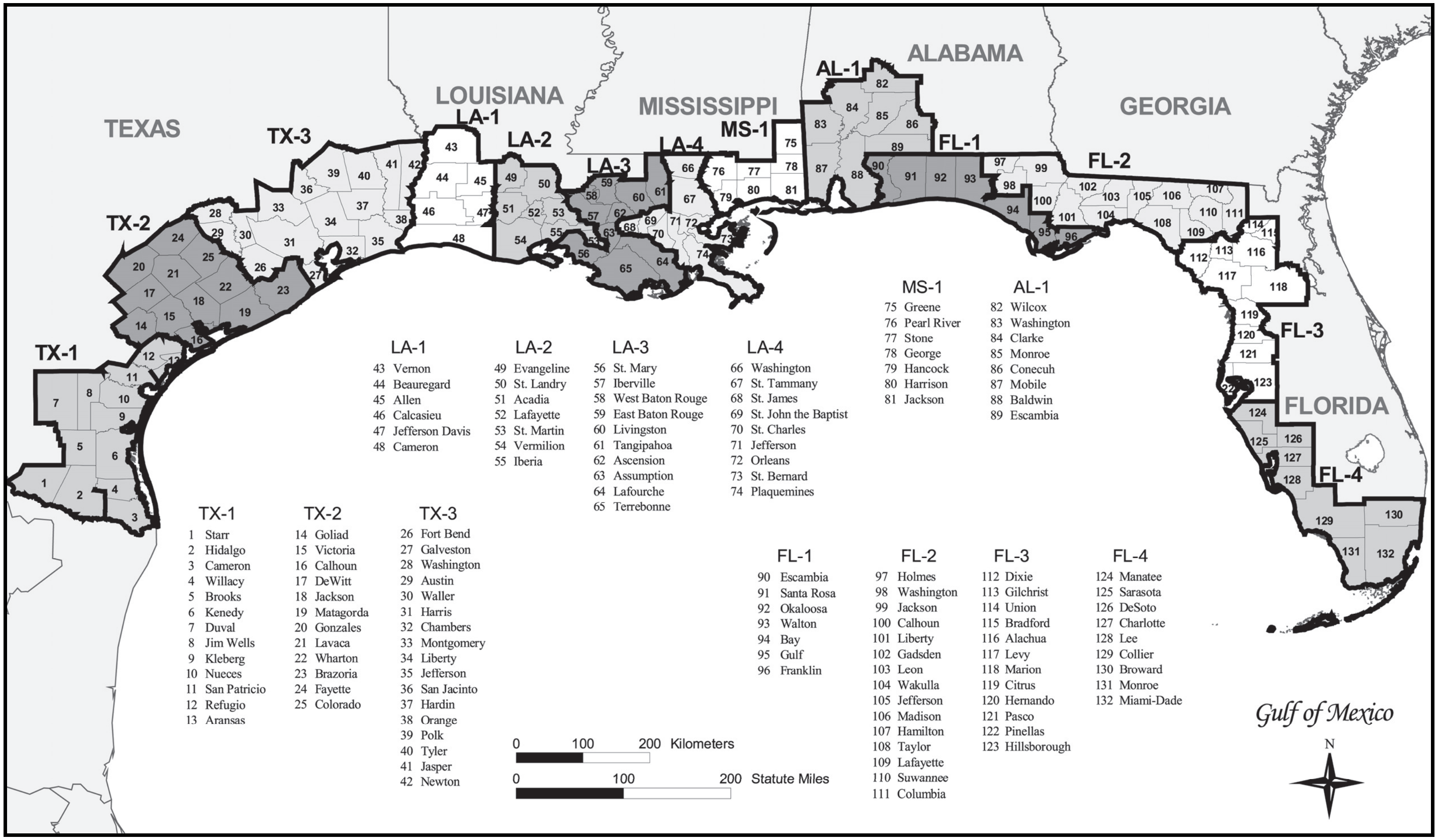

Figure 2-2. Economic Impact Areas in the Gulf of Mexico.

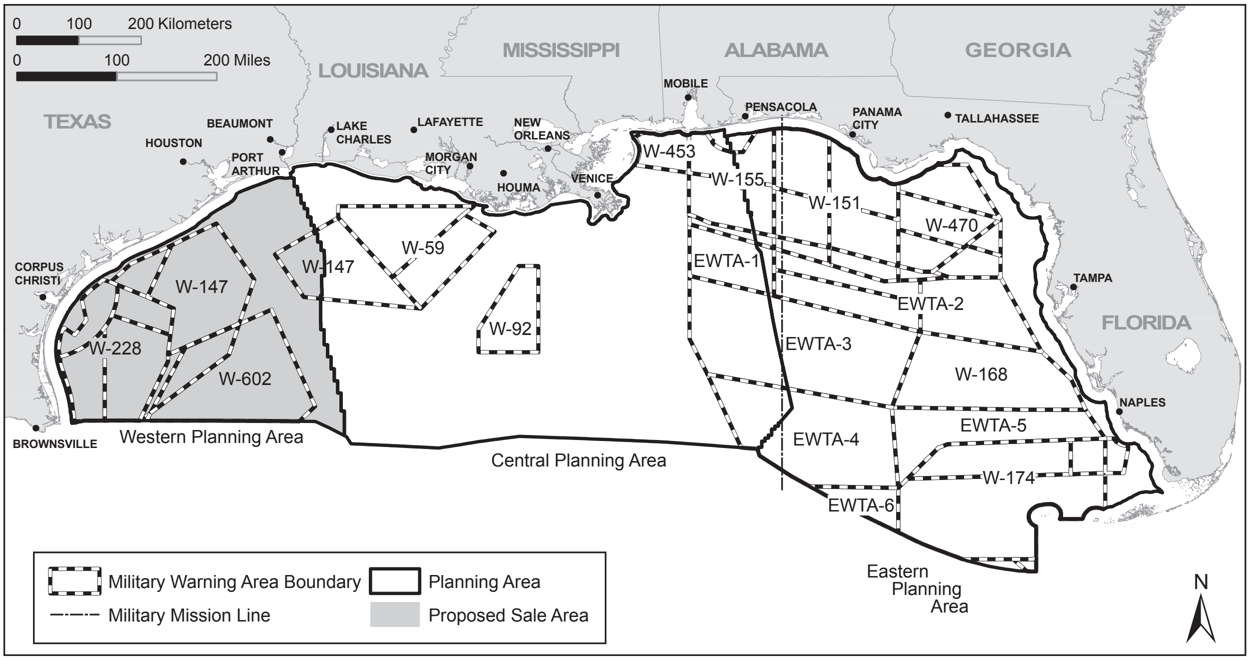

Figure 2-3. Military Warning Areas and Eglin Water Test Areas Located in the Gulf of Mexico.

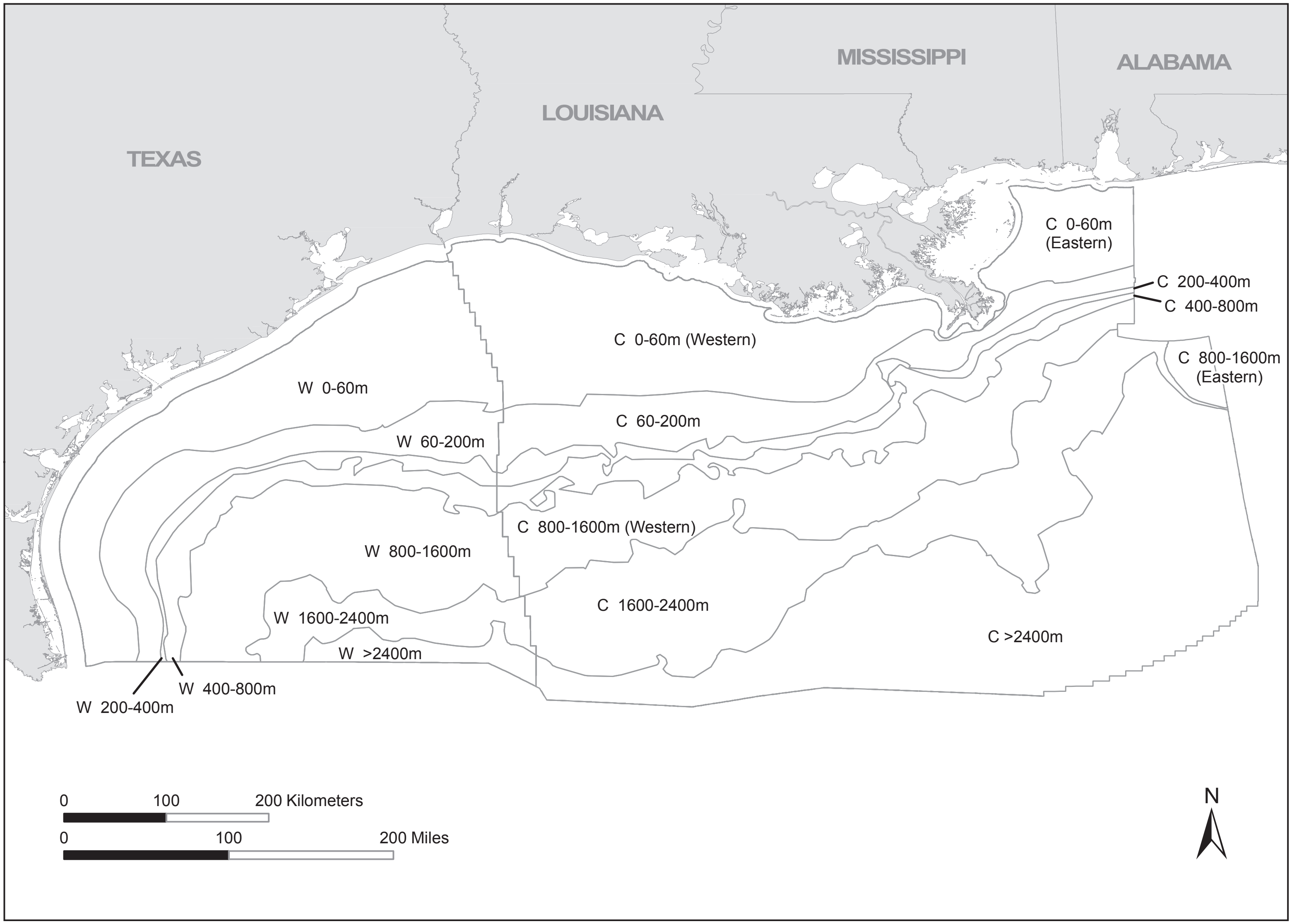

Figure 3-1. Offshore Subareas in the Gulf of Mexico.

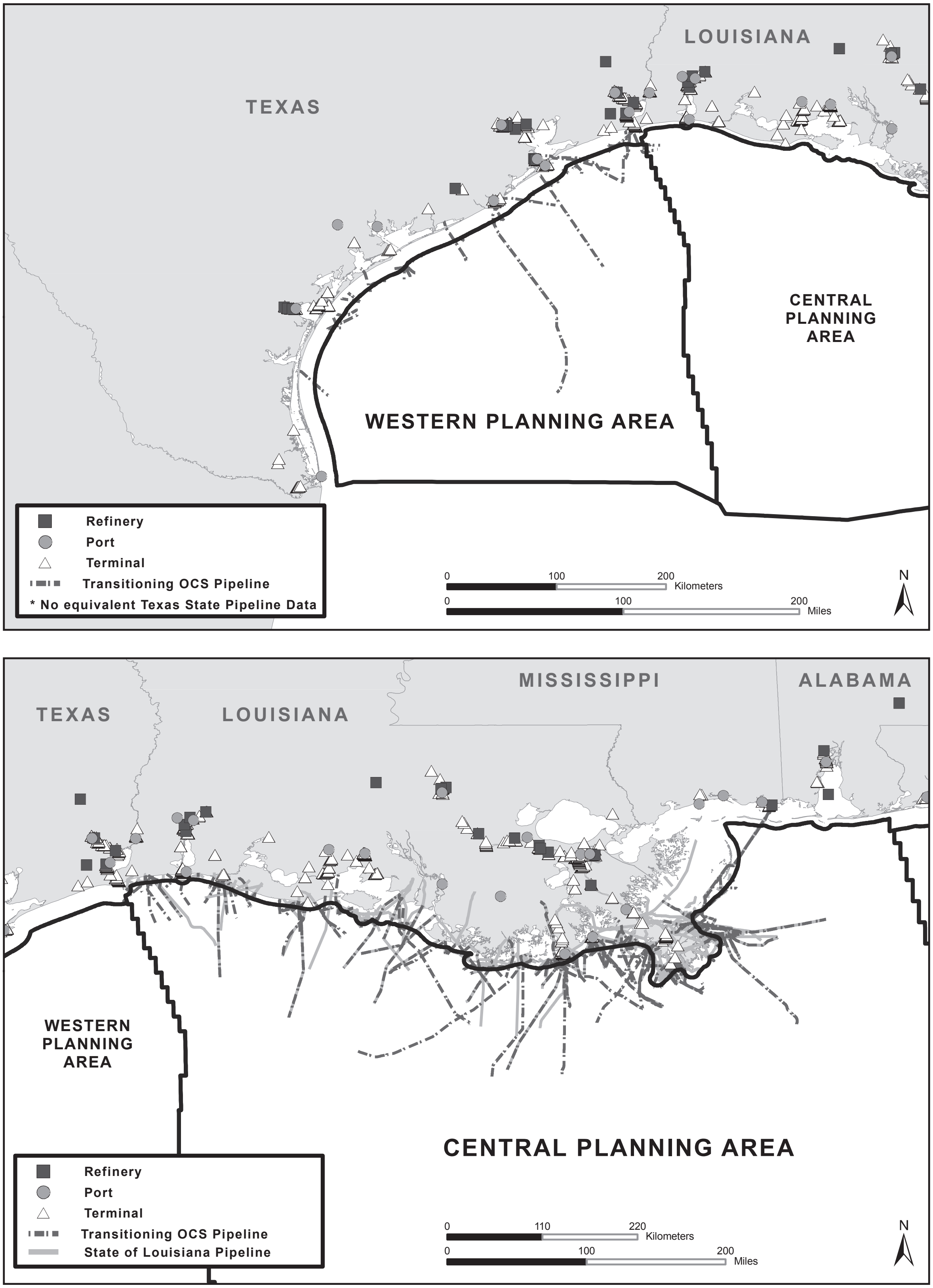

Figure 3-2. Infrastructure and Transitioning Pipelines (from Federal OCS waters) in Texas and Louisiana.

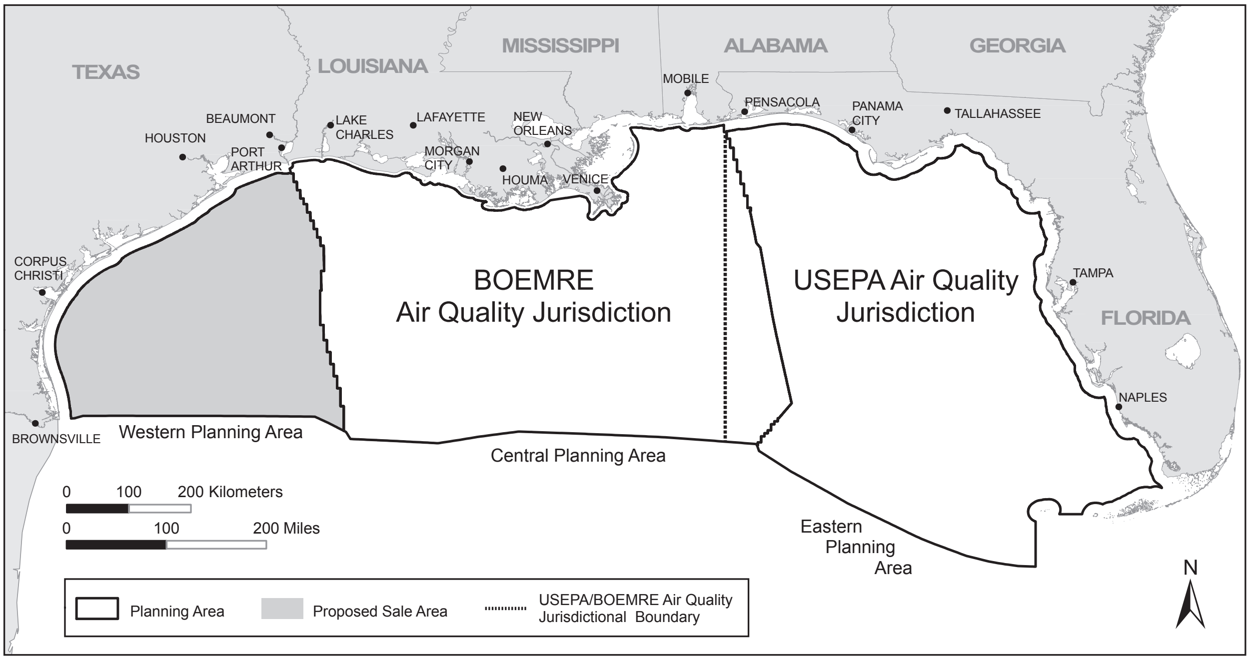

Figure 3-3. Air Quality Jurisdiction.

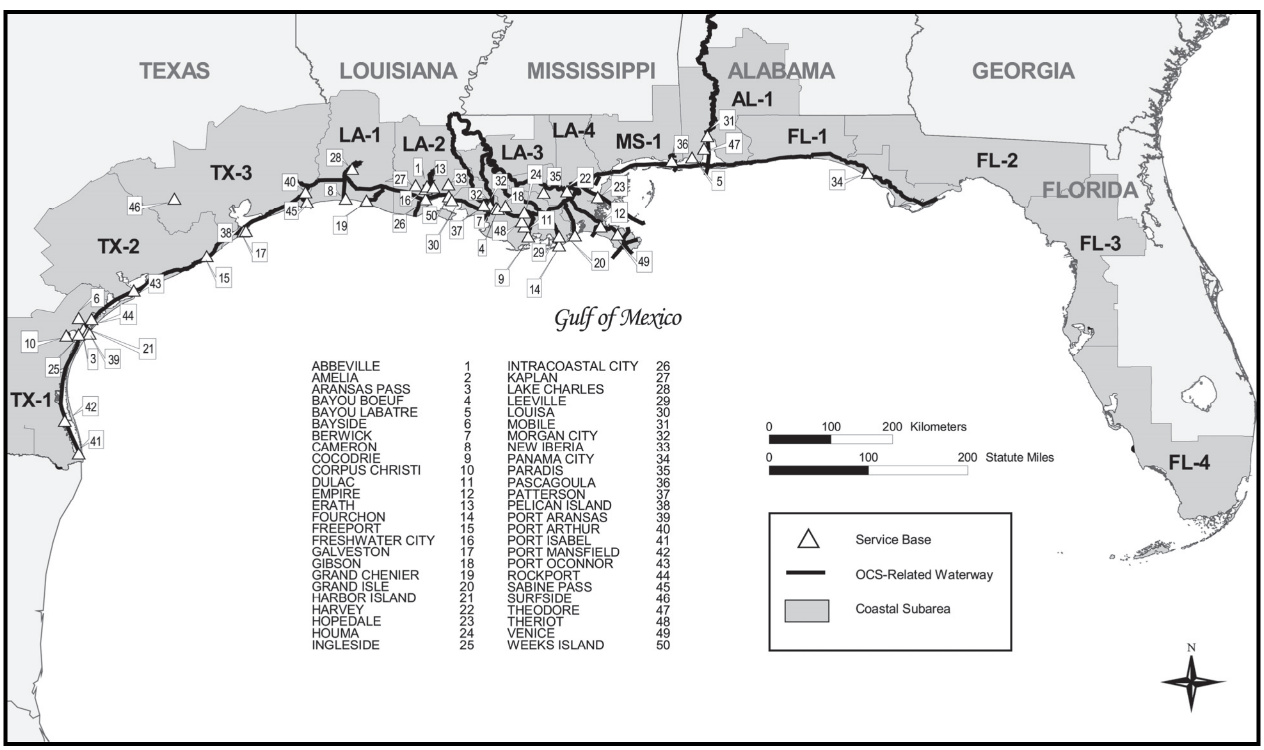

Figure 3-4. OCS-Related Service Bases in the Gulf of Mexico.

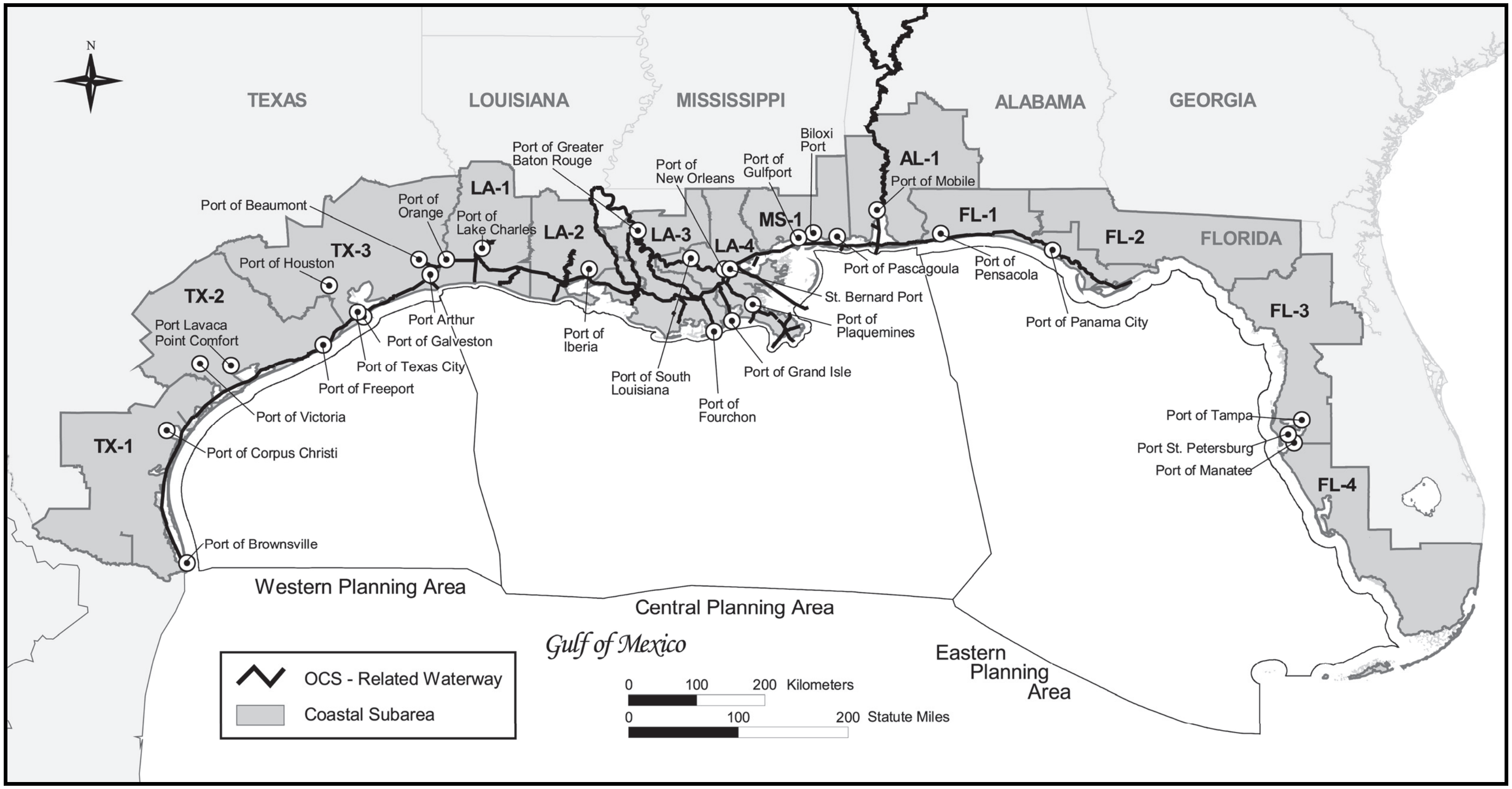

Figure 3-5. Major Ports and Domestic Waterways in the Gulf of Mexico.

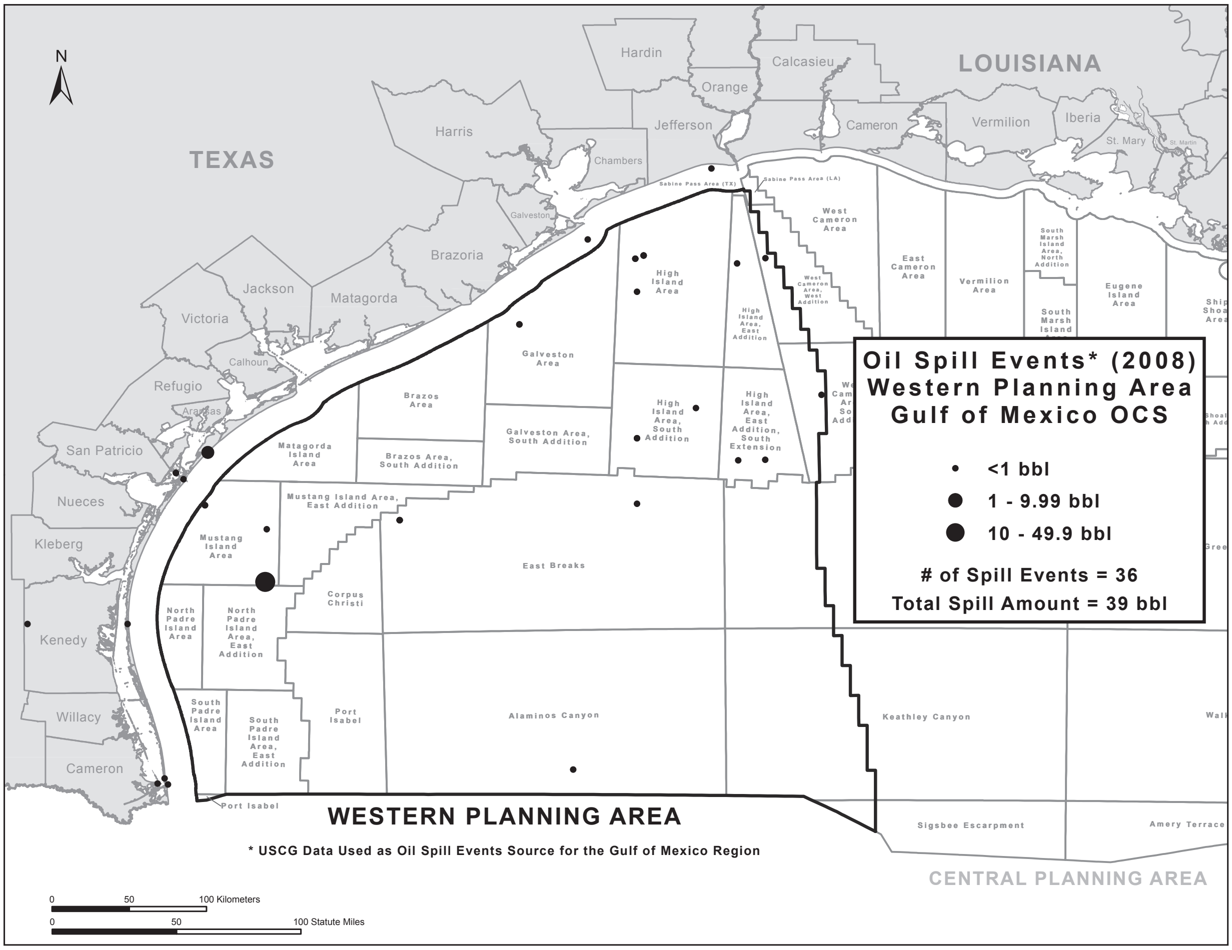

Figure 3-6. Oil-Spill Events (2008) in the Western Planning Area (Dickey, personal communication, 2010).

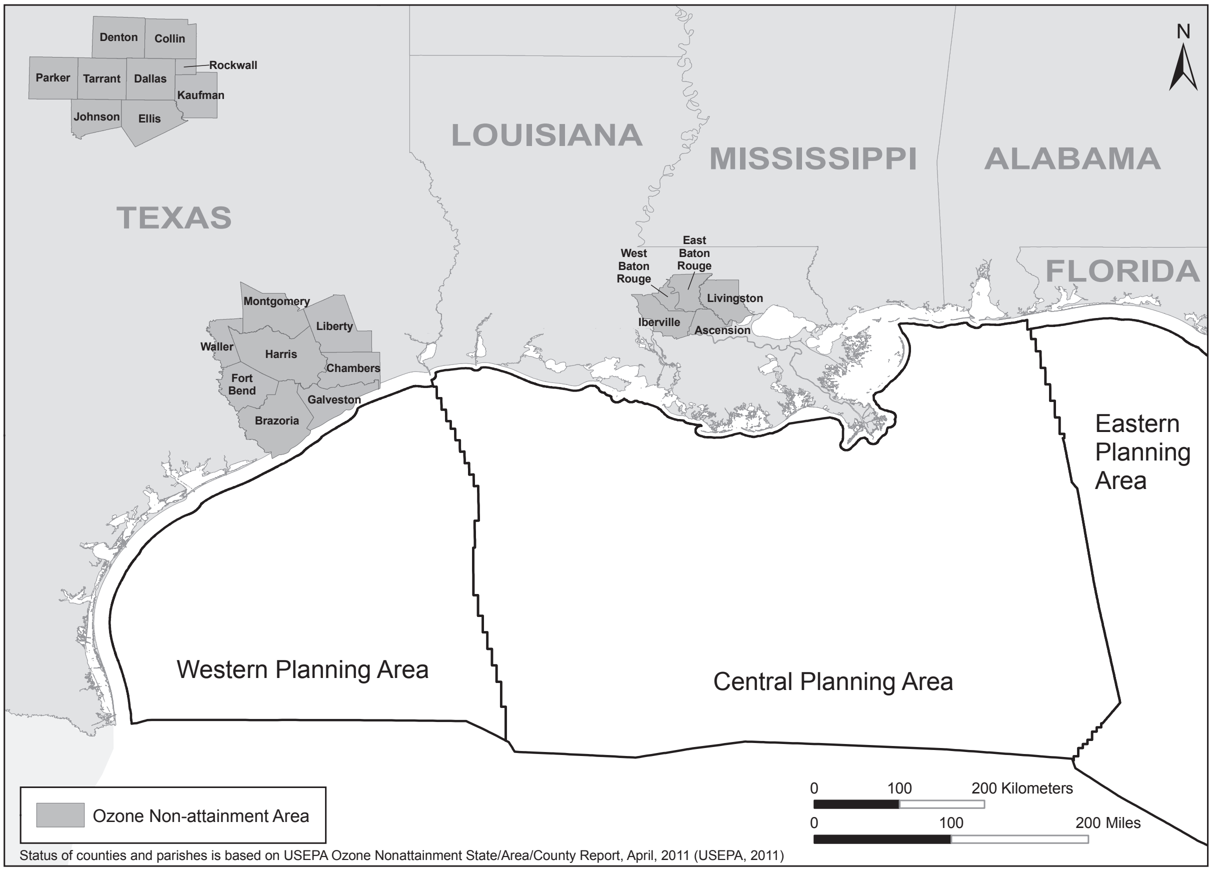

Figure 4-1. Status of Ozone Attainment in Coastal Counties and Parishes of the Central and Western Planning Areas (USEPA, 2011).

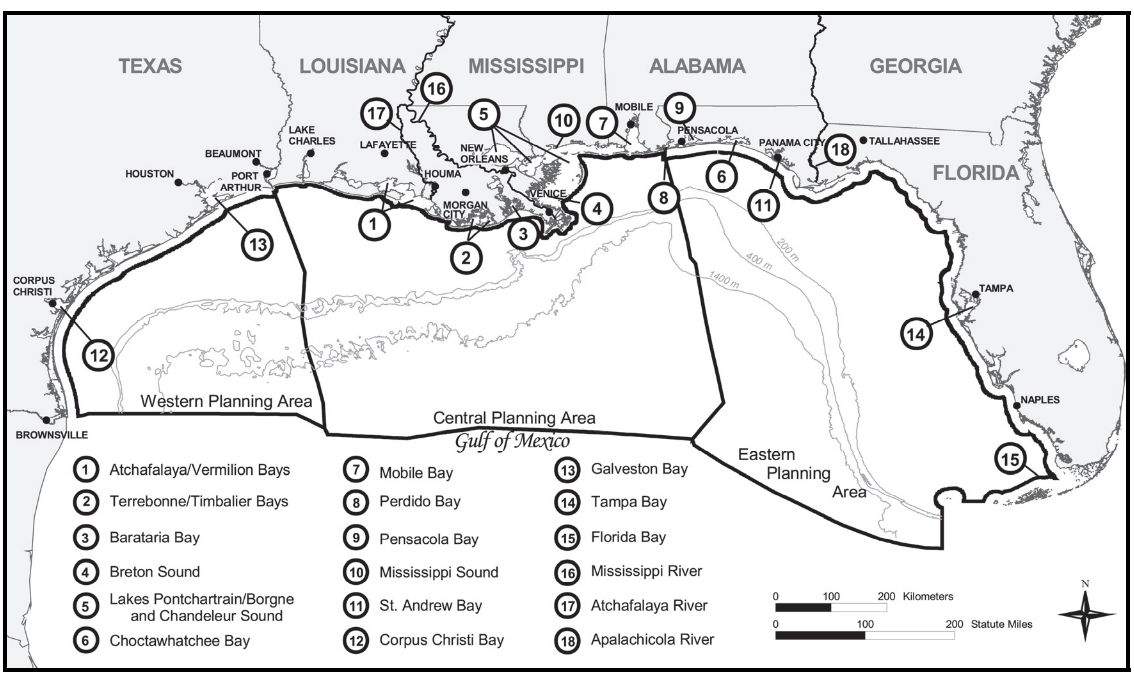

Figure 4-2. Coastal and Marine Waters of the Gulf of Mexico with Selected Rivers and Water Depths.

Figure 4-3. Seagrass Locations of the Northern Gulf of Mexico.

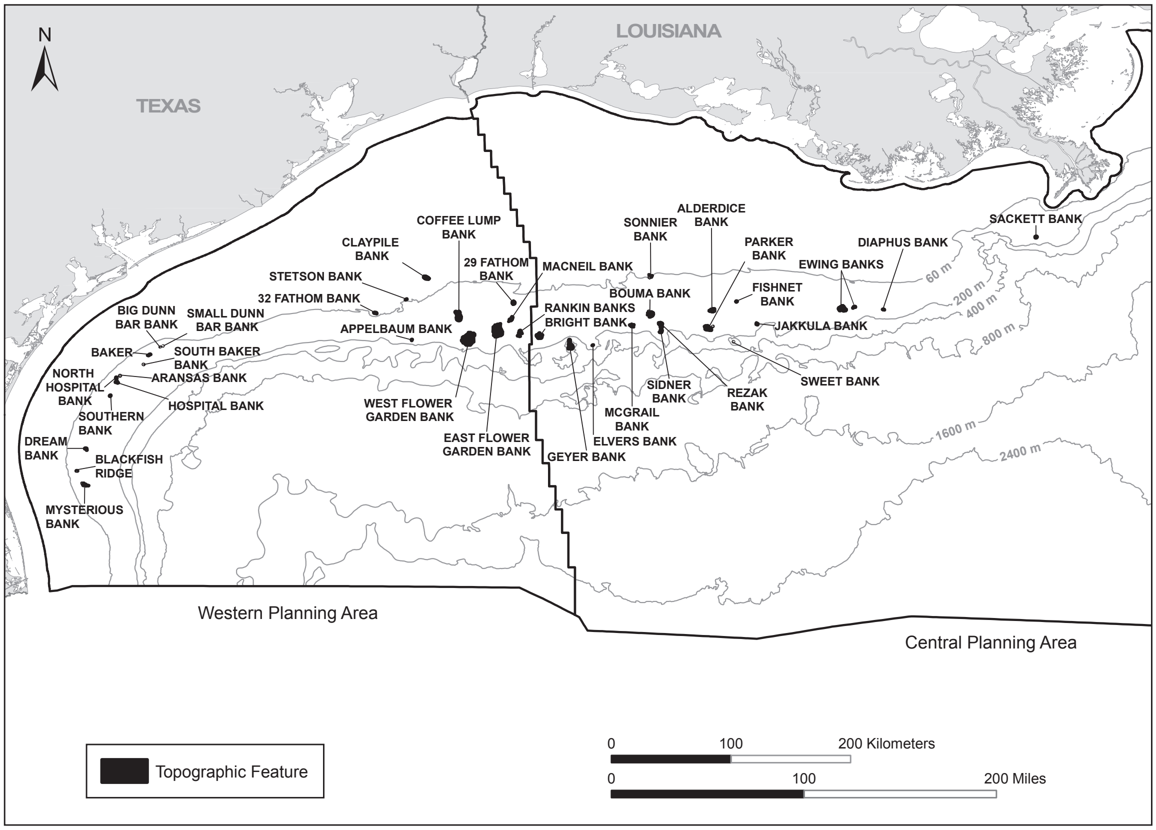

Figure 4-4. Location of Topographic Features in the Gulf of Mexico.

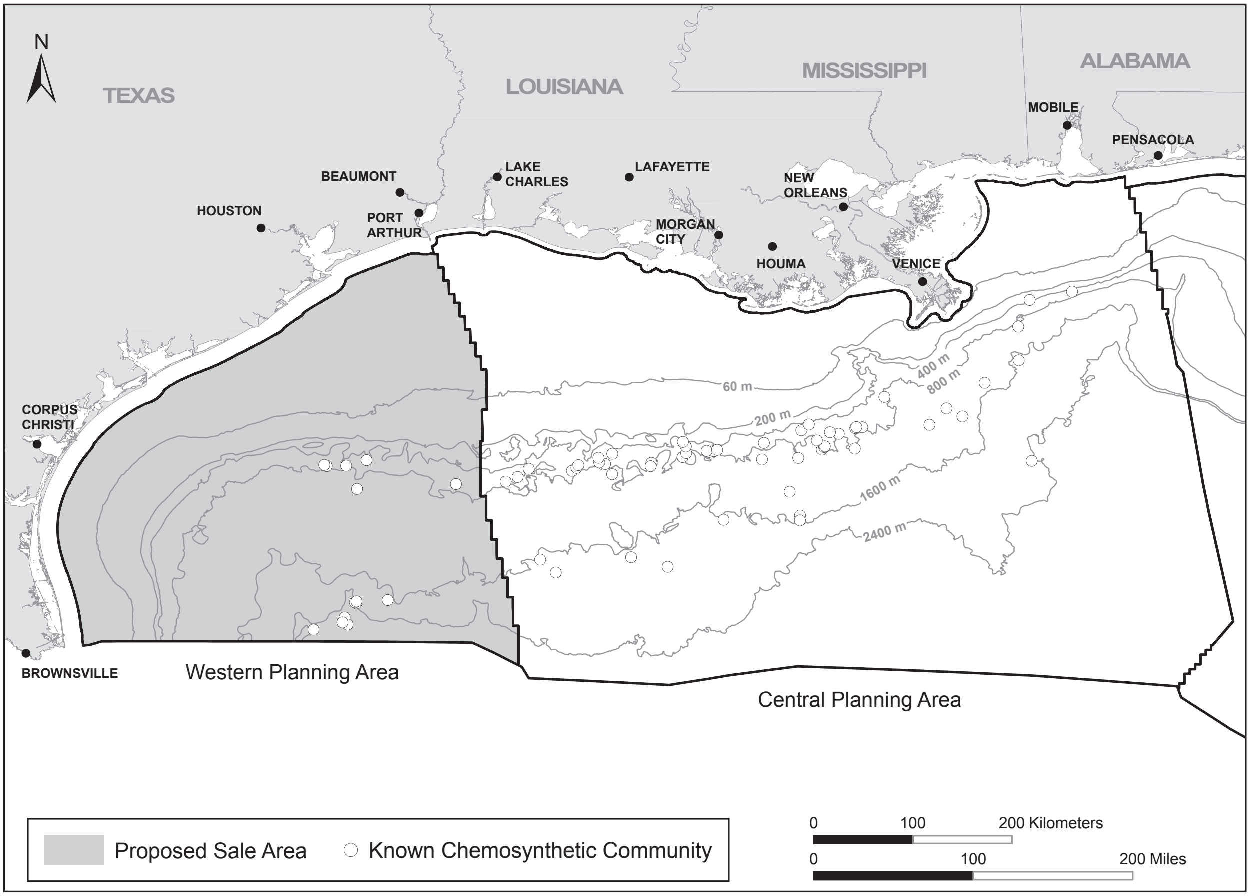

Figure 4-5. Location of Known Chemosynthetic Communities in the Gulf of Mexico.

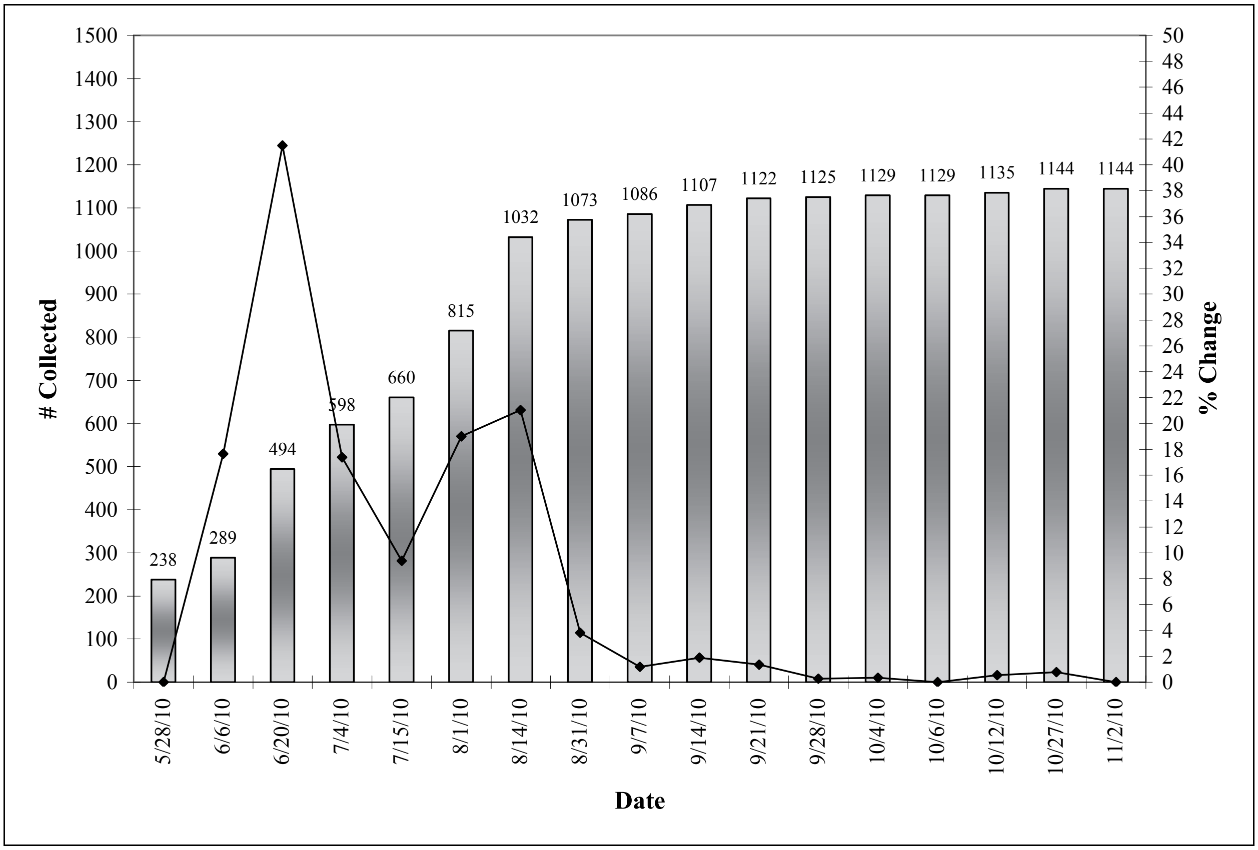

Figure 4-6. Summary of Sea Turtles Collected by Date Obtained from the Consolidated Numbers of Collected Fish and Wildlife That Have Been Reported to the Unified Area Command from the Fish and Wildlife Service, National Oceanic and Atmospheric Administration, Incident Area Commands, Rehabilitation Centers, and Other Authorized Sources Operating within the *Deepwater Horizon*/BP Incident Impact Area through November 2, 2010. (Data on the Y-axis reflects the cumulative number of individual sea turtles collected by date [alive and dead] and data on the Z-axis reflects proportional change from one reporting date to the next. For the latest available information on oiled or affected sea turtles documented in the area, event response, and daily maps of the current location of spilled oil, see RestoreTheGulf.gov, 2011).

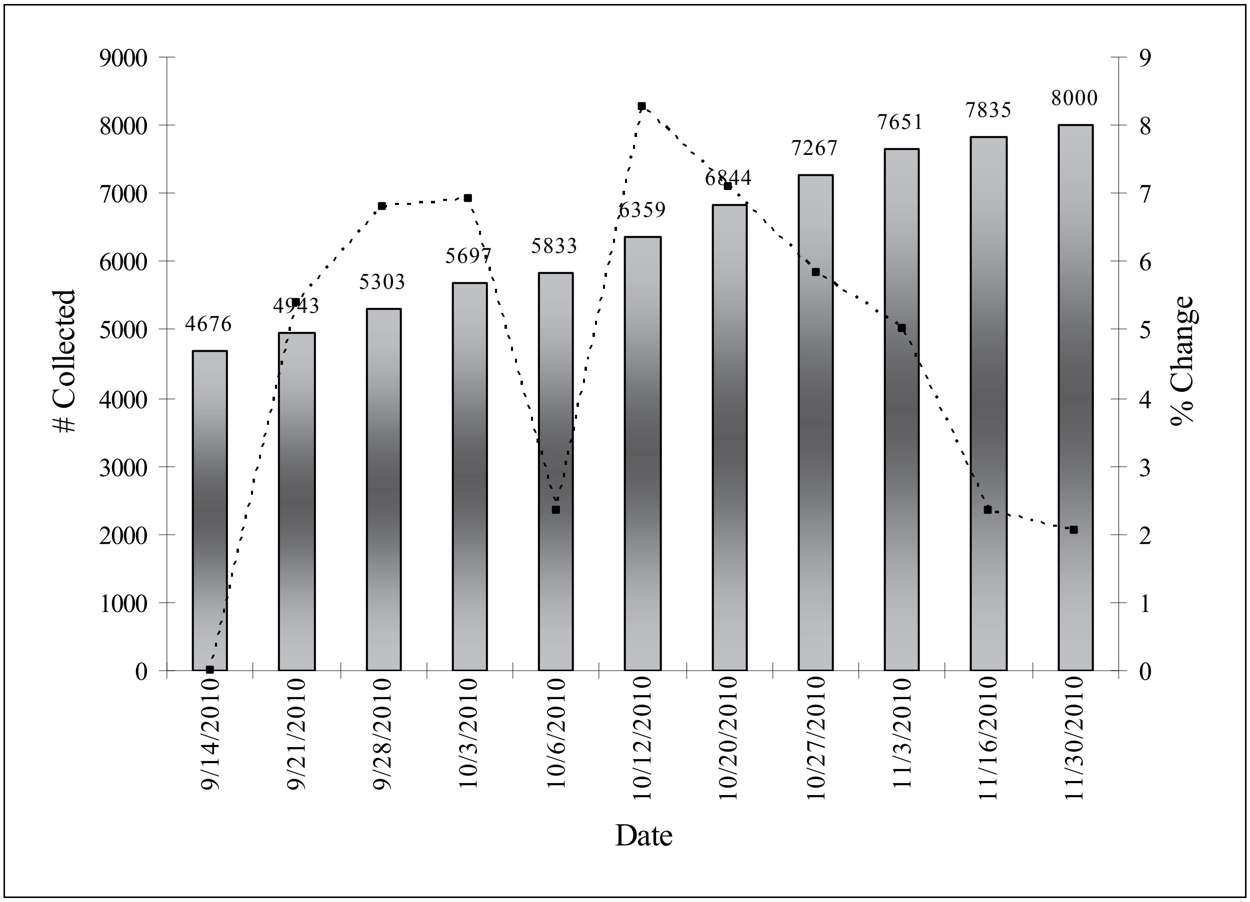

Figure 4-7. Summary of Avian Species Collected by Date Obtained from the U.S. Fish and Wildlife Service (FWS) as Part of the NRDA Process through November 30, 2010. (Data on the Y-axis reflects the cumulative number of individual birds collected, identified, and summarized by date; data on the Z-axis reflects proportional change from one reporting date to the next. The data used in this table are verified as per the FWS QA/QC processes. Disclaimer: All data should be considered provisional, incomplete, and subject to change. For more information, see USDOI, FWS, 2010).

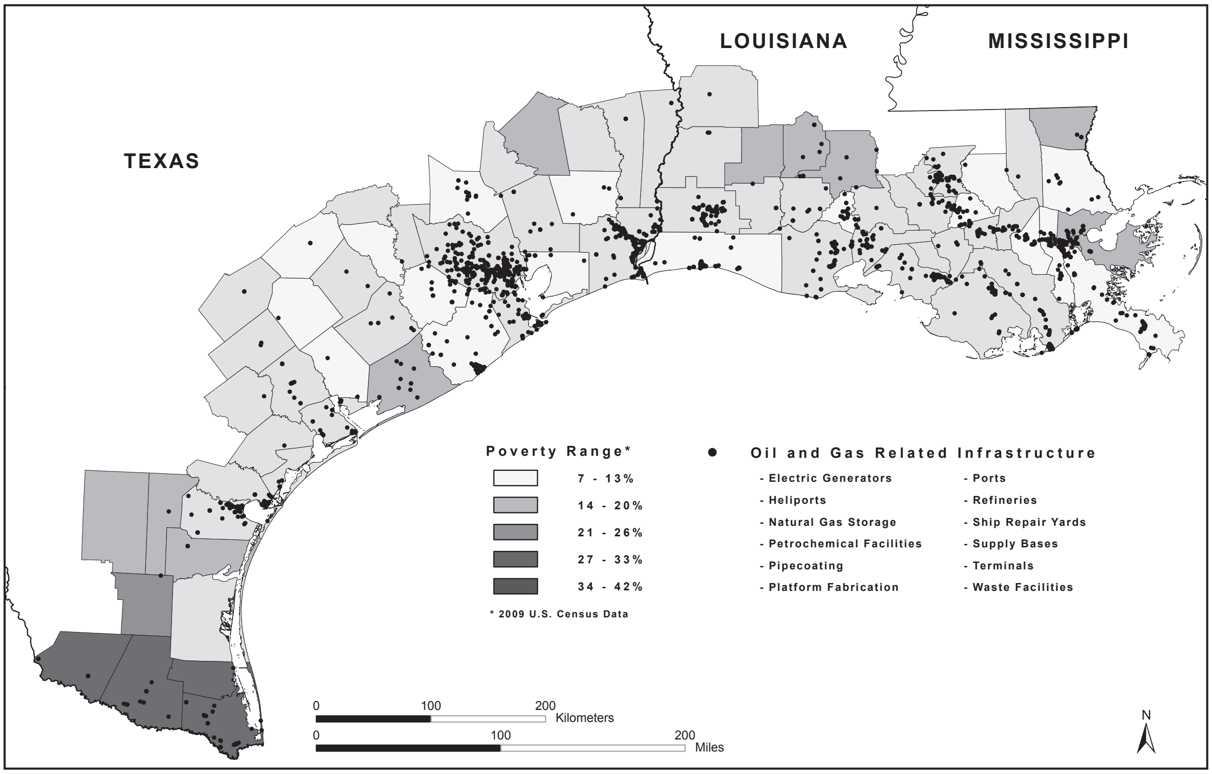

Figure 4-8. Locations of Oil- and Gas-Related Infrastructure and the Distribution of Low-Income Residents across Counties and Parishes in Texas and Louisiana based on U.S. Census Data from 2010 (USDOC, Census Bureau, 2010; Dismukes, in preparation).

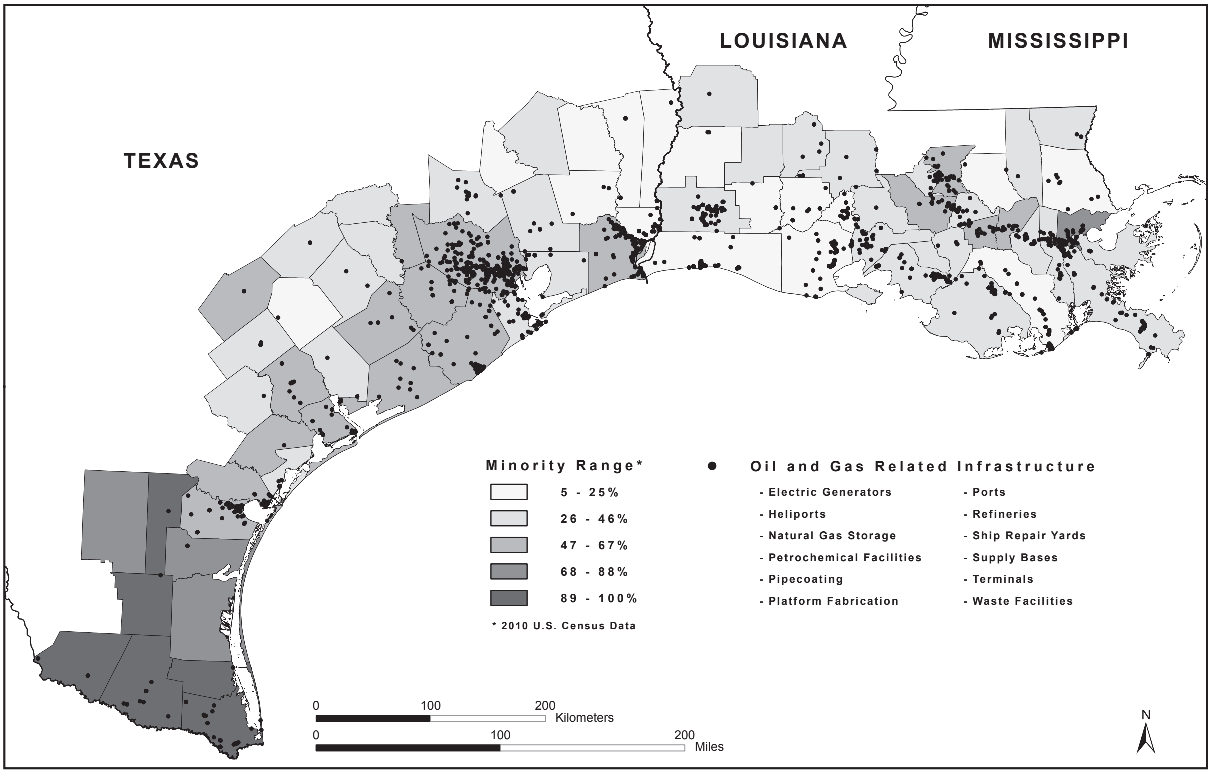

Figure 4-9. Locations of Oil- and Gas-Related Infrastructure and the Distribution of Minority Residents across Counties and Parishes in Texas and Louisiana based on U.S. Census Data from 2010 (USDOC, Census Bureau, 2010; Dismukes, in preparation).

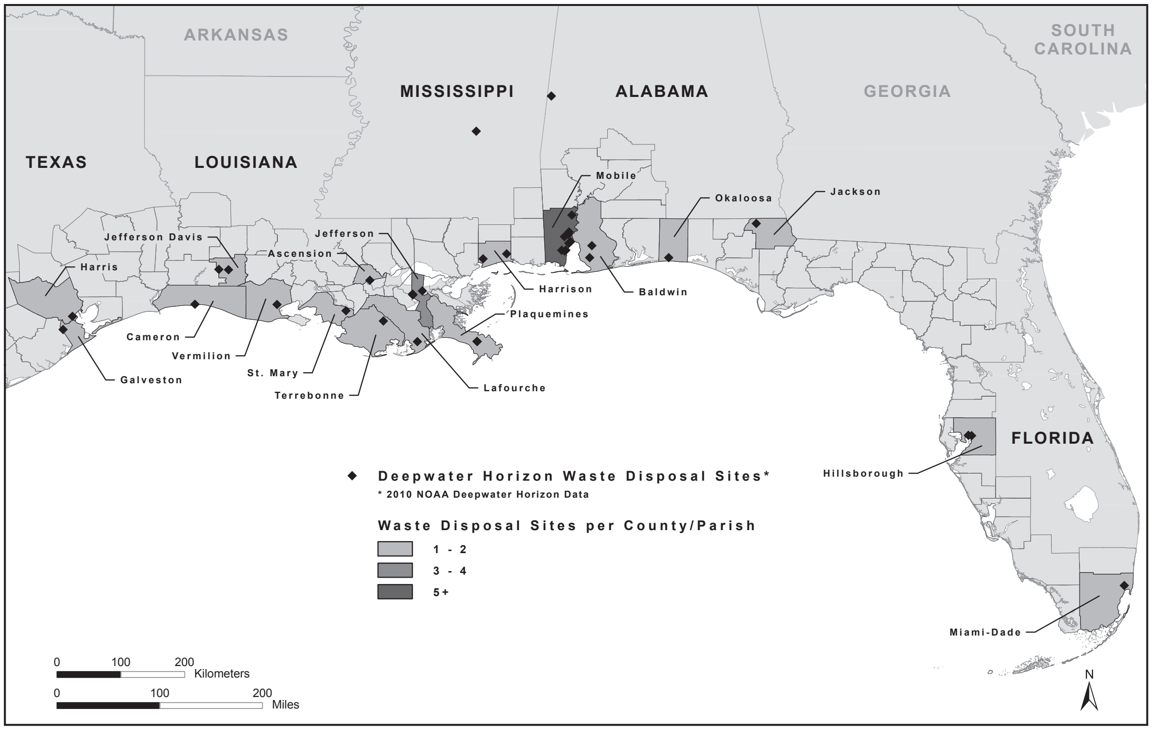

Figure 4-10. Location of All *Deepwater Horizon* Waste Disposal Sites (USDOC, NOAA, 2011; USEPA and British Petroleum, 2010; British Petroleum, 2011a and 2011b).

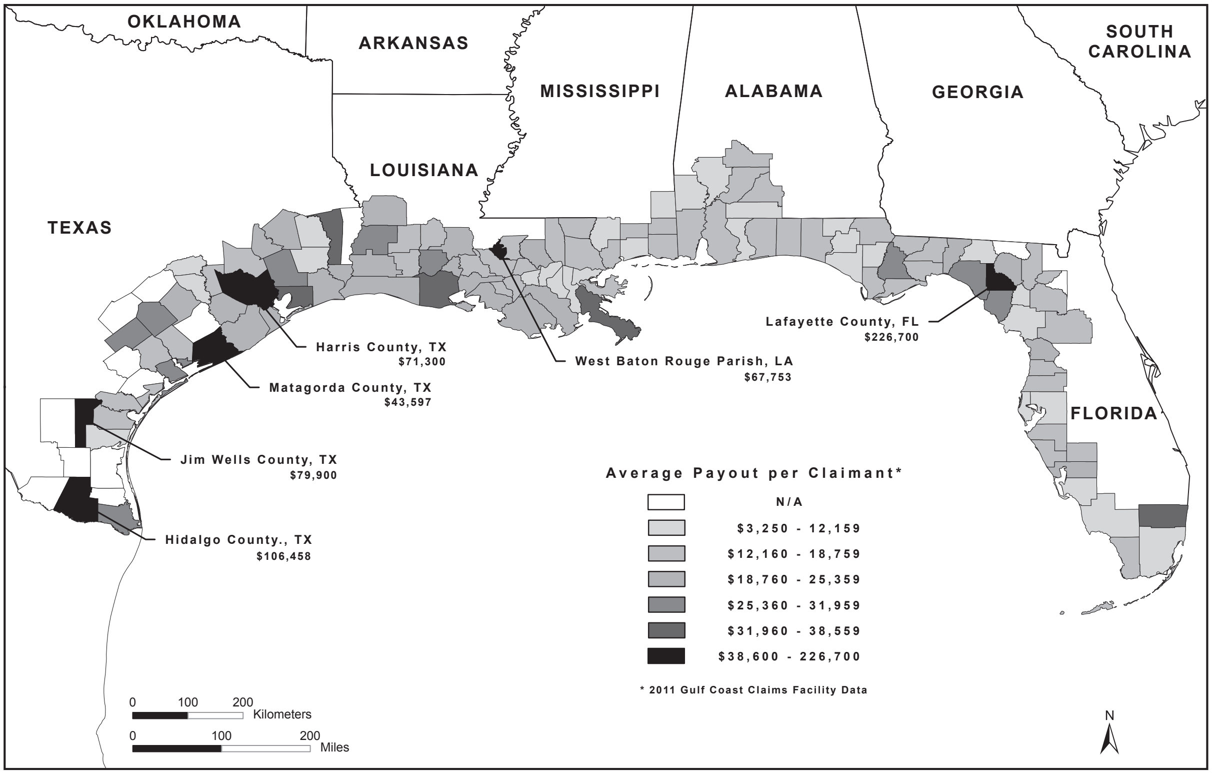

Figure 4-11. Distribution of the Gulf Coast Claims Facility's Claimants and the Average Amount Paid to Each Claimant across Gulf of Mexico Counties and Parishes (Gulf Coast Claims Facility, 2011).

Table 1-1

Emergency 30 CFR 250 Subpart D Interim Final Rule Provisions

Regulation	Summary	Existing Requirement	New Requirement	Cost
30 CFR §250.415(f)	Evaluate best practices in API RP 65-Part 2	No evaluation required	Requires the operator to evaluate the best practices according to API RP 65-Part 2 and submit a written description for the evaluation.	No meaningful cost
			Written description must include the mechanical barriers and cementing practices the operator will use for each casing string.	
			API RP 65 Part 2 addresses cementing practices and factors affecting cementing success.	
30 CFR §250.416(d)	Submittal of schematics of all control systems for BOP stack	Schematic of BOP system showing inside diameter of BOP stack, number and type of preventers, location of choke and kill lines	Schematics of all control systems, including primary controls, secondary controls, and pods for the BOP system must be submitted.	No meaningful cost
			Location of the controls must be included	
30 CFR §250.416(e)	Independent third party verification to ensure blind-shear rams are capable of cutting the drill pipe used	Information that the blind-shear ram is capable of shearing the pipe	Verification that the blind-shear rams installed in the BOP stack are capable of shearing the drill pipe in the hole under maximum anticipated surface pressure.	Independent third-party certification will require a small cost per well
		No independent third-party certification required	Independent third party must be a technical classification society or an API licensed manufacturing, inspection, certification firm, or licensed professional engineering firm.	Will add moderate costs
			Independent third-party must not be the OEM.	
30 CFR §250.418(i)	Submit qualifications of independent third parties with APD	No independent third-party certification required	Description of qualifications in accordance with §250.416 (e)	No meaningful cost

Table 1-1. Emergency 30 CFR 250 Subpart D Interim Final Rule Provisions (continued).

Regulation	Summary	Existing Requirement	New Requirement	Cost
30 CFR §250.420(a) (6)	Professional Engineer verification of well casing and cementing program	No PE verification required	PE will verify there are two independent barriers	Small cost per well if performed by an independent third party
			Verify the casing cementing design is appropriate for the purpose it was intended under expected wellbore conditions	No cost if PE certification is done in house
				Assumed that some majors would verify in-house; smaller operators will use third party
30 CFR §250.420(b) (3)	Dual mechanical barriers	No requirement	Operator must install dual mechanical barriers in addition to cement in the final casing string and document to BOEMRE. Dual float valves, or one float valve and a mechanical plug.	Estimated that 80% of wells already use dual mechanical barriers
				Installation of dual mechanical barriers is estimated to take 21 hours
				Will add significant costs to regulation
30 CFR §250.423(b) (2)	Pressure test on the casing seal assembly	Perform a pressure test on all casing strings (except drive/structural) according to 250.423 (a)	Additional pressure test for the intermediate and production casing strings on the casing seal assembly to ensure proper installation of the casing in the subsea wellhead.	Pressure tests are already required, no extra equipment time
		No requirement to ensure proper installation of the casing in the subsea wellhead		Each pressure test only takes a few minutes
				No meaningful cost
30 CFR §250.423(c)	Negative pressure test	No negative pressure test required	Perform a negative pressure test to ensure proper installation of intermediate and production casing strings	Negative pressure test will take 90 minutes for each required string of casing
				Will result in significant costs for the regulation
30 CFR §250.442(e)	Maintain ROV and a trained crew	ROV’s used for visual inspection every 3 days; 250.446(b)	Required to maintain an ROV and trained crew on each floating rig on a continuous basis.	All rigs are assumed to have an ROV on board. This regulation will not add additional costs.

Table 1-1. Emergency 30 CFR 250 Subpart D Interim Final Rule Provisions (continued).

Regulation	Summary	Existing Requirement	New Requirement	Cost
			ROV must be capable of shutting in the well during emergency situations	Regulation does not require a timed test, therefore current ROV's will be capable of performing all required functions.
30 CFR §250.442(f)	Provide an autoshear and deadman system for dynamically positioned rigs	No autoshear/deadman system requirement	All dynamically positioned rigs must have an autoshear and deadman system	Industry standard for dynamically positioned rigs to have autoshear/deadman systems No meaningful cost
30 CFR §250.442(g)	Barriers on BOP control panels to prevent accidental disconnect functions	No two-handed requirement	Incorporate enable buttons on control panels to ensure 2-handed operations for all critical functions.	No meaningful cost
30 CFR §250.442(h)	Label subsea BOP control panel	No labeling requirement	Clearly label all control panels, such as hydraulic control panels and ROV interface on the BOP	No meaningful cost
30 CFR §250.442(i)	Develop management system for BOP	No management requirement	Develop and use a management system for operating the BOP system	No meaningful cost
			Written procedures for operating the BOP stack and LMRP	
			Minimum knowledge requirements for personnel authorized to operate and maintain critical BOP components	
30 CFR §250.442(j)	Training for BOP equipment	No training requirement	Train BOP personnel in deepwater well control theory and practice in accordance with 30 CFR 250, Subpart O	No meaningful cost
30 CFR §250.446(a)	Document maintenance and inspections to BOP system	No documentation requirement	BOP maintenance and inspections must meet or exceed provisions of Sections 17.10 and 18.10	No meaningful cost
30 CFR §250.449(j)	Subsea function test for ROV intervention	No initial test on the seafloor	All ROV intervention functions must be tested during the stump test and one set of rams during the initial test on the seafloor	Initial test on the seafloor is not industry standard

Table 1-1. Emergency 30 CFR 250 Subpart D Interim Final Rule Provisions (continued).

Regulation	Summary	Existing Requirement	New Requirement	Cost
	on a subsea BOP stack	Stump test for subsea BOP stack	ROV hot stabs must be function tested and capable of actuating at least 1 set of pipe rams, 1 set of blind-shear rams and unlatching the LMRP	ROV seafloor test is estimated to take about 24 hours Will add significant costs
			Operator must examine all surface and subsea well-control equipment to ensure that it is properly maintained and capable of shutting in the well during emergency operations	
30 CFR §250.449(k)	Autoshear/ deadman function test	No required function test	The autoshear and deadman systems must be function tested during the stump test and during the initial test on the seafloor.	No meaningful cost
30 CFR §250.451(i)	Emergency activation of blind or casing shear rams	No required action	If the blind-shear or casing shear rams are activated in a well control situation, the BOP must be retrieved and fully inspected and tested	Emergency situation only, will incur significant loss of rig time
30 CFR §250.456(j)	District Manager approval for displacing kill-weight drilling fluid	No approval requirement	Approval required from District Manager before displacing kill-weight drilling fluid from the wellbore	No meaningful cost
			Submit reasons for displacing and provide detailed procedures of displacement process.	
			Follow procedures in 250.456	
30 CFR §250.516(d) (8)	Subsea function test for ROV intervention on a subsea BOP stack	Stump test BOP stack before installation	All ROV intervention functions must be tested during the stump test and 1 set of rams during the initial test on the seafloor	Will add costs for well completions operations
			ROV hot stabs must be function tested and capable of actuating at least 1 set of pipe rams, 1 set of blind-shear rams and unlatching the LMRP	
			Operator must examine all surface and subsea well-control equipment to ensure that it is properly maintained and capable of shutting in the well during emergency operations	

Table 1-1. Emergency 30 CFR 250 Subpart D Interim Final Rule Provisions (continued).

Regulation	Summary	Existing Requirement	New Requirement	Cost
30 CFR §250.616(h) (1)	Subsea function test for ROV intervention on a subsea BOP stack	Stump test BOP stack before installation	All ROV intervention functions must be tested during the stump test and 1 set of rams during the initial test on the seafloor	Will add costs for well workover operations
			ROV hot stabs must be function tested and capable of actuating at least 1 set of pipe rams, 1 set of blind-shear rams and unlatching the LMRP	
			Operator must examine all surface and subsea well-control equipment to ensure that it is properly maintained and capable of shutting in the well during emergency operations	

Source: *Federal Register*, 2010.

Table 2-1

Presidential and Secretarial Inquiries Resulting from the *Deepwater Horizon* Event and Spill

Initiator and Date	Purpose	Expected Outputs
April 30, 2010 President Obama	Reported if additional precautions and technologies should be required to improve the safety of oil and gas operations on the OCS.	The so-called "30-day Report" or "Safety Measures Report" was delivered to the Secretary on May 27, 2010 (USDOI, 2010a).
April 30, 2010 Secretary Salazar	Created OCS Safety Oversight Board (Board) to provide recommendations for improving and strengthening DOI's overall management, regulation, and oversight of OCS operations, including undertaking further audits or reviews, and reviewing existing authorities and procedures.	The Board delivered its report to the Secretary on September 1. It was made public with an implementation plan on September 8, 2010 (USDOI, 2010b).
May 11, 2010 Secretary Salazar	Impaneled a review by the National Academy of Engineering (NAE) of the root causes of the *Deepwater Horizon* event and provide recommendations	The NAE panel forecasts delivery of their final report that presents the Committee's final analysis, including findings and/or recommendations, by June 1, 2011 (pre-publication version); a final published version will follow by December 30, 2011 (NAE and NRC, 2011).
May 21, 2010 President Obama	Created the National Commission on the BP *Deepwater Horizon* Oil Spill and Offshore Drilling to develop findings and recommendations within 6 months.	The Commission delivered the Final Report to the President on January 11, 2011 (Oil Spill Commission, 2011).
May 25, 2010 Secretary Salazar	Requested that the DOI's Office of the Inspector General investigate any deficiencies in BOEMRE policies and practices that may have contributed to the *Deepwater Horizon* event.	The DOI's Office of the Inspector General released its report on December 7, 2010 (USDOI, Office of the Inspector General, 2010).

Table 3-1

Projected Oil and Gas in the Gulf of Mexico OCS

	Proposed Action	OCS Program (2007-2046)
Western Planning Area		
Reserve/Resource Production		
Oil (BBO)	0.222-0.423	6.629-8.060
Gas (Tcf)	1.495-2.647	52.211-59.961
Central Planning Area		
Reserve/Resource Production		
Oil (BBO)	0.801-1.624	21.933-24.510
Gas (Tcf)	3.332-6.560	90.155-102.761

BBO = billion barrels of oil
Tcf = trillion cubic feet

Table 3-2

Offshore Scenario Information Related to the Proposed Action in the Western Planning Area

	Offshore Subareas[1]							
	0-60 m	60-200 m	200-400 m	400-800 m	800-1,600 m	1,600-2,400 m	>2,400 m	Total WPA[2]
Wells Drilled								
Exploration and Delineation Wells	21-36	5-7	1	3-4	5-10	2-3	3-5	40-66
Development and Production Wells	58-89	11-15	4-7	8-13	43-75	8-15	5-8	137-221
Producing Oil Wells	3-4	1-2	1-2	4-7	23-39	4-8	3-4	39-65
Producing Gas Wells	48-73	9-11	3-4	3-4	15-26	3-5	2-3	83-127
Production Structures								
Installed	19-31	2	1	1	1-3	1-2	1	26-41
Removed Using Explosives	9-17	1	0	0	0	0	0	14-25
Total Removed	12-22	2	1	1	1-3	1	1	19-33
Length of Installed Pipelines (km)[3]	60-420	NA	NA	NA	NA	NA	NA	130-760
Service-Vessel Trips (1,000's round trips)	21-33	3	1	1-3	18-51	16-33	16-17	76-141
Helicopter Operations (1,000's operations)	300-680	30-44	14-22	14-22	14-66	14-44	14-22	400-900

[1] See Figure 3-1.

[2] Subarea totals may not add up to the planning area total because of rounding.

[3] Projected length of pipelines does not include length in State waters.

NA = not available.

Table 3-3

Deepwater Rig Counts, Day Rates, and Annual Drill Rates in the Gulf of Mexico*

Rig Type	Number of Rigs	Loaded Day Rate
Drillship	11	$1,000,000
Deep Semisubmersible	21	$923,953
Low Semisubmersible	4	$715,792
MODU Total or Weighted Average	36	$924,060
Platform	10	$400,000

* Current to August 2010.

Table 3-4

Oil Spilled from Pipelines on the Federal OCS, 2002-2009

Regulator	Area	Total Oil Spilled (bbl)	Oil Spilled due to Hurricanes (bbl)	Proportion of Total due to Hurricanes (%)
BOEMRE	Federal OCS	5,522	5,179	94
DOT	Federal OCS	5,667	3,272	58
DOT	State Waters	9,903	9,622	97

Source: USDOI, BOEMRE and DOT data.

Table 3-5

Mean Number and Sizes of Spills Estimated to Occur
in OCS Offshore Waters from an Accident Related
to Activities Supporting the Proposed Action Over a 40-Year Time Period

Spill Size Group	Spill Rate (spills/BBO) [1]	Number of Spills Estimated for a WPA Proposed Action [2]	Number of Spills Estimated for a CPA Proposed Action [2]	Estimated Spill Size [1]
0-1.0 bbl	3,357.31	745-1,420	2,690 -5,452	0.07[3]
1.1-9.9 bbl	74.7	17-32	60-121	3[4]
10.0-49.9 bbl	16.18	4-7	13-27	20[4]
50.0-499.9 bbl	6.37	1-3	5-11	90[4]
500.0-999.9 bbl	0.52	<1	<1-1	640[4]
≥1,000 bbl	1.51	<1-1	1-3	4,600[4]
≥10,000 bbl	0.39	<1	<1-1	15,000[4]

Notes: The number of spills estimated is derived by application of the historical rate of spills per volume crude oil handled (1985-1999) (Anderson and LaBelle, 2000) to the projected production for a proposed action in the WPA or CPA (Table 4-1). Projected production is an estimate of recoverable resource and is influenced by supporting infrastructure, as well as economic and technological factors. The actual number of spills that may occur in the future could vary from the estimated number.

[1] Source: Anderson and LaBelle, 2000.
[2] Source: Table 4-1.
[3] Average spill size.
[4] Median spill size.

Table 3-6

Properties and Persistence by Oil Component Group

Properties and Persistence	Light-weight	Medium-weight	Heavy-weight
Hydrocarbon compounds	Up to 10 carbon atoms	10-22 carbon atoms	>20 carbon atoms
API º	>31.1º	31.1º-22.3 º	<22.3 º
Evaporation rate	Rapid (within 1 day) and complete	Up to several days; not complete at ambient temperatures	Negligible
Solubility in water	High	Low (at most a few mg/L)	Negligible
Acute toxicity	High due to monoaromatic hydrocarbons (BTEX)	Moderate due to diaromatic hydrocarbons (naphthalenes – 2 ring PAH's)	Low except due to smothering (i.e., heavier oils may sink)
Chronic toxicity	None, does not persist due to evaporation	PAH components components (e.g., naphthalenes – 2 ring PAH's)	PAH components (e.g., phenanthrene, anthracene – 3 ring PAH's)
Bioaccumulation potential	None, does not persist due to evaporation	Moderate	Low, may bioaccumulate through sediment sorption
Compositional majority	Alkanes and cycloalkanes	Alkanes that are readily degraded (specify, as done for others)	Waxes, asphaltenes, and polar compounds (not significantly bioavailable or toxic)
Persistence	Low due to evaporation	Alkanes readily degrade, but the diaromatic hydrocarbons are more persistent	High; very low degradation rates and can persist in sediments as tarballs or asphalt pavements

Sources: Michel, 1992; Canadian Center for Energy Information, 2010.

Table 3-7

Estimated Number of Spills that Could Happen in Gulf Coastal Waters from an Accident Related to Activities Supporting a Proposed Action

Size Category	Assumed Size	WPA Proposed Action	CPA Proposed Action
Total		15-34	49-126
≤1 bbl	1 bbl	12-29	44-114
>1 bbl and <50 bbl	3 bbl	1-2	2-5
≥50 bbl and <1,000 bbl	150 bbl	1-2	2-6
≥1,000 bbl	3,000 bbl	<1-1	<1-1

Note: The estimated number of spills is obtained from the count of coastal spills for 2001 proportioned to reflect that OCS oil comprised 19 percent of the oil crossing into GOM coastal waters in 2001. Intrastate oil and refined product transport were not included. The low estimate in the range was obtained from Dickey (personal communication, 2006) and the high estimate was obtained from aggregated national data available on the Internet (USDOT, Coast Guard, 2001).

Sources: Dickey, personal communication, 2006; USDOT, Coast Guard, 2001; National Ocean Economics Program, 2006; USDOE, EIA, 2006.

Table 3-8

Primary Cleanup Options Used during the *Deepwater Horizon* Response

	Fresh Oil	Sheens	Mousse	Tarballs	Burn Residue
On-Water Response	Disperse, skim, burn	Light sheens very difficult to recover, heavier sheens picked up with sorbent boom or sorbent pads	Skim	Snare boom	Manual removal
On-Land Response	Sorbent pads, manual recovery, flushing with water, possible use of chemical shoreline cleaning agents	Light sheens very difficult to recover, heavier sheens picked up with sorbent boom or sorbent pads	Sorbent pads, manual recovery	Snare boom, manual removal, beach cleaning machinery	Manual removal

Source: USDOC, NOAA, 2010a.

Table 3-9

Pipelines* Damaged after 2004-2008 Hurricanes Passing through the WPA and CPA

Hurricane	Total Damage Reports	Pipe and Movement	Platform Connection	Riser	Mudflow	Outside Impact	Unknown
Ivan	168	38	20	67	16	9	18
Katrina	299	61	139	66	1	9	14
Rita	243	31	94	89	0	8	21
Gustav/Ike	314	14	2	273	2	7	16

* Not discriminated by diameter.
Sources: Energo Engineering, 2010; Atkins et al., 2007.

Table 3-10

Causes of Hurricane-Related Pipeline Spills Greater Than 50 Barrels

Hurricane	Amount Spilled (bbl)	Cause
Ivan	1,720	Mudflow
Ivan	671	Movement
Ivan	126	Platform
Ivan	200	Platform
Ivan	250	Platform
Ivan	260	Platform
Ivan	95	Movement
Ivan	123	Movement
Katrina	960	Movement
Katrina	50	Platform
Katrina	55	Riser
Katrina	132	Mudslide
Katrina	50	Movement
Rita	75	Riser
Rita	100	Outside Force
Rita	862	Outside Force/Platform
Rita	67	Platform
Rita	108	Riser
Ike	69	Movement
Ike	108	Riser
Ike	56	Platform
Ike	1,316	Outside Force
Ike	209	Riser
Ike	268	Riser

Source: USDOI, BOEMRE data.

Table 3-11

2009 Offshore Total Oil and Gas Production in the Offshore Areas of 11 Contiguous Texas Coastal Counties

County	Texas State District No.	Total Oil Produced (bbl)	Total Gas Produced (MMcf)
Jefferson	3	86,078	35,936
Chambers	3	6,166	10,035
Galveston	3	0	0
Brazoria	3	0	0
Matagorda	3	0	0
Calhoun	2	116,934	0
Aransas	4	0	0
Nueces	4	20,806	39,967
Kleberg	4	0	0
Kenedy	4	0	0
Willacy	4	0	0
Cameron	4	0	0

Source: Railroad Commission of Texas, 2010.

Table 3-12

Total Producing Wells, Total Oil, and Total Gas Production in the Nine Coastal Parishes of Louisiana in 2009

Parish	Total Producing Wells	Total Oil Produced (bbl)	Total Gas Produced (Mcf)
St. Bernard	114	666,757	12,662,442
Plaquemines	1,734	16,870,508	74,737,520
Jefferson	221	1,202,961	11,199,616
Lafourche	539	5,769,795	35,366,426
Terrebonne	569	5,984,437	93,070,163
St. Mary	345	3,400,486	40,127,959
Iberia	172	2,891,805	48,567,357
Vermilion	249	3,062,983	63,928,992
Cameron	323	3,278,189	57,276,938
TOTAL	4,266	43,127,921	436,940,000

Mcf = 1,000 ft^3
bbl = 42 U.S. gal
Source: SONRIS lite database (Louisiana Dept. of Natural Resources, 2010).

Table 3-13

Designated Ocean Dredged-Material Disposal Sites in the Cumulative Impact Area

ODMDS Name	Location Coordinates		Water Depth	Size	Authorized Material, Last Time Used and Amount Disposed
	Latitude	Longitude			
Pensacola Nearshore	30°17'24"N 30°17'00"N 30°15'36"N 30°15'15"N	87°18'30"W 87°19'50"W 87°17'48"W 87°19'18"W	~36 ft, ~11 m	2.48 mi^2, 642 ha, 1,587 ac	Medium-grained sand, <10% fines. 1987; 157,100 yd^3
Pensacola Offshore	30°08'50"N 30°08'50"N 30°07'05"N 30°07'05"N	87°19'30"W 87°16'30"W 87°16'30"W 87°19'30"W	65-80 ft 20-24 m	6 mi^2, 1,554 ha, 3,840 ac	Primarily fine-grained. 2005; 63,000 yd^3
Mobile	30°10'00"N 30°10'24"N 30°09'24"N 30°08'30"N 30°08'30"N	88°07'42"W 88°05'12"W 88°04'42"W 88°05'12"W 88°08'12"W	~46 ft, ~14 m	4.8 mi^2, 1,243 ha, 3,072 ac	Dredged material meeting US EPA Ocean Dumping Criteria. 2008; 2,235,993 yd^3
Pascagoula	30°12'06"N 30°11'42"N 30°08'30"N 30°08'18"N	88°44'30"W 88°33'24"W 88°37'00"W 88°41'54"W	38-52 ft, 11.5-19 m	18.5 mi^2, 4,791 ha, 11,840ac	Suitable material from the Mississippi Sound and vicinity. 2008; 1,489,100 yd^3
Gulfport West	30°12'00"N 30°12'00"N 30°11'00"N 30°07'00"N 30°06'36"N 30°10'30"N	89°00'30"W 88°59'30"W 89°00'00"W 88°56'30"W 88°57'00"W 89°00'36"W	~27 ft, ~8.2 m	5.2 mi^2, 1,346 ha, 3,328 ac	Dredged material meeting US EPA Ocean Dumping Criteria. 2005; 390,000 yd^3
Gulfport East	30°11'10"N 30°11'12"N 30°07'36"N 30°07'24"N	88°58'24"W 88°57'30"W 88°54'24"W 88°54'48"W	~30 ft, ~9.1 m	2.47 mi^2, 640 ha, 1,581 ac	Meet US EPA Ocean Dumping Criteria. 1996; 323,300 yd^3
Mississippi River - Gulf Outlet	29°22'00"N 29°23'00"N 29°24'30"N	88°56'30"W 88°54'30"W 88°52'30"W	20-40 ft, 6-12 m	6.03 mi^2, 1,562 ha, 3,859 ac	Dredged material from the vicinity of Mississippi River Gulf Outlet. 2005; 909,100 yd^3
Mississippi River - Southwest Pass	28°53'58"N 28°53'45"N 28°53'13"N 28°53'11"N	89°25'31"W 89°25'09"W 89°25'28"W 89°24'49"W	8-106 ft, 2.7-32.2 m	3.44 mi^2, 891 ha, 2,202 ac	Dredged material from the vicinity of the Southwest Pass Channel. 2008; 6,890,400 yd^3
Barataria Bay Waterway	29°13'30"N 29°13'54"N 29°14'21"N	89°53'30"W 89°53'48"W 89°54'06"W	8-20 ft, 2.4-6.1 m	1,4 mi^2, 362 ha, 896 ac	Dredged material from the vicinity of Barataria Bay Waterway. 1988; 775,000 yd^3
Houma Navigation Canal (Cat Island Pass)	28°58'09"N 28°58'57"N 28°57'57"N	90°29'30"W 90°31'30"W 90°31'54"W	6-30 ft, 1.8-9.1 m	2.08 mi^2, 539 ha, 1,331 ac	Dredged material from the vicinity of Cat Island Pass, Louisiana. 1997; 117,400 yd^3

Table 3-13. Designated Ocean Dredged-Material Disposal Sites in the Cumulative Impact Area (continued).

ODMDS Name	Location Coordinates		Water Depth	Size	Authorized Material, Last Time Used and Amount Disposed
	Latitude	Longitude			
Atchafalaya Bar Channel	29°07'00"N 29°08'00"N 29°09'00"N	91°31'30"W 91°29'00"W 91°27'00"W	~16 ft, ~4.8 m	9.14 mi², 2,367 ha, 5,850 ac	Dredged material from the bar channel of the Atchafalaya River. 2008; 9,545,800 yd³
Calcasieu River & Pass	29°30'00"N 29°30'51"N 29°30'00"N	93°10'18"W 93°10'00"W 93°09'27"W	36-46 ft, 11 to 14 m	5.8 mi², 1,502 ha, 3,712 ac	Dredged material from the vicinity of the Calcasieu River and Pass Project. 2008; 364,700 yd³
Sabine-Neches Waterway No. 1 & 2	29°27'30"N 29°27'30"N 29°26'38"N 29°26'38"N	93°37'00"W 93°36'45"W 93°36'45"W 93°37'00"W	25.7-42.6 ft, 9-13 m	6.6 mi², 1709 ha, 4,224 ac	Dredged material from the Sabine-Neches area. 2006; 1,524,200 yd³
Sabine-Neches Waterway No. 3 & 4	29°35'52"N 29°35'52"N 29°35'00"N 29°35'00"N	93°41'45"W 93°41'30"W 93°41'30"W 93°41'45"W	16.4-33 ft, 5-10 m	8.9 mi², 2,305 ha, 5,696 ac	Dredged material from the Sabine-Neches area. 2008; 1,691,900 yd³
Galveston Harbor & Channel	29°20'22"N 29°19'32"N 29°19'23"N 29°20'13"N	94°37'11"W 94°36'56"W 94°37'06"W 94°37'21"W	33-51 ft, 10-15.5 m	6.6 mi², 1,709 ha, 4,224 ac	Dredged material from the Galveston, Texas, area. 2008; 2,395,800 yd³
Freeport Harbor, New Work	28°54'28"N 28°54'35"N 28°55'07"N 28°54'60"N	95°13'40"W 95°13'28"W 95°14'01"W 95°14'13"W	54-61 ft, 16.4-18.6 m	2.64 mi², 684 ha, 1,690 ac	Dredged material from the Freeport Harbor Entrance and Jetty Channels, Texas. 1992; 46,800 yd³
Matagorda Ship Channel	28°24'27"N 28°24'33"N 28°25'10"N 28°25'04"N	96°16'04"W 96°15'52"W 96°16'30"W 96°16'42"W	25-40 ft, 7.5-12.2 m	0.56 mi², 145 ha, 358 ac	Dredged material from the Matagorda Ship Channel, Texas. 2006; 336,700 yd³
Corpus Christi Ship Channel	27°50'10"N 27°50'20"N 27°50'48"N 27°50'38"N	96°59'17"W 96°59'09"W 96°59'57"W 97°00'05"W	35-50 ft, 10.6-15.2m	0.63 mi², 163 ha, 403 ac	Dredged material from the Corpus Christi Ship Channel, Texas. 2007; 954,600 yd³
Port Mansfield	26°32'11"N 26°31'58"N 26°31'58"N 26°32'11"N	97°13'44"W 97°13'44"W 97°14'42"W 97°14'42"W	35-50 ft, 10.6-15.2 m	0.42 mi², 109 ha, 269 ac	Dredged material from the Port Mansfield Entrance Channel, Texas. 1986; 104,200 yd³
Brazos Island Harbor	26°02'18"N 26°02'18"N 26°02'05"N 26°02'05"N	96°06'30"W 97°07'26"W 97°07'26"W 96°06'30"W	55-65 ft, 16.7-19.8 m	0.42 mi², 109 ha, 269 ac	Dredged material from the Brazos Island Harbor Entrance Channel, Texas. 1997; 350,900

~ approximately.
Sources: National Archives and Records Administration, 2010; U.S. Dept. of the Army, COE, 2011a.

Table 3-14

Projected OCS Sand Borrowing Needs for Planned Restoration Projects

Restoration Project	Maximum Sand (yd^3)	Source (OCS Area and Block) (if known)
Pelican Island (CWPPRA BA-35)	~5,500,000	West Delta (Sandy Point site)
Raccoon Island (CWPPRA TE-48)	750,000 to 830,000	Ship Shoal 64 & 71
Cameron Parish Shoreline	~10,000,000	Sabine Bank
Point Au Fer Shoreline	N/A	N/A
LCA Terrebonne Basin		
Raccoon Island	~8,340,000	Ship Shoal 88 & 89; South Pelto 12 & 13
Whiskey Island	~7,720,000	Ship Shoal 88 & 89; South Pelto 12 & 13
Trinity and East Islands	~16,260,000	Ship Shoal 88 & 89; South Pelto 12 & 13
Timbalier Island	~10,700,000	Ship Shoal 88 & 89; South Pelto 12 & 13
East Timbalier Island	~11,230,000	N/A
LCA Barataria Basin		
Caminada Headland	~6,000,000	South Pelto 12 &13
TOTAL	~76,500,000	

N/A = not available
~ approximately

Table 3-15

Vessel Calls at U.S. Gulf Coast Ports in 2004 and 2009

Vessel Type	2004 Percent of Total Calls in U.S.	2009 Percent of Total Calls in U.S.
Tanker	52.4	55.8
Container	7.0	9.0
Dry Bulk	42.6	46.8
RO-RO (Roll-on Roll-off)	7.0	9.9
Gas	59.8	62.6
Combo	56.2	75.6
General	28.8	39.0
All Types	31.2	34.1

Source: USDOT, MARAD, 2009.

Table 3-16

Corps of Engineers' Galveston District Maintenance Dredging Activity 2000-2008
for Federal Navigation Channels in Texas

Harbor, Channel, or Waterway	Year	Volume Dredged	
		yd^3	m^3
Houston-Galveston Ship Channel	2000	1,860,000	1,422,072
Sabine-Neches Waterway	2001	3,107,000	2,375,472
Freeport Harbor and Channel	2001	1,895,000	1,448,831
Matagorda Ship Channel	2001	218,400	166,979
Freeport Harbor and Channel	2002	1,526,400	1,167,017
Sabine-Neches Waterway	2002	2,200,400	1,682,327
Corpus Christi Ship Channel	2003	711,600	544,057
Sabine-Neches Waterway	2003	2,710,500	2,072,326
Freeport Harbor	2003	1,261,600	964,562
Galveston Harbor and Channel	2003	1,602,300	1,225,046
Freeport Harbor	2004	1,417,600	1,083,833
Matagorda Ship Channel	2004	279,200	213,464
Sabine-Neches Waterway	2004	1,421,900	1,087,121
Sabine-Neches Waterway	2005	812,500	621,201
Freeport Harbor	2005	143,900	110,019
Sabine-Neches Waterway	2006	1,165,000	890,706
Freeport Harbor	2006	2,620,300	2,003,363
Galveston Harbor and Channel	2006	2,863,000	2,188,921
Matagorda Ship Channel	2006	257,400	196,796
Corpus Christi Ship Channel	2006	114,500	87,541
Freeport Harbor	2007	1,856,200	1,419,167
Galveston Harbor	2007	2,247,100	1,718,031
Corpus Christi Ship Channel	2007	729,900	558,049
Sabine-Neches Waterway	2007	30,600	23,395
Sabine-Neches Waterway	2008	1,293,600	989,028
Freeport Harbor	2008	1,205,900	921,977
Galveston Harbor and Channel	2008	1,851,800	1,415,803
TOTAL		37,403,600	28,597,104

Source: U.S Dept. of the Army, COE, 2011b.

Table 3-17

Designated Louisiana Service Bases Identified in Applications for Pipelines, Exploration, and Development Plans between 2003 and 2008 and Miles of Navigation Canal Bordered by Saline, Brackish Water, and Freshwater Wetlands

Shore Base	Number of Pipeline Applications with Designated Service Base		Number of Exploration and Development Plans with Designated Service Base		Miles Bordering Salt and Brackish Wetlands	Miles Bordering Fresh Wetlands
	2003-2008	Percent	2003-2008	Percent		
Fourchon	303	31.5	618	44.4	0**	0**
Cameron	247	25.7	383	27.5	0	0
Intracoastal City	102	10.6	94	6.7	6.4	0
Venice	96	10.0	139	9.9	Miss. River	0
Morgan City	68	7.1	52	3.7	Miss. River	0
Leeville	37	3.9	18	1.3	0	0
Grand Isle	29	3.0	2	0.1	0	0
Dulac	20	2.1	8	0.6	1.7	0
Berwick	14	1.5	19	1.4	Atch. River	0
Lake Charles	12	1.2	1	0.1	3.4	0
Freshwater City	10	1.0	18	1.3	0	0
Houma	8	0.8	18	1.3	5.3	6.6
Amelia	2	0.2	7	0.5	0	0
Galliano	1	0.1	7	0.5	0	0
Boothville	3	0.3	6	0.4	Miss. River	0
Abbeville	7	0.7	0	0.0	0	0
Grand Chenier	2	0.2	1	0.1	0	0
Grand Total	961	99.9	1,391	99.8	16.8	6.6

*= compiled by BOEMRE staff using operator-designated service bases from OCS plans and pipeline applications.
**= "0" indicates the service base has no surrounding wetlands in the category.

Table 3-18

CIAP Allocations for all Eligible States ($)

Recipient	FY 2007	FY 2008	FY 2009	FY 2010	Total
Alabama	25,551,607.04	25,551,607.04	19,728,257.36	19,524,845.48	90,356,316.92
State Share	16,608,544.58	16,608,544.58	12,823,367.28	12,691,149.56	58,731,606.00
County Share	8,943,062.46	8,943,062.46	6,904,890.08	6,833,695.92	31,624,710.92
Alaska	2,425,000.00	2,425,000.00	37,471,876.48	37,085,568.47	79,407,444.95
State Share	1,576,250.00	1,576,250.00	24,356,719.71	24,105,619.51	51,614,839.22
Borough Share	848,750.00	848,750.00	13,115,156.77	12,979,948.97	27,792,605.74
California	7,444,441.75	7,444,441.75	4,923,124.98	4,872,363.83	24,684,372.31
State Share	4,838,887.13	4,838,887.13	3,200,031.24	3,167,036.49	16,044,841.99
County Share	2,605,554.61	2,605,554.61	1,723,093.74	1,705,327.34	8,639,530.30
Louisiana	127,547,898.57	127,547,898.57	120,911,588.83	119,663,560.77	495,670,946.74
State Share	82,906,134.07	82,906,134.07	78,592,532.74	77,781,314.50	322,186,115.38
Parish Share	44,641,764.50	44,641,764.50	42,319,056.09	41,882,246.27	173,484,831.36
Mississippi	30,939,850.55	30,939,850.55	23,819,815.26	23,574,217.72	109,273,734.08
State Share	20,110,902.86	20,110,902.86	15,482,879.92	15,323,241.52	71,027,927.16
County Share	10,828,947.69	10,828,947.69	8,336,935.34	8,250,976.20	38,245,806.92
Texas	48,591,202.09	48,591,202.09	35,645,337.09	35,279,443.73	168,107,185.00
State Share	31,584,281.36	31,584,281.36	23,169,469.11	22,931,638.42	109,269,670.25
County Share	17,006,920.73	17,006,920.73	12,475,867.98	12,347,805.30	58,837,514.74

Table 3-19

CIAP Grants Status for Gulf of Mexico States ($)

Recipient	Total Allocation	Amount Applied For	Amount Awarded	Amount Under Review	Allocation Balance
Alabama	90,356,316.92	26,371,168.00	17,665,845.59	8,705,322.41	63,985,148.92
State	58,731,606.00	13,408,368.07	10,576,735.04	2,831,633.03	45,323,237.93
County	31,624,710.92	12,962,799.93	7,089,110.55	5,873,689.38	18,661,910.99
Louisiana	495,670,946.74	167,570,557.69	151,147,595.40	16,422,962.29	328,100,389.05
State	322,186,115.38	114,414,404.38	109,013,629.00	5,400,775.38	207,771,711.00
Parish	173,484,831.36	53,156,153.31	42,133,966.40	11,022,186.91	120,328,678.05
Mississippi	109,273,734.08	41,527,869.50	32,065,439.00	9,462,430.50	67,745,864.58
State	71,027,927.16	33,239,105.50	30,083,154.00	3,155,951.50	37,788,821.66
County	38,245,806.92	8,288,764.00	1,982,285.00	6,306,479.00	29,957,042.92
Texas	168,107,185.00	25,091,736.63	22,005,691.30	3,086,045.33	143,015,448.36
State	109,269,670.25	19,627,047.36	18,627,047.36	1,000,000.00	89,642,622.89
County	58,837,514.74	5,464,689.27	3,378,643.94	2,086,045.33	53,372,825.47
Total GOM	863,408,182.74	260,561,331.82	222,884,571.29	37,676,760.53	602,846,850.91

Table 3-20

Hurricane Landfalls in the Northern Gulf of Mexico
from 1995 to 2010

Event	Year	Impacted State	Storm Name	Intensity at Landfall
1	1995	AL, FL	Opal	Hurricane Category 3
2	1995	FL	Erin	Hurricane Category 2
3	1997	LA, AL	Danny	Hurricane Category 1
4	1998	FL	Earl	Hurricane Category 1
5	1998	MS, AL	Georges	Hurricane Category 2
6	1999	TX	Bret	Hurricane Category 3
7	2002	LA	Lili	Hurricane Category 1
8	2003	TX	Claudette	Hurricane Category 1
9	2004	MS, AL	Ivan	Hurricane Category 4
10	2005	LA, MS	Cindy	Hurricane Category 1
11	2005	FL, AL	Dennis	Hurricane Category 3
12	2005	LA, MS	Katrina	Hurricane Category 5
13	2005	TX, LA	Rita	Hurricane Category 3
14	2007	TX, LA	Humberto	Hurricane Category 1
15	2008	LA	Gustav	Hurricane Category 2
16	2008	TX, LA	Ike	Hurricane Category 4
17	2008	TX	Dolly	Hurricane Category 1

* No hurricane landfalls in the northern Gulf of Mexico in 2009 or 2010.
Source: USDOC, NOAA, 2010b.

Table 3-21

OCS Facility Damage after the 2004-2008 Hurricanes in the WPA and CPA

Storm	Platforms Exposed to High Winds (≥73 mph)	Platforms		Damaged Pipelines (≥10 in)
		Destroyed	Damaged	
Ivan (2004)	150	7	14	13
Katrina (2005)	3,050*	43	NR	40
Rita (2005)		69	NR	101
Gustav (2008)	677	1	40	NR
Ike (2008)	2,127	60	124	NR

NR = not reported.
* Combined totals for both Hurricanes Katrina and Rita.
Statistics compiled from BOEMRE website and press releases.

Table 4-1

National Ambient Air Quality Standards

Pollutant	Primary Standards		Secondary Standards	
	Level	Averaging Time	Level	Averaging Time
Carbon Monoxide	9 ppm (10 mg/m^3)	8-hour (1)	None	
	35 ppm (40 mg/m^3)	1-hour (1)		
Lead	0.15 µg/m^3 (2)	Rolling 3-Month Average	Same as Primary	
	1.5 µg/m^3	Quarterly Average	Same as Primary	
Nitrogen Dioxide	53 ppb (3)	Annual (Arithmetic Average)	Same as Primary	
	100 ppb	1-hour (4)	None	
Particulate Matter (PM_{10})	150 µg/m^3	24-hour (5)	Same as Primary	
Particulate Matter ($PM_{2.5}$)	15.0 µg/m^3	Annual (6) (Arithmetic Average)	Same as Primary	
	35 µg/m^3	24-hour (7)	Same as Primary	
Ozone	0.075 ppm (2008 std)	8-hour (8)	Same as Primary	
	0.08 ppm (1997 std)	8-hour (9)	Same as Primary	
	0.12 ppm	1-hour (10)	Same as Primary	
Sulfur Dioxide	0.03 ppm	Annual (Arithmetic Average)	0.5 ppm	3-hour (1)
	0.14 ppm	24-hour (1)		
	75 ppb (11)	1-hour	None	

(1) Not to be exceeded more than once per year.
(2) Final rule signed October 15, 2008.
(3) The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.
(4) To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 100 ppb (effective January 22, 2010).
(5) Not to be exceeded more than once per year on average over 3 years.
(6) To attain this standard, the 3-year average of the weighted annual mean $PM^{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m^3.
(7) To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m^3 (effective December 17, 2006).
(8) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm (effective May 27, 2008).
(9) (a) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.
(b) The 1997 standard—and the implementation rules for that standard—will remain in place for implementation purposes as USEPA undertakes rulemaking to address the transition from the 1997 ozone standard to the 2008 ozone standard.
(c) USEPA is in the process of reconsidering these standards (set in March 2008).
(10) (a) USEPA revoked the 1-hour ozone standard in all areas, although some areas have continuing obligations under that standard ("anti-backsliding").
(b) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is ≤ 1.
(11) (a) Final rule signed June 2, 2010. To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 ppb.

Table 4-2

Estimated Abundance of Cetaceans
in the Northern Gulf of Mexico

Species	Common Name	Estimated Number of Individuals
Balaenoptera edeni	Bryde's whale	15
Physeter macrocephalus	Sperm whale*	1,665
Kogia spp.	Dwarf and Pygmy sperm whale	453
Ziphius cavirostris	Cuvier's beaked whale	65
Mesoplodon sp.	Blainville's and Gervais' beaked whale	57
Feresa attenuata	Pygmy killer whale	323
Pseudorca crassidens	False killer whale	777
Orcinus orca	Killer whale	49
Globicephala sp.	Pilot whale, short-finned	716
Peponocephala electra	Melon-headed whale	2,283
Grampus griseus	Risso's dolphin	1,589
Tursiops truncatus	Bottlenose dolphin	13,883
Steno bredanensis	Rough-toothed dolphin	unknown
Lagenodelphis hosei	Fraser's dolphin	unknown
Stenella frontalis	Atlantic spotted dolphin	unknown
Stenella longirostris	Spinner dolphin	1,989
Stenella attenuate	Pantropical spotted dolphin	34,067
Stenella clymene	Clymene dolphin	6,575
Stenella coeruleoalba	Striped dolphin	3,325

*Endangered.
Source: Waring et al., 2010.

Table 4-3

Sea Turtle Taxa of the Northern Gulf of Mexico

Order Testudines (turtles)	Relative Occurrence	ESA Status
Family Cheloniidae (hardshell sea turtles)		
Loggerhead sea turtle (*Caretta caretta*)	C	T
Green sea turtle (*Chelonia mydas*)	C	T/E
Hawksbill sea turtle (*Eretmochelys imbricata*)	R	E
Kemp's ridley sea turtle (*Lepidochelys kempii*)	C	E
Family Dermochelyidae (leatherback sea turtle)		
Leatherback sea turtle (*Dermochelys coriacea*)	U	E

Population status in the northern Gulf is summarized according to the following categories:
COMMON (C): A common species is one that is abundant wherever it occurs in the region (i.e., the northern Gulf). Most common species are widely distributed over the area.
UNCOMMON (U): An uncommon species may or may not be widely distributed but does not occur in large numbers. Uncommon species are not necessarily rare or endangered.
RARE (R): A rare species is one that is present in such small numbers throughout the region that it is seldom seen. Although not threatened with extinction, a rare species may become endangered if conditions in its environment change.

Endangered Species Act (ESA) status is summarized according to listing status under the following categories:
ENDANGERED (E): Species determined to be in imminent danger of extinction throughout all of a significant portion of their range.
THREATENED (T): Species determined likely to become endangered in the foreseeable future.

Table 4-4

Comparison of Oil Spills by Type, Location, Year, and Volume (in U.S. gallons) and Their Relative Impacts to Birds based on Surveys and Modeling[a]

Incident	Type	Location	Year	Volume[b, c]	Bird Surveys[d]	Estimated Mortality[e]	Reference[f]
Ixtoc	Blowout	Mexico	1979	145.6 million	>3,000	No research or models*	1
Exxon Valdez	Tanker	Alaska, USA	1989	10.8 million	>30,000	100,000-645,000	2, 3, 4, 5
Sea Empress	Tanker	Wales, UK	1996	22.1 million	>4,500	No research or models	6, 7
M/V *Citrus*	Tanker	Alaska, USA	1996	Unknown	>1,000	1,930	8
Erika	Tanker	France	1999	6.1 million	>74,000	80,000-150,000	9, 10
Prestige	Tanker	Spain	2002	19.2 million	>9,000	115,000-300,000	11, 12, 13, 14, 15, 16
Terra Nova	Rig	Newfoundland, CAN	2004	42,000	No survey	3,593-16,122	17
M/V *Selendang Ayu*	Tanker	Alaska, USA	2004	354,218	1,603	Pending**	2, 18
Black Sea	Tanker	Kerch Strait, RUS	2007	1.47 million	>30,000	No research or models	19
Deepwater Horizon	Blowout	Louisiana, USA	2010	210 million	8,000	Pending**	20, 21

[a] Since the *Exxon Valdez* oil spill in March 1989, but including the *Ixtoc I* blowout in the Bay of Campeche, Mexico (1979; Jernelöv, 2010). Refer to Tables 1-5 in Helm et al. (2008) for additional information. Includes oil spills associated with tankers, barges, wells, rigs-platforms, and blowouts in which bird mortality data are available. This list of spills is not exhaustive but reflects a representative cross-section of oil-spill events across the world over the last ≥20 years. For a more comprehensive review of oil spills, locations, spill volumes, and bird mortality, refer to Burger (1993, Table 1), Castege et al. (2007, Table 2), Helm et al. (2008, Tables 1-6), and Tan et al. (2010, Table 1).

[b] Volume estimates are in gallons.

[c] Volume estimates were in some cases converted from figures cited in a specific reference using the conversion of metric tons to gallons of 7.3 bbl/ton and 42 gal/bbl (Wilhelm et al., 2007, p. 540). In other cases, the figures were pulled from the Tables in Helm et al. (2008). NOTE: Spill volume tends to be a poor predictor of bird mortality associated with an oil spill (Burger, 1993), although it should be considered for inclusion in any models to estimate total bird mortality, preferably with some metric of species composition and abundance (preferably density) pre-spill (Wilhelm et al., 2007).

[d] Figures cited in specific references usually as a part of the damage assessment process including beached-bird surveys, boat or ship-based surveys, or aerial surveys to collect dead or oiled birds. It has been well documented that, in most cases, survey efforts to collect bird carcasses represents a small fraction of the total mortality for a given oil-spill event. That is, the recovery rate of oiled carcasses is biased low; Burger (1993) and Wiese and Jones (2001), using different methodologies, arrived at recovery rate estimates of only 20%. Piatt and Ford (1996) derived a recovery mean rate estimate of only 17% (range 0.0%-59.0%) based on 17 different studies spanning 21 years (1970-1991).

[e] Final estimated mortality typically includes results from drift and carcass experiments plus modeling efforts to account for birds oiled, but 'unavailable' to be detected; that is, a correction for detection and scavenging bias, deposition and persistence rates, and the effects of wind, currents, weather, topography, and habitat. Refer to Flint and Fowler (1998), Flint et al. (1999), Castège et al. (2007), Wilhelm et al. (2007), Byrd et al. (2009), and other references herein for additional information regarding biases associated with mortality estimates from carcass surveys only.

[f] Most of the references used herein are from the peer-reviewed scientific literature.

Table 4-4. Comparison of Oil Spills by Type, Location, Year, and Volume (in U.S. gallons) and Their Relative Impacts to Birds based on Surveys and Modeling[a] (continued).

[*] Literature searches on the Internet revealed only two avian-related references as a result of the *Ixtoc I* oil spill: Chapman, 1981 and 1984.
[**] Pending results of the NRDA process and litigation regarding damage claims against litigants; see also Helm et al., 2006 and 2008.
[1] Jernelöv, 2010.
[2] Helm et al., 2006.
[3] Helm et al., 2008.
[4] Ford et al., 1996.
[5] Piatt and Ford, 1996.
[6] Banks et al., 2008.
[7] Law and Kelley, 2004.
[8] Flint et al., 1999.
[9] Cadiou et al., 2004.
[10] Castège et al., 2004.
[11] Castège et al., 2007.
[12] Alonso-Alvarez et al., 2007.
[13] Munilla and Velando. 2010.
[14] Velando et al., 2005a.
[15] Velando et al., 2005b.
[16] Camphuysen et al., 2002.
[17] Wilhelm et al., 2007.
[18] Byrd et al., 2009.
[19] Tan et al., 2010.
[20] USDOI, FWS, 2010.
[21] Oil Spill Commission, 2010.

Table 4-5

Relative Oiling Ranks for Various Avian Species Groupings Collected Post-*Deepwater Horizon* Event in the Gulf of Mexico[a]

Species Group	# Representative Spp.[1]	# Collected	# Oiled	Oiling Rate (% $\pm$ SE)[2]	Oiling Rank[3]
Diving*	5	182	102	0.50 $\pm$ 0.19	1
Seabirds*	25	5946	2512	0.37 $\pm$ 0.05	2
Shorebirds*	13	97	24	0.13 $\pm$ 0.06	6
Passerines*	21	77	17	0.20 $\pm$ 0.07	5
Marsh/Wading*	21	424	117	0.24 $\pm$ 0.05	4
Waterfowl*	11	56	16	0.37 $\pm$ 0.13	3
Raptors*	6	16	3	0.05 $\pm$ 0.05	7

a Data obtained from the U.S. Fish and Wildlife Service (FWS) as summarized a table dated November 30, 2010. The data used in this table are verified as per the FWS QA/QC processes. Disclaimer: All data should be considered provisional, incomplete, and subject to change. For more information, see USDOI, FWS, 2010.

* Species Group: As defined in the text of this Supplemental EIS. As of November 30, 2010, 8,000 individuals of 102 species had been collected and identified by FWS. Six new species were added since the November 16th summary. NOTE: The Top 5 most-impacted species are all representative of the “seabirds” group, with an oiling rate (0.44) above the combined average of all species, including “unknowns” and “other” (0.27).

1 Represents the actual number of birds identified to the species level for each of the Species Groups; reflects sample size for determining mean Oiling Rate. This number should be fairly representative of the suite of species available to be oiled. However, this number is dependent on efforts to correctly assign species to unidentified birds or unknowns, which is also a function of the search effort. The search effort has likely declined dramatically since the *Deepwater Horizon* was plugged/capped.

2 Oiling Rate: For each species, an oiling rate was calculated by dividing the “total” number of oiled individuals ($\sum$ alive + dead) /$\sum$ of individuals collected for a given species/row. These rates were then used to calculate summary statistics. In general, it has been well documented that the number of birds collected after a spill event represents a small fraction of the total oiled population (direct mortality) due to various factors: species-specific differences in vulnerability to spilled oil; species-specific differences in distribution, habitat use, and behavior; species-specific differences in abundance; species-specific differences in carcass deposition rates, persistence rates, and detection probabilities; overall search effort and temporal and spatial variation in search effort; and carcass loss due to predation, habitat, weather, tides, and currents (Piatt et al., 1990a and 1990b; Ford et al., 1996; Piatt and Ford, 1996; Fowler and Flint, 1997; Flint and Fowler, 1998; Flint et al., 1999; Castege et al., 2007; Byrd et al., 2009; Flint et al., 2010). For example, Piatt and Ford (1996, Table 1) estimated a mean carcass recovery rate of only 17% for a number of previous oil-bird impact studies. Burger (1993) and Wiese and Jones (2001) estimated recovery rates of 20%, with the latter study based on a drift-block design to estimate carcass recovery rate from beached-bird surveys. NOTE: Spill volume tends to be a poor predictor of bird mortality associated with an oil spill (Burger, 1993), although it should be considered for inclusion in any models to estimate total bird mortality, preferably with some metric of species composition and abundance (preferably density) pre-spill (Wilhelm et al., 2007). For this table, the value obtained for passerines and raptors is almost certainly biased high due to the small sample sizes (several cases where only 1-2 birds/species) for individual species and due to the influence of high estimates for oiling (100%). For the other Species Groups, e.g., shorebirds, the value obtained is likely biased low due the larger number of species with several instances where only one bird was collected and it did not meet the criteria to be designated as oiled. There was a significant difference ($F = 20.80$, $df = 1, 12$; $P = 0.0006$) in oiling rates among species.

3 Oiling Rank: Reflects the relative rank of a given Species Group as a function of the mean Oiling Rate. As expected, diving birds and seabirds had the highest oiling rate of any of the Species Groups (King and Sanger, 1979; Wiens et al., 1984; Piatt et al., 1990a; Williams et al., 1995) due to their reliance on offshore habitat for foraging and as a substrate for resting, preening, and other maintenance behaviors.

Table 4-6

Birds Collected and Summarized by the U.S. Fish and Wildlife Service Post-*Deepwater Horizon* Event in the Gulf of Mexico[a, b]

Common Name	Species Group*	Grand Total	Visibly Oiled		Total	Not Visibly Oiled		Total	Unknown Oiling		Total	Oiling Rate[1,2]
			Dead	Alive		Dead	Alive		Dead	Alive		
American Coot	Marsh/Wading	5	2	2	4	0	0	0	1	0	1	0.80
American Oystercatcher	Shorebird	17	7	3	10	3	3	6	1	0	1	0.59
American Redstart	Passerine	1	0	0	0	1	0	1	0	0	0	0.00
American White Pelican	Seabird	17	2	0	2	2	6	8	7	0	7	0.12
Audubon's Shearwater	Seabird	6	1	1	2	2	2	4	0	0	0	0.33
Barn Owl	Raptor	1	0	0	0	1	0	1	0	0	0	0.00
Barn Swallow	Passerine	1	1	0	1	0	0	0	0	0	0	1.00
Belted Kingfisher	Passerine	2	0	0	0	1	1	2	0	0	0	0.00
Black-crowned Night Heron	Marsh/Wading	22	6	3	9	7	5	12	1	0	1	0.41
Black Oystercatcher	Shorebird	1	0	0	0	1	0	1	0	0	0	0.00
Black Skimmer	**Seabird**	**263**	**51**	**16**	**67**	**141**	**14**	**155**	**41**	**0**	**41**	**0.25**
Black Tern	Seabird	12	1	0	1	7	3	10	1	0	1	0.08
Black-bellied Whistling Duck	Waterfowl	2	0	0	0	0	2	2	0	0	0	0.00
Black-necked Stilt	Shorebird	3	0	0	0	3	0	3	0	0	0	0.00
Blue-winged Teal	Waterfowl	3	0	0	0	3	0	3	0	0	0	0.00
Boat-tailed Grackle	Passerine	2	0	0	0	1	1	2	0	0	0	0.00
Brown Pelican	**Seabird**	**911**	**136**	**210**	**346**	**225**	**146**	**371**	**194**	**0**	**194**	**0.38**
Brown-headed Cowbird	Passerine	1	0	0	0	0	1	1	0	0	0	0.00
Bufflehead	Waterfowl	1	0	1	1	0	0	0	0	0	0	1.00
Canada Goose	Waterfowl	4	0	1	1	1	2	3	0	0	0	0.25
Caspian Tern	Seabird	20	7	2	9	5	4	9	2	0	2	0.45
Cattle Egret	Marsh/Wading	32	1	1	2	21	4	25	5	0	5	0.06
Clapper Rail	Marsh/Wading	128	27	5	32	63	12	75	21	0	21	0.25
Common Loon	Diving	106	33	27	60	22	20	42	4	0	4	0.57
Common Moorhen	Marsh/Wading	4	1	0	1	3	0	3	0	0	0	0.25
Common Nighthawk	Passerine	1	0	0	0	0	1	1	0	0	0	0.00
Common Tern	Seabird	32	13	9	22	8	1	9	1	0	1	0.69
Common Yellowthroat	Passerine	2	0	0	0	2	0	2	0	0	0	0.00
Cooper's Hawk	Raptor	1	0	0	0	0	1	1	0	0	0	0.00
Cory's Shearwater	Seabird	1	0	0	0	0	1	1	0	0	0	0.00
Double-crested Cormorant	Diving	25	2	1	3	13	7	20	2	0	2	0.12
Eastern Kingbird	Passerine	2	1	0	1	1	0	1	0	0	0	0.50
Eastern Meadowlark	Passerine	1	0	0	0	1	0	1	0	0	0	0.00

Table 4-6. Birds Collected and Summarized by the U.S. Fish and Wildlife Service Post-*Deepwater Horizon* Event in the Gulf of Mexico[a, b] (continued).

Common Name	Species Group*	Grand Total	Visibly Oiled		Total	Not Visibly Oiled		Total	Unknown Oiling		Total	Oiling Rate[1,2]
			Dead	Alive		Dead	Alive		Dead	Alive		
Eurasian Collared-Dove	Passerine	1	0	0	0	1	0	1	0	0	0	0.00
European Starling	Passerine	2	0	1	1	1	0	1	0	0	0	0.50
Forster's Tern	Seabird	52	16	8	24	13	9	22	6	0	6	0.46
Fulvous Whistling Duck	Waterfowl	1	0	0	0	0	1	1	0	0	0	0.00
Glossy Ibis	Marsh/Wading	2	0	0	0	1	0	1	1	0	1	0.00
Great Blue Heron	Marsh/Wading	50	5	2	7	23	16	39	4	0	4	0.14
Great Egret	Marsh/Wading	33	6	6	12	10	3	13	8	0	8	0.36
Great-horned Owl	Raptor	1	0	0	0	1	0	1	0	0	0	0.00
Greater Shearwater	Seabird	28	7	4	11	12	4	16	1	0	1	0.39
Green Heron	Marsh/Wading	18	2	0	2	9	6	15	1	0	1	0.11
Gull-billed Tern	Seabird	8	0	0	0	2	4	6	2	0	2	0.00
Herring Gull	Seabird	42	8	8	16	9	13	22	4	0	4	0.38
Horned Grebe	Diving	1	0	1	1	0	0	0	0	0	0	1.00
House Sparrow	Passerine	2	0	0	0	1	1	2	0	0	0	0.00
Killdeer	Shorebird	3	0	0	0	3	0	3	0	0	0	0.00
King Rail	Marsh/Wading	1	0	0	0	0	1	1	0	0	0	0.00
Laughing Gull	**Seabird**	**3,339**	**968**	**341**	**1,309**	**1,341**	**365**	**1,706**	**323**	**1**	**324**	**0.39**
Least Bittern	Marsh/ Wading	6	0	0	0	4	2	6	0	0	0	0.00
Least Tern	Seabird	110	45	6	51	40	6	46	13	0	13	0.46
Lesser Black-backed Gull	Seabird	5	1	1	2	0	1	1	2	0	2	0.40
Lesser Scaup	Waterfowl	1	0	0	0	0	0	0	1	0	1	0.00
Little Blue Heron	Marsh/Wading	6	0	0	0	4	1	5	1	0	1	0.00
Long-billed Dowitcher	Shorebird	1	0	0	0	0	1	1	0	0	0	0.00
Magnificant Frigatebird	Seabird	9	3	2	5	1	1	2	2	0	2	0.56
Mallard	Waterfowl	31	5	4	9	15	7	22	0	0	0	0.29
Manx Shearwater	Seabird	1	1	0	1	0	0	0	0	0	0	1.00
Masked Booby	Seabird	12	4	3	7	1	4	5	0	0	0	0.58
Mottled Duck	Waterfowl	6	0	0	0	5	0	5	1	0	1	0.00
Mourning Dove	Passerine	17	2	1	3	8	6	14	0	0	0	0.18
Neotropic Cormorant	Diving	3	0	0	0	1	0	1	2	0	2	0.00
Northern Cardinal	Passerine	3	0	0	0	3	0	3	0	0	0	0.00
Northern Gannet	**Seabird**	**632**	**221**	**187**	**408**	**89**	**103**	**192**	**31**	**1**	**32**	**0.65**
Northern Mockingbird	Passerine	4	0	0	0	3	1	4	0	0	0	0.00
Osprey	Raptor	11	2	1	3	5	3	8	0	0	0	0.27
Pied-billed Grebe	Diving	47	14	24	38	5	3	8	1	0	1	0.81
Piping Plover	Shorebird	1	0	0	0	1	0	1	0	0	0	0.00
Purple Gallinule	Marsh/Wading	1	0	0	0	1	0	1	0	0	0	0.00

Table 4-6. Birds Collected and Summarized by the U.S. Fish and Wildlife Service Post-*Deepwater Horizon* Event in the Gulf of Mexico[a, b] (continued).

Common Name	Species Group*	Grand Total	Visibly Oiled		Total	Not Visibly Oiled		Total	Unknown Oiling		Total	Oiling Rate[1,2]
			Dead	Alive		Dead	Alive		Dead	Alive		
Purple Martin	Passerine	5	1	0	1	3	1	4	0	0	0	0.20
Red-breasted Merganser	Waterfowl	4	1	1	2	1	1	2	0	0	0	0.50
Reddish Egret	Marsh/Wading	4	1	1	2	1	1	2	0	0	0	0.50
Red-shouldered Hawk	Raptor	1	0	0	0	0	1	1	0	0	0	0.00
Red-tailed Hawk	Raptor	1	0	0	0	1	0	1	0	0	0	0.00
Red-winged Blackbird	Passerine	1	0	0	0	1	0	1	0	0	0	0.00
Ring-billed Gull	Seabird	2	0	1	1	1	0	1	0	0	0	0.50
Rock Dove (pigeon)	Passerine	19	2	2	4	4	9	13	2	0	2	0.21
Roseate Spoonbill	Marsh/Wading	18	7	2	9	3	1	4	5	0	5	0.50
Royal Tern	**Seabird**	**348**	**116**	**66**	**182**	**95**	**49**	**144**	**22**	**0**	**22**	**0.52**
Ruddy Duck	Waterfowl	1	1	0	1	0	0	0	0	0	0	1.00
Ruddy Turnstone	Shorebird	18	1	3	4	8	5	13	1	0	1	0.22
Sanderling	Shorebird	32	4	2	6	17	6	23	3	0	3	0.19
Sandwich Tern	Seabird	90	26	19	45	23	13	36	9	0	9	0.50
Seaside Sparrow	Passerine	6	4	0	4	2	0	2	0	0	0	0.67
Semipalm. Sandpiper	Shorebird	2	1	0	1	0	0	0	1	0	1	0.50
Short-billed Dowitcher	Shorebird	1	0	0	0	1	0	1	0	0	0	0.00
Snowy Egret	Marsh/Wading	30	10	8	18	7	3	10	2	0	2	0.60
Sooty Shearwater	Seabird	1	0	0	0	0	1	1	0	0	0	0.00
Sooty Tern	Seabird	4	0	1	1	2	1	3	0	0	0	0.25
Sora	Marsh/Wading	6	2	1	3	1	0	1	2	0	2	0.50
Spotted Sandpiper	Shorebird	1	0	0	0	1	0	1	0	0	0	0.00
Surf Scoter	Waterfowl	2	1	1	2	0	0	0	0	0	0	1.00
Tri-colored Heron	Marsh/Wading	34	9	5	14	7	2	9	11	0	11	0.41
Virginia Rail	Marsh/Wading	4	0	0	0	3	1	4	0	0	0	0.00
White Ibis	Marsh/Wading	11	1	1	2	4	3	7	2	0	2	0.18
White-winged Dove	Passerine	2	0	0	0	1	1	2	0	0	0	0.00
Willet	Shorebird	15	2	1	3	7	3	10	2	0	2	0.20
Wilson's Plover	Shorebird	2	0	0	0	1	0	1	1	0	1	0.00
Wilson's Storm Petrel	Seabird	1	0	0	0	0	1	1	0	0	0	0.00
Yellow-billed Cuckoo	Passerine	2	2	0	2	0	0	0	0	0	0	1.00
Yellow-crowned Night Heron	Marsh/Wading	9	0	0	0	7	2	9	0	0	0	0.00
Unid. Blackbird	Passerine	1	0	0	0	0	1	1	0	0	0	0.00
Unid. Cormorant	Diving	14	3	0	3	10	0	10	1	0	1	0.21
Unid. Dowitcher	Shorebird	5	2	0	2	1	2	3	0	0	0	0.40
Unid. Duck	Waterfowl	4	0	0	0	2	1	3	1	0	1	0.00
Unid. Egret	Marsh/Wading	11	2	0	2	7	0	7	2	0	2	0.18

Table 4-6. Birds Collected and Summarized by the U.S. Fish and Wildlife Service Post-*Deepwater Horizon* Event in the Gulf of Mexico[a, b] (continued).

Common Name	Species Group*	Grand Total	Visibly Oiled		Total	Not Visibly Oiled		Total	Unknown Oiling		Total	Oiling Rate[1,2]
			Dead	Alive		Dead	Alive		Dead	Alive		
Unid. Flycatcher	Passerine	1	1	0	1	0	0	0	0	0	0	1.00
Unid. Grackle	Passerine	1	1	0	1	0	0	0	0	0	0	1.00
Unid. Grebe	Diving	6	4	0	4	2	0	2	0	0	0	0.67
Unid. Gull	Seabird	253	79	3	82	131	7	138	33	0	33	0.32
Unid. Hawk	Raptor	1	0	0	0	1	0	1	0	0	0	0.00
Unid. Heron	Marsh/Wading	14	5	0	5	6	1	7	2	0	2	0.36
Unid. Loon	Diving	9	2	2	4	4	1	5	0	0	0	0.44
Unid. Mockingbird	Passerine	2	0	0	0	1	1	2	0	0	0	0.00
Unid. Owl	Raptor	1	0	0	0	1	0	1	0	0	0	0.00
Unid. Passerine	Passerine	1	0	0	0	1	0	1	0	0	0	0.00
Unid. Pelican	Seabird	26	5	1	6	15	1	16	4	0	4	0.23
Unid. Pigeon	Passerine	17	2	1	3	6	7	13	1	0	1	0.18
Unid. Rail	Marsh/ Wading	4	1	0	1	3	0	3	0	0	0	0.25
Unid. Raptor	Raptor	1	0	0	0	1	0	1	0	0	0	0.00
Unid. Sandpiper	Shorebird	4	0	0	0	2	2	4	0	0	0	0.00
Unid. Shearwater	Seabird	4	0	0	0	3	0	3	1	0	1	0.00
Unid. Shorebird	Shorebird	3	2	0	2	0	0	0	1	0	1	0.67
Unid. Skimmer	Seabird	6	0	0	0	6	0	6	0	0	0	0.00
Unid. Sparrow	Passerine	3	0	0	0	1	0	1	2	0	2	0.00
Unid. Swallow	Passerine	1	0	0	0	1	0	1	0	0	0	0.00
Unid. Tern	Seabird	129	37	1	38	72	1	73	18	0	18	0.29
Unknown spp.		561	51	2	53	420	3	423	85	0	85	0.09
Other		119	33	4	37	58	16	74	8	0	8	0.31
Column Totals		8,000	2,024	1,011	3,035	3,108	948	4,056	907	2	909	0.27

[a] Data obtained from the U.S. Fish and Wildlife Service (FWS) as a summarized table dated November 30, 2010. The data used in this table are verified as per the FWS QA/QC processes. Disclaimer: All data should be considered provisional, incomplete, and subject to change. For more information, see USDOI, FWS, 2010.

[b] As of November 30, 2010, 102 avian species had been identified through the *Deepwater Horizon* post-spill monitoring and collection process. Overall oiling rate across species including "others" and "unknowns" was 0.27. Oiling rate for the Top 5 (see bold rows in table) most-impacted avian species was 0.44 and included representatives from *only* the seabird group. In descending order based on the number collected: laughing gull (3,339 collected, 0.39 oiling rate); brown pelican (911 collected, 0.38 oiling rate); northern gannet (632 collected, 0.65 oiling rate); royal tern (348 collected, 0.52 oiling rate); and black skimmer (263 collected, 0.25 oiling rate).

* Species Group: As defined in the text of this Supplemental EIS.

[1] Oiling Rate: For each species, an oiling rate was calculated by dividing the "total" number of oiled individuals ($\sum$ alive + dead) /$\sum$ of individuals collected for a given species/row. In general, it has been well documented that the number of birds collected after a spill event *represents a small fraction* of the total oiled population (direct mortality) due to various factors: species-specific differences in vulnerability to spilled oil; species-specific differences in distribution, habitat use, and behavior; species-specific differences in abundance; species-specific differences in carcass deposition rates, persistence rates, and detection probabilities; overall search effort and temporal and spatial variation in search effort; and carcass loss due to predation, habitat, weather, tides, and currents (Piatt et al., 1990a and 1990b; Ford et al., 1996; Piatt and Ford, 1996; Fowler and Flint, 1997; Flint and Fowler, 1998; Flint et al., 1999; Castege et al., 2007; Byrd et al., 2009; Flint et al., 2010). For example, Piatt and

Ford (1996, Table 1) estimated a mean carcass recovery rate of only 17% for a number of previous oil-bird impact studies. Burger (1993) and Wiese and Jones (2001) estimated recovery rates of 20%, with the latter study based on a drift-block design to estimate carcass recovery rate from beached-bird surveys. NOTE: Spill volume tends to be a poor predictor of bird mortality associated with an oil spill (Burger 1993), although it should be considered for inclusion in any models to estimate total bird mortality, preferably with some metric of species composition and abundance (preferably density) pre-spill (Wilhelm et al., 2007).

[2] For additional information on oiling rates by Species Group and additional statistics, see Table 4-5.

Table 4-7

Economic Significance of Commercial Fishing in the Gulf of Mexico

State	Landings Revenue	Sales Impacts	Job Impacts	CFQ
Alabama	44,317	445,449	9,750	0.33
Florida	169,711	5,657,246	108,695	0.99
Louisiana	272,884	2,033,587	43,711	2.50
Mississippi	43,696	390,702	8,575	1.96
Texas	176,098	2,013,272	42,541	0.32
Total	706,706	10,540,256	213,272	--

Source: USDOC, NOAA, 2010c.

Table 4-8

Top Species Landed by Recreational Fishermen in Texas

Panel A: Total Landings					Panel B: Landings in Bays			
Species	2007	2008	2009		Species	2007	2008	2009
Atlantic Croaker	95	64	117		Atlantic Croaker	95	64	117
Black Drum	66	82	98		Black Drum	65	80	97
King Mackerel	11	8	16		King Mackerel	--	--	--
Red Drum	289	267	285		Red Drum	286	262	277
Red Snapper	45	39	31		Red Snapper	--	--	--
Sand Seatrout	95	152	111		Sand Seatrout	89	137	108
Sheepshead	46	46	34		Sheepshead	46	46	34
Southern Flounder	49	64	47		Southern Flounder	49	64	47
Spotted Seatrout	916	920	810		Spotted Seatrout	892	895	789
Panel C: Landings in State Waters					Panel D: Landings in EEZ			
Species	2007	2008	2009		Species	2007	2008	2009
Atlantic Croaker	--	--	--		Atlantic Croaker	--	--	--
Black Drum	1	2	1		Black Drum	--	--	--
King Mackerel	3	5	7		King Mackerel	8	4	9
Red Drum	3	4	8		Red Drum	0	0	1
Red Snapper	18	28	13		Red Snapper	27	13	19
Sand Seatrout	6	13	2		Sand Seatrout	--	1	1
Sheepshead	--	--	--		Sheepshead	--	--	--
Southern Flounder	--	--	--		Southern Flounder	--	--	--
Spotted Seatrout	23	18	14		Spotted Seatrout	1	5	8

Note: Data are presented in terms of thousands of fish.
Source: Fisher, personal communication, 2011.

Table 4-9

Angler Effort in 2009 in Texas

Area	Private	Charter	Total
Bay	859,742	115,690	975,431
TTS*	32,773	2,825	35,598
EEZ**	21,128	3,336	24,464
Total	913,642	121,851	1,035,493

*TTS – Texas Territorial State Waters
**EEZ – Economic Exclusion Zone
Source: Fisher, personal communication, 2011.

Table 4-10

Economic Impact of Recreational Fishing in the Gulf of Mexico in 2008

	Expenditures*	Sales*	Value Added*	Employment
Alabama	480,587	455,093	235,481	4,719
West Florida	6,332,287	5,650,068	3,075,710	54,589
Mississippi	410,007	382,778	148,837	2,930
Louisiana	2,727,225	2,297,078	1,156,796	25,590
Texas	2,594,714	3,288,135	1,656,545	25,544
Total	12,544,820	12,073,152	6,273,369	113,372

*Data on expenditures, sales, and value added are presented in thousands of dollars
Source: USDOC, NOAA, 2010c.

Table 4-11

Top Species Landed by Recreational Fishermen in Texas — Seasonal

Panel A: Total Landings

Species	2009 Season A	2009 Season B	2010 Season A	2010 Season B
Atlantic Croaker	12	105	8	117
Black Drum	38	59	36	128
King Mackerel	--	16	--	6
Red Drum	93	193	58	206
Red Snapper	2	30	11	22
Sand Seatrout	21	90	16	112
Sheepshead	26	8	40	10
Southern Flounder	12	36	--	25
Spotted Seatrout	179	631	124	607

Panel B: Landings in Bays

Species	2009 Season A	2009 Season B	2010 Season A	2010 Season B
Atlantic Croaker	12	105	8	117
Black Drum	38	59	36	127
King Mackerel	--	--	--	--
Red Drum	89	188	58	203
Red Snapper	--	--	--	--
Sand Seatrout	21	87	16	110
Sheepshead	26	8	40	10
Southern Flounder	12	36	--	25
Spotted Seatrout	179	610	124	597

Panel C: Landings in State Waters

Species	2009 Season A	2009 Season B	2010 Season A	2010 Season B
Atlantic Croaker	--	--	--	--
Black Drum	--	--	--	1
King Mackerel	--	7	--	1
Red Drum	4	4	--	3
Red Snapper	2	11	10	11
Sand Seatrout	--	2	--	1
Sheepshead	--	--	--	--
Southern Flounder	--	--	--	--
Spotted Seatrout	--	13	--	10

Panel D: Landings in the Economic Exclusion Zone

Species	2009 Season A	2009 Season B	2010 Season A	2010 Season B
Atlantic Croaker	--	--	--	--
Black Drum	--	--	--	--
King Mackerel	--	9	--	5
Red Drum	--	1	--	--
Red Snapper	--	19	1	11
Sand Seatrout	--	1	--	1
Sheepshead	--	--	--	--
Southern Flounder	--	--	--	--
Spotted Seatrout	--	8	--	--

Fish landings are measured in thousands of fish.
Season A was November 21 through May 14. Season B was May 15 through November 20.
Source: Fisher, personal communication, 2011,

Table 4-12

Angler Effort in 2009 and 2010

2009							
Season A				Season B			
Area	Private	Charter	Total	Area	Private	Charter	Total
Bay	291,400	33,256	324,655	Bay	573,978	82,242	656,220
TTS*	3,804	431	4,235	TTS*	29,060	2,394	31,454
EEZ**	252	0	252	EEZ**	20,874	3,336	24,211
Total	295,456	33,687	329,143	Total	623,912	87,972	711,885
2010							
Season A				Season B			
Area	Private	Charter	Total	Area	Private	Charter	Total
Bay	255,995	23,570	279,565	Bay	567,522	93,650	661,171
TTS*	3,250	2,187	5,437	TTS*	22,837	2,052	24,888
EEZ**	744	0	744	EEZ**	14,129	1,602	15,731
Total	259,989	25,758	285,747	Total	604,487	97,303	701,791

*TTS – Texas Territorial State Waters
**EEZ – Economic Exclusion Zone
Season A was November 21 through May 14. Season B was May 15 through November 20.
Source: Fisher, personal communication, 2011.

Table 4-13

Employment in the Leisure/Hospitality Industry in Selected Geographic Regions

Region	2001	2002	2003	2004	2005	2006	2007	2008	2009
Panel A — Economic Impact Area									
TX-1	45,553	46,979	48,490	49,165	50,446	53,281	54,654	54,551	53,691
TX-2	14,055	14,113	14,241	14,728	14,670	16,153	16,564	16,883	16,702
TX-3	195,214	203,090	207,245	214,025	219,203	231,840	241,110	240,231	240,366
LA-1	13,682	14,065	14,300	14,725	15,339	14,747	14,563	14,295	14,246
LA-2	17,653	17,451	18,560	19,817	20,787	21,072	21,517	21,364	20,588
LA-3	37,902	38,048	40,752	42,229	43,483	44,533	44,810	46,037	44,157
LA-4	80,990	80,677	81,243	85,093	47,641	64,812	68,531	68,605	67,438
MS-1	31,485	32,752	33,714	33,297	18,024	29,191	29,680	27,702	26,938
AL-1	23,785	23,937	24,488	24,464	25,481	26,463	26,850	26,516	26,034
FL-1	34,829	36,139	36,520	39,956	41,133	41,887	41,688	40,001	41,003
FL-2	17,934	19,733	18,860	21,588	21,861	22,478	22,913	22,502	21,699
FL-3	123,248	130,250	132,256	137,302	145,005	145,894	149,448	146,368	142,393
FL-4	238,090	251,658	256,472	268,487	274,635	280,874	283,748	283,359	280,380
TX EIA Total	254,822	264,182	269,976	277,918	284,319	301,274	312,328	311,665	310,759
LA EIA Total	150,227	150,241	154,855	161,864	127,250	145,164	149,421	150,301	146,429
MS EIA Total	31,485	32,752	33,714	33,297	18,024	29,191	29,680	27,702	26,938
AL EIA Total	23,785	23,937	24,488	24,464	25,481	26,463	26,850	26,516	26,034
FL EIA Total	414,101	437,780	444,108	467,333	482,634	491,133	497,797	492,230	485,475
EIA Total	874,420	908,892	927,141	964,876	937,708	993,225	1,016,076	1,008,414	995,635
Panel B — Coastal									
TX	57,637	59,250	60,873	61,983	63,069	67,625	68,195	67,388	68,025
LA	88,235	87,640	88,431	92,703	56,242	73,405	77,567	77,580	75,958
MS	30,052	31,295	32,172	31,625	16,152	26,926	27,444	25,575	25,080
AL	21,231	21,690	22,249	22,250	23,099	24,186	24,437	24,319	23,990
FL	377,323	399,122	404,048	423,855	437,761	445,948	450,414	445,164	441,068
Coastal Total	574,478	598,997	607,773	632,416	596,323	638,090	648,057	640,026	634,121
Panel C — Statewide									
TX	818,164	840,506	854,733	877,284	900,646	943,581	982,437	995,445	982,122
LA	191,394	192,342	198,195	206,298	171,674	189,822	194,614	194,905	189,527
MS	116,714	120,243	121,528	122,557	110,430	123,402	125,192	121,033	115,924
AL	148,989	149,172	154,287	158,390	163,390	168,558	171,697	168,413	166,237
FL	772,721	808,429	817,571	866,269	893,043	912,409	932,012	922,534	896,923
State Total	2,047,982	2,110,692	2,146,314	2,230,798	2,239,183	2,337,772	2,405,952	2,402,330	2,350,733

1) Economic Impact Areas are defined in Figure 2-2.
2) The Coastal category refers to counties within EIA's that are directly along the coast of the U.S.
3) The Statewide category refers to the number of employees within the borders of the entire state.
4) The leisure/hospitality industry is defined according to the North American Industrial Classification System (NAICS).
5) The employment figure for any given year corresponds to the total number of employees in December of that year.
Source: U.S. Dept. of Labor, Bureau of Labor Statistics, 2010.

Table 4-14

Total Wages Earned by Employees in the Leisure/Hospitality Industry in Selected Geographic Regions

Region	2001	2002	2003	2004	2005	2006	2007	2008	2009
Panel A — Economic Impact Area									
TX-1	516,185	544,244	566,896	586,252	627,083	685,028	739,142	746,670	766,750
TX-2	148,743	155,321	158,437	168,256	175,260	190,740	209,082	221,889	237,274
TX-3	3,018,006	3,184,819	3,269,332	3,482,253	3,711,467	4,067,402	4,341,536	4,559,854	4,635,997
LA-1	179,049	190,839	196,760	207,015	252,162	250,432	251,148	257,990	263,543
LA-2	176,741	186,845	195,892	219,352	243,347	280,120	295,347	308,107	314,147
LA-3	446,102	452,046	487,564	498,022	543,970	597,138	633,241	654,806	667,398
LA-4	1,318,417	1,378,771	1,429,488	1,493,019	1,409,983	1,246,477	1,505,206	1,633,224	1,595,567
MS-1	591,065	591,974	608,043	618,987	617,535	453,168	621,439	616,442	560,510
AL-1	281,331	287,381	300,006	305,922	321,934	347,512	371,712	388,644	390,968
FL-1	470,616	508,316	528,008	599,949	655,141	721,483	761,247	738,910	743,731
FL-2	182,944	209,213	210,758	232,143	249,152	270,339	294,144	293,528	291,417
FL-3	1,849,168	1,956,066	2,046,441	2,224,235	2,418,168	2,576,029	2,752,991	2,906,630	2,795,652
FL-4	4,219,638	4,391,881	4,669,982	5,131,115	5,650,225	5,981,862	6,304,312	6,493,402	6,344,752
TX EIA Total	3,682,934	3,884,384	3,994,665	4,236,761	4,513,810	4,943,170	5,289,760	5,528,413	5,640,021
LA EIA Total	2,120,309	2,208,501	2,309,704	2,417,408	2,449,462	2,374,167	2,684,942	2,854,127	2,840,655
MS EIA Total	591,065	591,974	608,043	618,987	617,535	453,168	621,439	616,442	560,510
AL EIA Total	281,331	287,381	300,006	305,922	321,934	347,512	371,712	388,644	390,968
FL EIA Total	6,722,366	7,065,476	7,455,189	8,187,442	8,972,686	9,549,713	10,112,694	10,432,470	10,175,552
EIA Total	13,398,005	14,037,716	14,667,607	15,766,520	16,875,427	17,667,730	19,080,547	19,820,096	19,607,706
Panel B — Coastal									
TX	706,679	737,035	761,880	790,346	834,820	927,109	986,605	994,817	1,027,931
LA	1,401,025	1,459,632	1,512,219	1,578,886	1,503,750	1,359,770	1,631,966	1,764,631	1,734,276
MS	579,122	579,914	595,776	605,542	602,391	433,995	600,226	594,626	539,240
AL	259,024	265,870	279,872	284,844	299,662	324,127	347,209	363,802	367,039
FL	6,309,393	6,624,756	6,991,895	7,687,112	8,410,661	8,955,648	9,456,949	9,762,721	9,522,041
Coastal Total	9,255,243	9,667,207	10,141,642	10,946,730	11,651,284	12,000,649	13,022,955	13,480,597	13,190,527
Panel C — Statewide									
TX	12,226,217	12,630,640	12,936,441	13,601,748	14,407,978	15,653,469	16,677,752	17,490,862	17,674,963
LA	2,674,740	2,762,055	2,886,189	3,028,338	3,069,485	3,013,979	3,336,193	3,530,708	3,511,171
MS	1,714,340	1,746,899	1,778,922	1,840,583	1,872,402	1,789,900	1,990,974	2,024,034	1,915,700
AL	1,682,365	1,730,048	1,800,093	1,882,015	1,998,089	2,124,157	2,244,583	2,344,058	2,345,332
FL	13,388,764	13,677,833	14,336,358	15,686,585	17,089,645	18,132,360	19,354,496	19,990,305	19,103,860
State Total	31,686,426	32,547,475	33,738,003	36,039,269	38,437,599	40,713,865	43,603,998	45,379,967	44,551,026

1) Economic Impact Areas are defined in Figure 2-2.
2) The Coastal category refers to counties within EIA's that are directly along the coast of the U.S.
3) The Statewide category refers to the number of employees within the borders of the entire state.
4) The leisure/hospitality industry is defined according to the North American Industrial Classification System (NAICS)
5) Wages are presented in thousands of dollars.
Source: U.S. Dept. of Labor, Bureau of Labor Statistics, 2010.

Table 4-15

Total Tourism Spending in Gulf Coast States
(millions of dollars)

State	2000	2001	2002	2003	2004	2005	2006	2007	2008
Texas	36,753	35,106	34,238	34,589	37,065	40,790	44,707	44,428	50,874
Louisiana	9,227	9,266	9,262	9,418	9,964	8,248	6,718	9,021	9,642
Mississippi	5,282	5,227	5,345	5,489	5,755	5,939	5,633	6,060	6,329
Alabama	5,487	5,423	5,368	5,627	6,051	6,639	6,998	7,405	7,723
Florida	60,296	56,166	54,544	56,265	61,118	64,544	66,165	68,820	70,521

Source: U.S. Travel Association, 2010.

Table 4-16

Coastal Travel, Tourism, and Recreation Estimates in 2004

State	Employees	Payroll	Establishments
Texas	13,712	$366,374	1,626
Louisiana	4,362	$158,357	544
Mississippi	12,188	$192,864	148
Alabama	1,078	$35,407	212
Florida	31,166	$721,440	2,398
Gulf Total	62,506	$949,711	4,928

Source: Kaplan and Whitman, unpublished.

Table 4-17

Categories of Tourism Spending in Texas
(millions of dollars)

Category	1994	2002	2004	2006	2007	2008	2009
Accommodations	929	1,507	1,571	2,020	2,192	2,424	2,041
Food Service	1,183	1,793	1,939	2,288	2,418	2,571	2,449
Food Stores	272	387	422	480	510	545	521
Local Tran. And Gas	1,224	1,763	2,291	3,295	3,610	4,126	2,831
Arts, Entertainment, and Recreation	803	1,184	1,252	1,426	1,464	1,501	1,399
Retail Sales	1,152	1,631	1,631	1,813	1,844	1,847	1,745
Visitor Air Transportation	476	697	761	864	888	869	701
Other Travel Spending	1,725	2,541	2,629	2,971	2,996	3,145	2,819
Total Tourist Spending	7,764	11,504	12,496	15,157	15,923	17,027	14,506

Source: Dean Runyan Associates, 2010.

Table 4-18

Tourism in Gulf Coast Regions of Texas in 2009

Metro Area	Visitors	Spending
Beaumont/Port Arthur	2.60	557
Corpus Christi	6.61	1,030
Houston/Baytown/Sugarland	29.85	12,431
Victoria	1.51	190
Brownsville/Harlingen	1.85	663

Sources: Dean Runyan Associates, 2010.
D.K. Shifflet and Associates, 2010a and 2010b.

Table 4-19

Number of Beaches and Beach Participation in Gulf States

State	Number of Beaches[1]	Beach Visitation[2, 3]
Texas	168	4,929,000
Louisiana	28	578,000
Mississippi	20	956,000
Alabama	25	1,527,000
Florida	634	21,989,000

[1] USEPA, 2008.
[2] U.S. Dept of Agriculture, Forest Service. 2010.
[3] Beach visitation only refers to visitors originating from within the U.S.

Table 4-20

Deepwater Horizon Damage Claims in Texas

Panel A: Individual Claims		
Industry	No. of Claims	Amount Paid
Fishing	892	$12,156,671.30
Food, Beverage, and Lodging	247	$1,899,506.79
Multiple Industry/Business Types	42	$523,540.00
No Industry Designation	10	$114,579.00
Rental Property	33	$278,900.00
Retail, Sales, and Service	448	$8,130,329.92
Seafood Processing and Distribution	541	$4,550,644.16
Tourism and Recreation	9	$131,500.00
Total	2,222	$27,785,671.17
Panel B: Business Claims		
Industry	No. of Claims	Amount Paid
Fishing	1,172	$40,528,508.88
Food, Beverage, and Lodging	16	$1,707,100.00
Multiple Industry/Business Types	4	$129,500.00
No Industry Designation	30	$463,984.53
Rental Property	350	$5,100,500.00
Retail, Sales, and Service	55	$12,656,700.00
Seafood Processing and Distribution	80	$30,296,300.00
Tourism and Recreation	2	$31,200.00
Total	1,709	$90,913,793.41

Claims data are as of April 9, 2011.
Source: Gulf Coast Claims Facility, 2011.

Table 4-21

Monthly Employment in the Leisure/Hospitality Industry during 2010

Region	Jan	Feb	March	April	May	June	July	Aug	Sep
EIA									
TX-1	53,780	54,864	56,434	56,712	57,682	57,817	56,989	56,821	56,106
TX-2	16,372	16,535	16,879	17,357	17,488	17,953	17,744	17,668	17,234
TX-3	233,323	236,395	242,381	245,096	248,306	250,958	248,351	248,857	246,488
LA-1	14,195	14,203	14,435	14,500	14,698	14,774	14,632	14,402	14,487
LA-2	20,441	20,790	21,107	21,666	21,934	21,640	21,319	21,259	21,210
LA-3	42,988	43,485	44,710	44,925	45,606	45,695	45,320	45,556	45,492
LA-4	68,343	68,806	70,051	70,708	70,570	71,257	70,173	70,590	70,982
MS-1	26,404	26,645	27,211	27,583	27,879	28,290	28,052	27,981	27,570
AL-1	25,435	25,925	27,140	28,316	28,962	29,503	28,836	28,571	27,961
FL-1	40,374	42,431	46,703	48,351	49,119	50,806	49,889	48,372	46,160
FL-2	21,621	22,074	22,478	22,868	22,011	21,550	21,238	21,504	22,090
FL-3	142,690	145,777	149,670	150,654	149,325	148,017	145,285	145,267	145,346
FL-4	280,126	285,916	291,067	290,144	284,324	279,782	272,745	272,263	270,061
TX EIA Total	303,475	307,794	315,694	319,165	323,476	326,728	323,084	323,346	319,828
LA EIA Total	145,967	147,284	150,303	151,799	152,808	153,366	151,444	151,807	152,171
MS EIA Total	26,404	26,645	27,211	27,583	27,879	28,290	28,052	27,981	27,570
AL EIA Total	25,435	25,925	27,140	28,316	28,962	29,503	28,836	28,571	27,961
FL EIA Total	484,811	496,198	509,918	512,017	504,779	500,155	489,157	487,406	483,657
EIA Total	986,092	1,003,846	1,030,266	1,038,880	1,037,904	1,038,042	1,020,573	1,019,111	1,011,187
Coastal									
TX	66,575	67,809	70,159	71,833	72,737	73,916	72,832	72,110	70,337
LA	76,571	77,167	78,666	79,306	79,329	79,933	78,923	79,373	79,764
MS	24,585	24,803	25,313	25,675	25,972	26,376	26,249	26,153	25,750
AL	23,425	23,908	25,020	26,192	26,734	27,202	26,551	26,324	25,732
FL	440,714	451,034	464,086	465,718	460,000	456,131	445,905	443,901	438,708
Coastal Total	631,870	644,721	663,244	668,724	664,772	663,558	650,460	647,861	640,291
Statewide									
TX	955,907	971,203	993,927	1,007,287	1,025,007	1,035,662	1,024,465	1,026,375	1,017,550
LA	187,935	189,633	193,519	195,715	196,978	197,360	194,930	195,358	195,476
MS	113,199	114,644	117,222	119,567	120,425	121,213	119,571	120,795	119,569
AL	160,117	160,637	165,671	169,475	171,307	172,834	170,998	171,144	168,839
FL	893,174	915,016	937,711	942,916	934,556	926,893	910,396	907,547	901,179
State Total	2,310,332	2,351,133	2,408,050	2,434,960	2,448,273	2,453,962	2,420,360	2,421,219	2,402,613

Economic Impact Areas are defined in Figure 2-2.

The “Coastal” category refers to the counties/parishes within EIA's that are directly along the coast of the U.S.

The “Statewide” category refers to the number of employees within the borders of the entire state.

The leisure/hospitality industry is defined according to the North American Industrial Classification System (NAICS).
Source: U.S. Dept. of Labor, Bureau of Labor Statistics, 2011

Table 4-22

Quarterly Wages in the Leisure/Hospitality Industry in 2009 and 2010

Region	2009				2010		
	Q1	Q2	Q3		Q1	Q2	Q3
EIA							
TX-1	186,485	190,705	196,907		189,011	200,118	202,891
TX-2	55,947	59,888	60,406		56,807	62,136	62,005
TX-3	1,101,383	1,156,040	1,172,061		1,101,259	1,182,646	1,205,761
LA-1	66,498	62,427	68,772		67,858	63,177	69,412
LA-2	76,903	79,958	78,659		74,803	82,036	82,804
LA-3	146,758	147,760	151,476		146,165	155,619	157,535
LA-4	399,037	375,763	372,045		422,006	393,554	389,661
MS-1	139,067	139,486	144,690		137,586	138,553	144,858
AL-1	90,350	101,085	102,964		90,985	105,881	107,282
FL-1	165,362	199,059	208,098		161,938	201,780	203,336
FL-2	72,448	73,443	71,806		68,942	72,564	72,652
FL-3	704,036	685,052	661,734		683,879	706,460	704,891
FL-4	1,644,155	1,582,097	1,455,292		1,614,884	1,639,368	1,543,834
TX EIA Total	1,343,815	1,406,633	1,429,374		1,347,077	1,444,900	1,470,657
LA EIA Total	689,196	665,908	670,952		710,832	694,386	699,412
MS EIA Total	139,067	139,486	144,690		137,586	138,553	144,858
AL EIA Total	90,350	101,085	102,964		90,985	105,881	107,282
FL EIA Total	2,586,001	2,539,651	2,396,930		2,529,643	2,620,172	2,524,713
EIA Total	4,848,429	4,852,763	4,744,910		4,816,123	5,003,892	4,946,922
Coastal							
TX	242,514	258,365	266,840		245,102	271,683	274,253
LA	413,709	389,122	386,512		439,668	412,408	408,835
MS	133,736	134,172	139,231		132,549	133,384	139,556
AL	84,665	95,019	96,792		85,260	99,780	100,742
FL	2,423,701	2,377,078	2,234,861		2,371,990	2,454,904	2,360,412
Coastal Total	3,298,325	3,253,756	3,124,236		3,274,569	3,372,159	3,283,798
Statewide							
TX	4,309,905	4,381,324	4,412,854		4,261,565	4,470,937	4,596,176
LA	864,759	851,017	856,394		884,745	883,392	890,067
MS	466,911	482,749	482,404		456,300	486,254	495,765
AL	548,550	592,439	600,567		549,179	608,297	608,426
FL	4,816,481	4,795,973	4,515,640		4,769,647	4,895,534	4,791,884
State Total	11,006,606	11,103,502	10,867,859		10,921,436	11,344,414	11,382,318

Economic Impact Areas are defined in Figure 2-2.
The "Coastal" category refers to the counties/parishes within EIA's that are directly along the coast of the U.S.
The "Statewide" category refers to the number of employees within the borders of the entire state.
The leisure/hospitality industry is defined according to the North American Industrial Classification System (NAICS).
Wages are presented in thousands of dollars.
Source: U.S. Dept. of Labor, Bureau of Labor Statistics, 2011.

Table 4-23

Shipwrecks in the Western Planning Area

Map Area	No. Recorded Wrecks	Historic Wrecks (verified)
Alaminos Canyon	1	0
Brazos	62	0
Corpus Christi	3	0
East Breaks	6	0
Galveston	119	1
Garden Banks	1	0
High Island	111	1
Keathley Canyon	1	0
Matagorda Island	45	1
Mustang Island	72	0
North Padre Island	39	0
South Padre Island	53	0
Sabine Pass (Texas)	2	0
TOTAL	515	3

Table 4-24

OCS and Non-OCS Program Spill Rates

OCS Program Spill Rates	
<1,000 bbl	
≤1 bbl	3,357 spills/BBO handled
≥1 and < 50 bbl	91 spills/BBO handled
≥50 bbl and <1,000 bbl	7 spills/BBO handled
≥1,000 bbl	
Facility	0.13 spills/BBO handled
Pipeline	1.38 spills/BBO handled
Shuttle Tanker	0.72 spills/BBO handled
At sea	0.29 spills/BBO handled
In port	0.0.43 spills/BBO handled
Barge	1.23 spills/BBO handled
Non-OCS Program Spill Rates	
≤1,000 bbl	rate based on yearly occurrence information
≥1,000 bbl	
Tanker Worldwide	0.82 spills/BBO handled
At sea	0.46 spills/BBO handled
In port	0.36 spills/BBO handled
Tanker in U.S. waters	0.72 spills/BBO handled
At sea	0.29 spills/BBO handled
In port	0.43 spills/BBO handled
Barge in U.S. coastal, offshore and inland waters	1.23 spills/BBO handled
Pipeline	rate based on yearly occurrence information

BBO = billion barrels of oil.
Source: Anderson and LaBelle, 2000 (page 312 [Table 6], page 313 [Table 7], page 314 [Table 8], page 316 [Table 10], page 319 [Table 13]).

Table 4-25

Classification of the Gulf Economic Impact Areas

State	Area	Labor Market	County/Parish
Alabama	AL-1	Mobile	Baldwin
			Clarke
			Conecuh
			Escambia
			Mobile
			Monroe
			Washington
			Wilcox
Mississippi	MS-1	Biloxi-Gulfport	George
			Greene
			Hancock
			Harrison
			Jackson
			Pearl River
			Stone
Louisiana	LA-1	Lake Charles	Allen
			Beauregard
			Calcasieu
			Cameron
			Jefferson Davis
			Vernon

State	Area	Labor Market	County
Texas	TX-1	Brownsville	Cameron
			Hidalgo
			Starr
			Willacy
		Corpus Christi	Aransas
			Brooks
			Duval
			Jim Wells
			Kenedy
			Kleberg
			Nueces
			Refugio
			San Patricio
	TX-2	Brazoria	Brazoria
			Matagorda
			Wharton
		Victoria	Calhoun
			Colorado
			Dewitt
			Fayette
			Goliad
			Gonzales
			Jackson
			Lavaca
			Victoria

State	Area	Labor Market	County
Florida	FL-1	Panama City	Bay
			Franklin
			Gulf
		Pensacola	Escambia
			Okaloosa
			Santa Rosa
			Walton
	FL-2	Tallahassee	Calhoun
			Gadsden
			Holmes
			Jackson
			Jefferson
			Leon
			Liberty
			Wakulla
			Washington
		Lake City	Columbia
			Hamilton
			Lafayette
			Madison
			Suwannee
			Taylor

Table 4-25. Classification of the Gulf Economic Impact Areas (continued).

State	Area	Labor Market	County	State	Area	Labor Market	County	State	Area	Labor Market	County
									FL-3	Ocala	Citrus
	LA-2	Lafayette	Acadia								Marion
			Evangeline							Gainesville	Alachua
			Iberia		TX-3	Beaumont -	Hardin				Bradford
			Lafayette			Port Arthur	Jasper				Dixie
			St. Landry				Jefferson				Gilchrist
			St. Martin				Newton				Levy
			Vermillion				Orange				Union
	LA-3	Baton Rouge	Ascension				Polk			Tampa-St. Petersburg	Hernando
			East Baton Rouge				Tyler				Hillsborough
			Iberville			Houston -	Austin				Pasco
			Livingston			Galveston	Chambers				Pinellas
			Tangipahoa				Fort Band		FL-4	Ft. Myers	Collier
			West Baton Rouge				Galveston				Lee
		Houma	Assumption				Harris			Miami	Broward
			Lafourche				Liberty				Miami-Dade
			St. Mary				Montgomery				Monroe
			Terrebonne				San Jacinto			Sarasota	Charlotte
	LA-4	New Orleans	Jefferson				Waller				DeSoto
			Orleans				Washington				Manatee
			Plaquemines								Sarasota
			St. Bernard								
			St. Charles								
			St. James								
			St. John the Baptist								
			St. Tammany								
			Washington								

Table 4-26

Demographic and Employment Baseline Projections for Economic Impact Area TX-1

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	1,625.42	1,771.25	1,807.15	1,843.24	1,879.50	1,915.95	1,952.51	2,137.01	2,323.71	2,511.01	2,886.77
Age Under 19 Years	36.1%	36.4%	36.4%	36.4%	36.4%	36.4%	36.4%	36.6%	35.7%	34.9%	33.6%
Age 20 to 34	21.0%	20.2%	20.0%	20.0%	19.9%	19.9%	19.8%	18.8%	19.2%	19.6%	20.1%
Age 35 to 49	18.7%	18.0%	17.8%	17.6%	17.4%	17.3%	17.1%	17.1%	16.5%	16.3%	15.9%
Age 50 to 64	13.5%	14.6%	14.8%	14.8%	14.9%	14.9%	14.8%	14.5%	14.3%	13.8%	13.6%
Age 65 and Over	10.7%	10.9%	11.0%	11.2%	11.4%	11.6%	11.9%	13.1%	14.3%	15.4%	16.8%
Median Age of Population (years)	33	34	34	34	35	35	35	36	36	37	38
White Population (in thousands)	18.7%	16.8%	16.4%	16.1%	15.8%	15.5%	15.3%	14.1%	13.1%	12.3%	11.2%
Black Population (in thousands)	1.3%	1.3%	1.3%	1.2%	1.2%	1.2%	1.2%	1.1%	1.1%	1.1%	1.0%
Native American Population (in thousands)	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%
Asian and Pacific Islander Population (in thousands)	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%
Hispanic or Latino Population (in thousands)	79.0%	80.9%	81.2%	81.5%	81.9%	82.1%	82.4%	83.7%	84.7%	85.5%	86.8%
Male Population (in thousands)	48.7%	48.8%	48.8%	48.8%	48.8%	48.8%	48.8%	48.8%	48.8%	48.8%	48.8%
Total Employment (in thousands of jobs)	728.91	840.00	864.86	878.23	891.81	905.55	919.48	991.85	1,069.01	1,151.17	1,331.45
Farm Employment	1.7%	1.6%	1.6%	1.5%	1.5%	1.5%	1.4%	1.3%	1.2%	1.1%	0.9%
Forestry, Fishing, Related Activities	1.2%	1.1%	1.1%	1.1%	1.0%	1.0%	1.0%	1.0%	0.9%	0.8%	0.7%
Mining	1.8%	2.4%	2.4%	2.3%	2.3%	2.3%	2.3%	2.1%	2.0%	1.8%	1.6%
Utilities	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%
Construction	7.2%	6.0%	6.0%	6.0%	5.9%	5.9%	5.9%	5.8%	5.8%	5.7%	5.5%
Manufacturing	4.0%	3.2%	3.1%	3.1%	3.0%	3.0%	3.0%	2.7%	2.5%	2.3%	2.0%
Wholesale Trade	2.8%	2.4%	2.4%	2.3%	2.3%	2.3%	2.3%	2.1%	2.0%	1.9%	1.7%
Retail Trade	12.0%	11.4%	11.4%	11.3%	11.3%	11.3%	11.2%	11.1%	10.9%	10.7%	10.3%
Transportation and Warehousing	3.3%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.3%	3.3%	3.3%
Information Employment	1.2%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	0.9%
Finance and Insurance	3.1%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%
Real Estate / Rental and Lease	3.0%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	3.0%	3.0%	3.0%
Professional and Technical Services	3.4%	3.2%	3.2%	3.2%	3.2%	3.3%	3.3%	3.4%	3.5%	3.7%	3.9%
Management	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.3%	0.3%	0.3%	0.3%
Administrative and Waste Services	5.4%	5.6%	5.7%	5.7%	5.8%	5.8%	5.9%	6.1%	6.3%	6.6%	7.0%
Educational Services	0.8%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.1%	1.1%
Health Care and Social Assistance	15.6%	17.9%	18.0%	18.2%	18.4%	18.6%	18.7%	19.6%	20.5%	21.4%	23.3%
Arts, Entertainment, and Recreation	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%
Accommodation and Food Services	7.2%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.2%	7.2%
Other Services, Except Public Administration	6.5%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.4%	6.4%	6.4%
Federal Civilian Government	1.7%	1.8%	1.7%	1.7%	1.7%	1.7%	1.7%	1.6%	1.5%	1.4%	1.2%
Federal Military	1.3%	1.1%	1.1%	1.1%	1.0%	1.0%	1.0%	0.9%	0.9%	0.8%	0.7%
State and Local Government	15.1%	15.7%	15.6%	15.6%	15.6%	15.5%	15.5%	15.3%	15.1%	14.9%	14.4%

Table 4-26. Demographic and Employment Baseline Projections for Economic Impact Area TX-1 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	24,168.27	25,503.71	26,303.90	26,962.27	27,636.74	28,327.69	29,035.50	32,841.93	37,134.15	41,972.31	53,564.65
Farm	1.6%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%	0.3%	0.3%	0.2%
Forestry, Fishing, Related Activities	0.7%	0.7%	0.7%	0.7%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%	0.4%
Mining	3.6%	5.4%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%
Utilities	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
Construction	7.5%	6.2%	6.6%	6.5%	6.4%	6.3%	6.3%	5.9%	5.5%	5.1%	4.4%
Manufacturing	5.9%	4.8%	4.9%	4.8%	4.8%	4.7%	4.6%	4.3%	4.0%	3.6%	3.1%
Wholesale Trade	4.2%	4.0%	4.1%	4.1%	4.0%	4.0%	4.0%	3.8%	3.6%	3.4%	3.1%
Retail Trade	8.8%	7.9%	8.0%	7.9%	7.9%	7.9%	7.8%	7.6%	7.4%	7.1%	6.7%
Transportation and Warehousing	3.6%	3.6%	3.6%	3.6%	3.6%	3.6%	3.6%	3.5%	3.4%	3.4%	3.3%
Information	1.5%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%
Finance and Insurance	3.4%	2.9%	2.9%	2.9%	2.9%	3.0%	3.0%	3.1%	3.2%	3.3%	3.5%
Real Estate / Rental and Lease	1.4%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.2%	1.2%	1.2%	1.3%
Professional and Technical Services	4.6%	3.9%	3.8%	3.8%	3.9%	3.9%	3.9%	4.1%	4.2%	4.3%	4.6%
Management	0.1%	0.3%	0.2%	0.2%	0.2%	0.2%	0.3%	0.3%	0.3%	0.4%	0.4%
Administrative and Waste Services	3.0%	3.2%	3.2%	3.3%	3.3%	3.3%	3.4%	3.5%	3.7%	3.9%	4.3%
Educational Services	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%
Health Care and Social Assistance	14.9%	17.9%	18.0%	18.2%	18.4%	18.6%	18.8%	19.8%	20.8%	21.8%	23.8%
Arts, Entertainment, and Recreation	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%
Accommodation and Food Services	3.4%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%	3.1%	3.1%	3.1%	3.0%
Other Services, Except Public Administration	4.5%	4.1%	4.1%	4.1%	4.1%	4.1%	4.1%	4.1%	4.1%	4.1%	4.1%
Federal Civilian Government	4.9%	5.6%	5.5%	5.5%	5.4%	5.4%	5.4%	5.2%	5.1%	4.9%	4.6%
Federal Military	2.8%	2.8%	2.8%	2.7%	2.7%	2.7%	2.6%	2.5%	2.4%	2.3%	2.0%
State and Local Government	17.8%	18.8%	18.7%	18.7%	18.7%	18.7%	18.8%	18.8%	18.9%	18.9%	18.8%
Total Personal Income Per Capita (in 2005 dollars)	21,146	22,321	22,304	22,511	22,729	22,955	23,191	24,519	26,103	27,956	32,387
Woods & Poole Economics Wealth Index (U.S. = 100)	68.3	75.0	74.8	74.9	75.0	75.2	75.3	75.9	76.5	77.0	77.8
Persons Per Household (in number of people)	3.3	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.1	3.1	3.2
Mean Household Total Personal Income (in 2005 dollars)	69,895	79,290	79,758	80,471	81,303	82,071	82,820	87,661	93,266	100,012	116,180
Number of Households (in thousands)	499.93	548.88	560.61	573.81	586.98	600.13	613.23	677.74	740.82	801.64	914.78
Income < $10,000 (thousands of households, 2000 dollars)	15.6%	14.2%	13.9%	13.7%	13.5%	13.3%	13.1%	12.0%	10.6%	9.0%	6.7%
Income $10,000 to $19,999	17.6%	16.0%	15.7%	15.5%	15.2%	15.0%	14.8%	13.6%	12.0%	10.2%	7.6%
Income $20,000 to $29,999	15.0%	13.8%	13.6%	13.4%	13.2%	13.0%	12.8%	11.7%	10.3%	8.8%	6.5%
Income $30,000 to $44,999	18.8%	19.9%	20.0%	20.1%	20.2%	20.3%	20.4%	20.5%	19.8%	17.5%	13.0%
Income $45,000 to $59,999	12.5%	13.7%	14.0%	14.2%	14.4%	14.6%	14.8%	16.0%	17.7%	19.7%	19.7%
Income $60,000 to $74,999	7.7%	8.5%	8.6%	8.7%	8.9%	9.0%	9.1%	9.9%	11.2%	13.1%	17.3%
Income $75,000 to $99,999	6.6%	7.2%	7.3%	7.4%	7.5%	7.7%	7.8%	8.4%	9.5%	11.1%	15.0%
Income $100,000 or more	6.1%	6.7%	6.8%	6.9%	7.1%	7.2%	7.3%	7.9%	8.9%	10.5%	14.2%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 13 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-27

Demographic and Employment Baseline Projections for Economic Impact Area TX-2

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	579.99	626.33	634.39	642.51	650.70	658.94	667.23	709.17	751.75	794.43	879.89
Age Under 19 Years	29.7%	29.4%	29.3%	29.3%	29.2%	29.2%	29.1%	29.1%	28.9%	28.5%	27.9%
Age 20 to 34	18.6%	18.9%	19.2%	19.3%	19.4%	19.3%	19.2%	19.1%	19.0%	19.0%	19.4%
Age 35 to 49	22.5%	20.5%	20.0%	19.5%	19.1%	18.9%	18.7%	18.1%	17.9%	18.0%	18.1%
Age 50 to 64	16.8%	18.5%	18.8%	18.9%	19.1%	19.2%	19.2%	18.4%	17.2%	16.0%	15.4%
Age 65 and Over	12.3%	12.6%	12.7%	13.0%	13.2%	13.5%	13.7%	15.3%	17.1%	18.5%	19.2%
Median Age of Population (in years)	39	40	40	39	39	39	39	39	39	39	39
White Population (in thousands)	58.9%	55.1%	54.5%	53.8%	53.2%	52.6%	51.9%	48.8%	45.6%	42.5%	36.5%
Black Population (in thousands)	9.1%	9.9%	10.0%	10.0%	10.1%	10.2%	10.3%	10.7%	11.2%	11.8%	12.9%
Native American Population (in thousands)	0.3%	0.3%	0.3%	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.5%
Asian and Pacific Islander Population (in thousands)	2.3%	3.1%	3.2%	3.2%	3.3%	3.3%	3.4%	3.5%	3.7%	3.8%	3.9%
Hispanic or Latino Population (in thousands)	29.4%	31.5%	32.0%	32.6%	33.1%	33.6%	34.1%	36.6%	39.1%	41.6%	46.2%
Male Population (in thousands)	50.4%	50.4%	50.4%	50.4%	50.4%	50.4%	50.4%	50.4%	50.4%	50.3%	50.2%
Total Employment (in thousands of jobs)	287.61	309.97	317.96	321.85	325.78	329.76	333.78	354.48	376.26	399.12	448.26
Farm Employment	7.4%	7.0%	6.9%	6.8%	6.7%	6.7%	6.6%	6.2%	5.8%	5.5%	4.8%
Forestry, Fishing, Related Activities	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.1%	1.1%	1.1%
Mining	2.4%	3.4%	3.4%	3.4%	3.3%	3.3%	3.3%	3.2%	3.0%	2.9%	2.7%
Utilities	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%
Construction	9.6%	7.5%	7.5%	7.6%	7.6%	7.7%	7.8%	8.0%	8.3%	8.5%	9.0%
Manufacturing	9.7%	9.2%	9.1%	9.0%	8.9%	8.8%	8.7%	8.2%	7.8%	7.3%	6.5%
Wholesale Trade	2.7%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.4%
Retail Trade	11.3%	11.0%	11.0%	11.0%	11.0%	11.0%	11.0%	10.9%	10.9%	10.8%	10.7%
Transportation and Warehousing	2.9%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.1%	3.1%	3.1%	3.2%
Information Employment	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.7%	0.7%	0.6%	0.6%
Finance and Insurance	3.4%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.8%
Real Estate / Rental and Lease	3.4%	3.6%	3.6%	3.6%	3.6%	3.6%	3.7%	3.7%	3.8%	3.9%	4.1%
Professional and Technical Services	3.9%	4.1%	4.1%	4.1%	4.2%	4.2%	4.2%	4.4%	4.6%	4.8%	5.1%
Federal Civilian Government	0.5%	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%
Federal Military	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%	0.3%
State and Local Government	12.9%	13.4%	13.4%	13.4%	13.4%	13.3%	13.3%	13.3%	13.2%	13.1%	12.8%
Management	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Administrative and Waste Services	4.6%	4.3%	4.3%	4.4%	4.4%	4.5%	4.5%	4.7%	5.0%	5.2%	5.7%
Educational Services	0.9%	1.3%	1.3%	1.3%	1.4%	1.4%	1.4%	1.5%	1.6%	1.7%	2.0%
Health Care and Social Assistance	7.7%	8.9%	8.9%	9.0%	9.1%	9.1%	9.2%	9.6%	10.0%	10.4%	11.3%
Arts, Entertainment, and Recreation	1.2%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.3%	1.3%
Accommodation and Food Services	5.6%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.6%	5.5%	5.5%	5.3%
Other Services, Except Public Administration	6.5%	6.2%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%

Table 4-27. Demographic and Employment Baseline Projections for Economic Impact Area TX-2 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	10,282.28	10,218.80	10,728.94	10,949.05	11,173.46	11,402.24	11,635.47	12,871.31	14,231.04	15,725.90	19,170.07
Farm Employment	3.5%	1.4%	1.2%	1.2%	1.2%	1.2%	1.1%	1.0%	0.9%	0.8%	0.7%
Forestry, Fishing, Related Activities	0.7%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%
Mining	4.3%	6.0%	5.8%	5.8%	5.8%	5.9%	5.9%	6.1%	6.3%	6.4%	6.8%
Utilities	1.6%	1.5%	1.4%	1.4%	1.4%	1.4%	1.5%	1.5%	1.6%	1.7%	1.8%
Construction	11.7%	9.1%	10.1%	10.1%	10.0%	10.0%	10.0%	9.8%	9.6%	9.5%	9.0%
Manufacturing	20.2%	19.4%	19.6%	19.4%	19.1%	18.9%	18.7%	17.7%	16.8%	15.8%	14.0%
Wholesale Trade	3.5%	3.8%	3.7%	3.7%	3.7%	3.7%	3.7%	3.8%	3.8%	3.8%	3.9%
Retail Trade	8.1%	7.8%	7.7%	7.7%	7.7%	7.7%	7.7%	7.6%	7.5%	7.4%	7.2%
Transportation and Warehousing	3.5%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.8%	3.8%
Information Employment	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.7%	0.7%	0.7%	0.6%
Finance and Insurance	3.0%	3.2%	3.3%	3.3%	3.4%	3.4%	3.4%	3.5%	3.6%	3.7%	3.8%
Real Estate / Rental and Lease	1.5%	1.7%	1.6%	1.6%	1.7%	1.7%	1.7%	1.8%	1.8%	1.9%	2.1%
Professional and Technical Services	3.9%	4.1%	4.1%	4.1%	4.2%	4.2%	4.3%	4.5%	4.7%	5.0%	5.5%
Management	0.1%	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.4%
Administrative and Waste Services	2.5%	2.6%	2.6%	2.6%	2.7%	2.7%	2.7%	2.9%	3.1%	3.3%	3.7%
Educational Services	0.5%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.9%	1.0%
Health Care and Social Assistance	7.5%	8.5%	8.6%	8.7%	8.7%	8.8%	8.9%	9.2%	9.6%	10.0%	10.8%
Arts, Entertainment, and Recreation	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
Accommodation and Food Services	2.2%	2.5%	2.4%	2.4%	2.4%	2.4%	2.4%	2.3%	2.3%	2.2%	2.2%
Other Services, Except Public Administration	5.2%	4.9%	4.7%	4.7%	4.7%	4.7%	4.8%	4.8%	4.8%	4.8%	4.7%
Federal Civilian Government	0.9%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Federal Military	0.6%	0.7%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%
State and Local Government	13.9%	15.5%	15.1%	15.1%	15.2%	15.2%	15.2%	15.4%	15.5%	15.5%	15.6%
Total Personal Income Per Capita (in 2005 dollars)	29,643	30,101	30,571	30,892	31,211	31,533	31,862	33,626	35,635	37,920	43,270
Woods & Poole Economics Wealth Index (U.S. = 100)	79.0	80.7	81.0	81.2	81.4	81.6	81.8	82.8	83.8	84.8	86.9
Persons Per Household (in number of people)	2.8	2.8	2.8	2.8	2.7	2.7	2.7	2.7	2.7	2.7	2.8
Mean Household Total Personal Income (in 2005 dollars)	71,979	73,706	75,027	75,915	76,840	77,800	78,796	84,429	91,140	99,046	118,671
Total Number of Households (in thousands)	208.95	226.47	229.54	233.19	236.81	240.39	243.95	261.04	277.09	291.82	317.15
Income < $10,000 (thousands of households, 2000 dollars)	9.6%	8.8%	8.5%	8.4%	8.2%	8.1%	7.9%	7.1%	6.3%	5.5%	4.2%
Income $10,000 to $19,999	12.9%	11.8%	11.6%	11.4%	11.2%	11.0%	10.7%	9.7%	8.7%	7.6%	5.8%
Income $20,000 to $29,999	12.9%	11.9%	11.7%	11.5%	11.3%	11.1%	10.9%	9.8%	8.9%	7.8%	6.0%
Income $30,000 to $44,999	17.5%	16.9%	16.7%	16.5%	16.3%	16.1%	15.9%	14.5%	13.1%	11.5%	8.8%
Income $45,000 to $59,999	14.4%	15.0%	15.2%	15.3%	15.4%	15.6%	15.7%	16.1%	15.7%	14.2%	10.8%
Income $60,000 to $74,999	11.3%	12.1%	12.4%	12.6%	12.8%	13.0%	13.3%	14.6%	16.1%	17.6%	17.2%
Income $75,000 to $99,999	11.0%	11.9%	12.2%	12.4%	12.6%	12.8%	13.0%	14.4%	15.9%	18.1%	24.0%
Income $100,000 or More	10.6%	11.5%	11.8%	12.0%	12.2%	12.4%	12.6%	13.9%	15.4%	17.5%	23.3%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 12 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-28

Demographic and Employment Baseline Projections for Economic Impact Area TX-3

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	5,552.60	6,192.43	6,299.99	6,408.25	6,517.13	6,626.68	6,736.63	7,292.42	7,855.87	8,421.37	9,556.30
Age Under 19 years	30.9%	30.8%	30.7%	30.6%	30.6%	30.5%	30.4%	30.2%	29.7%	29.4%	28.8%
Age 20 to 34	22.3%	21.8%	21.8%	21.7%	21.7%	21.6%	21.5%	21.2%	21.4%	21.2%	20.9%
Age 35 to 49	22.7%	21.2%	20.9%	20.6%	20.4%	20.3%	20.2%	19.7%	19.1%	18.9%	19.0%
Age 50 to 64	15.6%	17.1%	17.4%	17.4%	17.5%	17.5%	17.5%	16.9%	16.1%	15.6%	15.1%
Age 65 and over	8.6%	9.1%	9.3%	9.5%	9.8%	10.1%	10.4%	12.0%	13.7%	14.9%	16.2%
Median Age of Population (in years)	37	38	38	38	38	38	38	38	39	39	40
White Population (in thousands)	46.5%	43.0%	42.3%	41.7%	41.1%	40.4%	39.8%	36.8%	33.9%	31.3%	26.4%
Black Population (in thousands)	17.4%	17.4%	17.3%	17.2%	17.0%	16.9%	16.8%	16.3%	15.7%	15.1%	13.9%
Native American Population (in thousands)	0.3%	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
Asian and Pacific Islander Population (in thousands)	5.4%	5.9%	6.1%	6.2%	6.3%	6.4%	6.5%	7.1%	7.6%	8.2%	9.2%
Hispanic or Latino Population (in thousands)	30.4%	33.4%	34.0%	34.6%	35.2%	35.9%	36.5%	39.5%	42.4%	45.1%	50.0%
Male Population (in thousands)	50.0%	50.1%	50.1%	50.1%	50.0%	50.0%	50.0%	49.9%	49.8%	49.7%	49.5%
Total Employment (in thousands of jobs)	3,218.66	3,596.00	3,700.61	3,758.99	3,818.15	3,878.09	3,938.83	4,254.86	4,592.14	4,951.73	5,742.46
Farm Employment	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%	0.4%	0.4%
Forestry, Fishing, Related Activities	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Mining	2.8%	3.5%	3.4%	3.4%	3.4%	3.3%	3.3%	3.1%	2.9%	2.8%	2.5%
Utilities	0.5%	0.6%	0.6%	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%
Construction	8.0%	7.2%	7.3%	7.3%	7.3%	7.3%	7.4%	7.5%	7.6%	7.8%	8.0%
Manufacturing	7.4%	7.4%	7.3%	7.2%	7.2%	7.1%	7.0%	6.6%	6.2%	5.9%	5.2%
Wholesale Trade	4.5%	4.3%	4.3%	4.3%	4.3%	4.2%	4.2%	4.2%	4.2%	4.2%	4.1%
Retail Trade	10.2%	9.4%	9.4%	9.4%	9.4%	9.4%	9.4%	9.3%	9.3%	9.2%	9.0%
Transportation and Warehousing	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%	4.2%	4.2%	4.1%	4.0%
Information Employment	1.5%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.2%	1.2%	1.1%	1.0%
Finance and Insurance	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.4%	4.4%
Real Estate / Rental and Lease	4.1%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%
Professional and Technical Services	7.8%	8.0%	8.0%	8.0%	8.1%	8.1%	8.2%	8.5%	8.7%	9.0%	9.6%
Management	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.8%
Administrative and Waste Services	7.4%	7.1%	7.1%	7.2%	7.2%	7.3%	7.3%	7.6%	7.9%	8.2%	8.8%
Educational Services	1.6%	1.7%	1.7%	1.8%	1.8%	1.8%	1.8%	1.8%	1.9%	1.9%	2.0%
Health Care and Social Assistance	8.2%	9.5%	9.5%	9.6%	9.6%	9.6%	9.7%	9.9%	10.1%	10.3%	10.8%
Arts, Entertainment, and Recreation	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Accommodation and Food Services	6.5%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.8%
Other Services, Except Public Administration	6.0%	5.8%	5.9%	5.9%	5.9%	5.9%	5.9%	6.0%	6.1%	6.1%	6.2%
Federal Civilian Government	1.0%	0.9%	0.9%	0.9%	0.9%	0.8%	0.8%	0.8%	0.7%	0.7%	0.6%
Federal Military	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%
State and Local Government	10.3%	10.5%	10.5%	10.4%	10.4%	10.4%	10.4%	10.3%	10.1%	10.0%	9.7%

Table 4-28. Demographic and Employment Baseline Projections for Economic Impact Area TX-3 (continued)

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	186,536.19	200,395.27	208,221.43	213,342.61	218,582.25	223,942.87	229,427.07	258,795.84	291,672.20	328,441.16	415,393.44
Farm Employment	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Forestry, Fishing, Related Activities	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Mining	12.3%	13.9%	13.7%	13.8%	13.8%	13.9%	13.9%	14.2%	14.4%	14.6%	15.0%
Utilities	1.6%	2.2%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.0%
Construction	8.2%	6.8%	7.3%	7.2%	7.2%	7.1%	7.1%	6.9%	6.6%	6.4%	5.9%
Manufacturing	11.7%	11.5%	11.8%	11.7%	11.5%	11.4%	11.3%	10.6%	10.0%	9.4%	8.4%
Wholesale Trade	6.2%	6.1%	6.2%	6.2%	6.2%	6.2%	6.2%	6.2%	6.3%	6.3%	6.3%
Retail Trade	5.2%	4.6%	4.6%	4.6%	4.6%	4.5%	4.5%	4.4%	4.3%	4.2%	4.0%
Transportation and Warehousing	5.6%	5.6%	5.6%	5.6%	5.5%	5.5%	5.5%	5.3%	5.2%	5.1%	4.8%
Information Employment	1.7%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.3%	1.2%	1.2%	1.1%
Finance and Insurance	5.5%	5.2%	5.2%	5.2%	5.2%	5.2%	5.3%	5.4%	5.4%	5.5%	5.6%
Real Estate / Rental and Lease	2.4%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.6%	1.6%	1.7%
Professional and Technical Services	10.8%	10.8%	10.7%	10.8%	10.8%	10.9%	11.0%	11.4%	11.8%	12.2%	13.0%
Management	0.6%	1.2%	1.2%	1.2%	1.2%	1.2%	1.3%	1.4%	1.5%	1.6%	1.8%
Administrative and Waste Services	4.4%	3.9%	4.0%	4.0%	4.1%	4.1%	4.1%	4.3%	4.6%	4.8%	5.2%
Educational Services	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.1%	1.1%	1.1%	1.2%
Health Care and Social Assistance	6.5%	7.2%	7.1%	7.2%	7.2%	7.2%	7.3%	7.4%	7.5%	7.7%	7.9%
Arts, Entertainment, and Recreation	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.6%	0.6%	0.6%
Accommodation and Food Services	2.3%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.1%	2.1%	2.1%
Other Services, Except Public Administration	3.1%	2.9%	2.8%	2.8%	2.8%	2.8%	2.8%	2.9%	2.9%	2.9%	2.9%
Federal Civilian Government	1.7%	1.7%	1.7%	1.7%	1.6%	1.6%	1.6%	1.6%	1.5%	1.5%	1.4%
Federal Military	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%
State and Local Government	8.3%	8.9%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.7%	8.6%
Total Personal Income Per Capita (in 2005 dollars)	38,941	38,315	39,041	39,421	39,818	40,231	40,661	43,035	45,798	48,984	56,613
Woods & Poole Economics Wealth Index (U.S. = 100)	85.7	87.4	87.9	87.8	87.6	87.5	87.4	86.9	86.7	86.7	87.2
Persons Per Household (in number of people)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.9
Mean Household Total Personal Income (in 2005 dollars)	80,484	82,582	84,242	84,841	85,460	86,115	86,816	91,101	96,652	103,525	121,269
Total Number of Households (in thousands)	1,988.28	2,215.36	2,252.62	2,295.55	2,338.22	2,380.57	2,422.51	2,625.44	2,817.83	2,996.74	3,310.18
Income < $10,000 (thousands of households, 2000 dollars)	8.7%	8.2%	8.0%	7.9%	7.7%	7.6%	7.4%	6.7%	6.0%	5.4%	4.2%
Income $10,000 to $19,999	11.0%	10.4%	10.1%	10.0%	9.8%	9.7%	9.5%	8.6%	7.7%	6.9%	5.5%
Income $20,000 to $29,999	12.0%	11.4%	11.1%	11.0%	10.8%	10.6%	10.4%	9.4%	8.5%	7.6%	6.0%
Income $30,000 to $44,999	16.8%	16.1%	15.8%	15.6%	15.4%	15.1%	14.8%	13.5%	12.2%	11.0%	8.7%
Income $45,000 to $59,999	14.0%	14.4%	14.5%	14.5%	14.6%	14.6%	14.6%	14.2%	13.1%	11.9%	9.4%
Income $60,000 to $74,999	10.8%	11.3%	11.5%	11.7%	11.9%	12.1%	12.3%	13.4%	14.4%	14.9%	13.3%
Income $75,000 to $99,999	11.4%	12.0%	12.3%	12.4%	12.6%	12.9%	13.1%	14.4%	16.0%	17.8%	21.5%
Income $100,000 or more	15.4%	16.3%	16.7%	16.9%	17.2%	17.5%	17.9%	19.7%	22.0%	24.6%	31.3%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 17 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-29

Demographic and Employment Baseline Projections for Economic Impact Area LA1

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	334.22	334.72	336.53	338.39	340.27	342.20	344.15	354.20	364.61	375.07	396.08
Age Under 19 years	29.2%	28.5%	28.4%	28.3%	28.3%	28.2%	28.2%	28.1%	27.8%	27.2%	26.0%
Age 20 to 34	21.8%	21.9%	21.9%	21.9%	21.7%	21.4%	20.8%	19.6%	19.1%	19.0%	19.4%
Age 35 to 49	20.9%	18.9%	18.5%	18.3%	18.1%	18.1%	18.4%	18.6%	18.9%	18.2%	17.3%
Age 50 to 64	16.2%	18.1%	18.5%	18.6%	18.8%	18.9%	19.0%	18.4%	17.1%	16.9%	17.8%
Age 65 and over	11.9%	12.6%	12.6%	12.9%	13.2%	13.4%	13.6%	15.2%	17.1%	18.7%	19.6%
Median Age of Population (in years)	35	35	36	36	36	36	36	38	39	40	41
White Population (in thousands)	74.6%	73.9%	73.8%	73.8%	73.7%	73.6%	73.6%	73.2%	72.8%	72.3%	71.4%
Black Population (in thousands)	20.8%	20.7%	20.7%	20.7%	20.7%	20.7%	20.6%	20.5%	20.4%	20.4%	20.3%
Native American Population (in thousands)	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%
Asian and Pacific Islander Population (in thousands)	1.0%	1.1%	1.1%	1.1%	1.1%	1.2%	1.2%	1.3%	1.4%	1.5%	1.7%
Hispanic or Latino Population (in thousands)	3.0%	3.5%	3.6%	3.7%	3.8%	3.8%	3.9%	4.3%	4.6%	5.0%	5.8%
Male Population (in thousands)	49.9%	49.8%	49.8%	49.8%	49.8%	49.8%	49.8%	49.8%	49.7%	49.7%	49.5%
Total Employment (in thousands of jobs)	171.65	177.73	182.05	183.91	185.81	187.70	189.62	199.43	209.65	220.27	242.80
Farm Employment	1.9%	1.9%	1.9%	1.9%	1.9%	1.9%	1.8%	1.8%	1.7%	1.6%	1.5%
Forestry, Fishing, Related Activities	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.1%
Mining	1.1%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.1%	1.0%	1.0%	0.9%
Utilities	0.4%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%
Construction	8.7%	8.9%	9.0%	9.0%	9.0%	9.1%	9.1%	9.3%	9.4%	9.6%	9.8%
Manufacturing	6.7%	6.7%	6.6%	6.5%	6.4%	6.4%	6.3%	5.9%	5.5%	5.1%	4.5%
Wholesale Trade	2.2%	2.0%	2.0%	2.0%	1.9%	1.9%	1.9%	1.8%	1.7%	1.6%	1.5%
Retail Trade	11.0%	10.4%	10.4%	10.4%	10.4%	10.4%	10.4%	10.3%	10.3%	10.2%	10.0%
Transportation and Warehousing	3.2%	2.8%	2.8%	2.8%	2.8%	2.8%	2.8%	2.8%	2.8%	2.7%	2.7%
Information Employment	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	0.9%	0.9%	0.9%	0.9%
Finance and Insurance	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.4%	2.4%	2.3%	2.2%	2.1%
Real Estate / Rental and Lease	2.4%	2.4%	2.4%	2.4%	2.4%	2.5%	2.5%	2.5%	2.6%	2.6%	2.8%
Professional and Technical Services	4.7%	4.5%	4.5%	4.5%	4.6%	4.6%	4.7%	4.9%	5.1%	5.3%	5.8%
Management	0.7%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%
Administrative and Waste Services	3.8%	4.9%	5.0%	5.0%	5.1%	5.2%	5.3%	5.8%	6.2%	6.8%	7.9%
Educational Services	1.0%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.8%
Health Care and Social Assistance	9.5%	10.7%	10.8%	10.9%	11.0%	11.1%	11.2%	11.8%	12.4%	12.9%	14.1%
Arts, Entertainment, and Recreation	2.3%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.1%	1.1%	1.1%	1.0%
Accommodation and Food Services	7.9%	7.6%	7.6%	7.6%	7.6%	7.6%	7.6%	7.7%	7.7%	7.7%	7.6%
Other Services, Except Public Administration	6.2%	5.8%	5.8%	5.8%	5.9%	5.9%	6.0%	6.2%	6.3%	6.5%	6.9%
Federal Civilian Government	2.1%	2.0%	2.0%	2.0%	2.0%	1.9%	1.9%	1.8%	1.7%	1.6%	1.4%
Federal Military	5.7%	5.8%	5.8%	5.7%	5.6%	5.6%	5.5%	5.2%	4.9%	4.6%	4.1%
State and Local Government	14.0%	14.8%	14.8%	14.7%	14.6%	14.5%	14.4%	14.0%	13.6%	13.2%	12.3%

Table 4-29. Demographic and Employment Baseline Projections for Economic Impact Area LA-1 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	6,873.26	7,285.45	7,545.69	7,677.77	7,811.98	7,948.32	8,086.83	8,813.22	9,599.12	10,449.14	12,361.78
Farm Employment	0.5%	0.8%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%	0.4%
Forestry, Fishing, Related Activities	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
Mining	1.7%	2.3%	1.9%	1.9%	1.9%	1.9%	1.9%	2.0%	2.0%	2.0%	2.1%
Utilities	0.8%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
Construction	7.6%	10.9%	11.8%	11.7%	11.7%	11.6%	11.6%	11.3%	11.0%	10.7%	10.0%
Manufacturing	14.6%	12.5%	12.7%	12.6%	12.4%	12.3%	12.2%	11.5%	10.8%	10.2%	8.9%
Wholesale Trade	2.7%	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%	2.3%	2.2%	2.2%	2.0%
Retail Trade	6.3%	5.6%	5.6%	5.6%	5.5%	5.5%	5.5%	5.5%	5.4%	5.4%	5.2%
Transportation and Warehousing	3.6%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.8%	2.8%	2.8%
Information Employment	2.6%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.3%	2.3%
Finance and Insurance	2.3%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%
Real Estate / Rental and Lease	1.2%	1.1%	1.1%	1.1%	1.2%	1.2%	1.2%	1.3%	1.3%	1.4%	1.6%
Professional and Technical Services	5.4%	5.4%	5.3%	5.4%	5.5%	5.5%	5.6%	6.0%	6.3%	6.7%	7.4%
Management	1.5%	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
Administrative and Waste Services	2.2%	3.0%	3.0%	3.1%	3.2%	3.2%	3.3%	3.7%	4.1%	4.5%	5.5%
Educational Services	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Health Care and Social Assistance	8.7%	9.2%	9.2%	9.3%	9.4%	9.5%	9.7%	10.2%	10.8%	11.4%	12.6%
Arts, Entertainment, and Recreation	1.5%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%
Accommodation and Food Services	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.8%
Other Services, Except Public Administration	3.7%	3.0%	3.0%	3.0%	3.1%	3.1%	3.1%	3.2%	3.3%	3.4%	3.7%
Federal Civilian Government	3.8%	4.1%	4.0%	4.0%	4.0%	4.0%	3.9%	3.9%	3.8%	3.7%	3.6%
Federal Military	10.6%	11.4%	11.3%	11.3%	11.2%	11.2%	11.2%	11.0%	10.8%	10.6%	10.1%
State and Local Government	13.8%	14.1%	13.8%	13.8%	13.8%	13.8%	13.7%	13.6%	13.4%	13.2%	12.8%
Total Personal Income Per Capita (in 2005 dollars)	27,573	29,916	30,288	30,714	31,145	31,584	32,032	34,415	37,065	39,997	46,695
Woods & Poole Economics Wealth Index (U.S. = 100)	70.1	84.8	84.6	84.8	85.0	85.2	85.4	86.4	87.4	88.4	90.3
Persons Per Household (in number of people)	2.7	2.7	2.7	2.7	2.7	2.7	2.6	2.6	2.6	2.6	2.6
Mean Household Total Personal Income (in 2005 dollars)	66,070	78,879	79,669	80,570	81,502	82,473	83,478	89,133	95,837	103,681	123,003
Total Number of Households (in thousands)	123.62	124.83	125.65	126.79	127.92	129.02	130.11	135.19	139.77	143.78	150.15
Income < $10,000 (thousands of households, 2000 dollars)	12.1%	10.9%	10.6%	10.5%	10.3%	10.1%	9.9%	8.7%	7.5%	6.4%	4.8%
Income $10,000 to $19,999	14.8%	13.3%	13.0%	12.8%	12.6%	12.3%	12.1%	10.6%	9.2%	7.8%	5.8%
Income $20,000 to $29,999	13.0%	11.6%	11.3%	11.1%	10.9%	10.7%	10.5%	9.2%	7.9%	6.8%	5.0%
Income $30,000 to $44,999	19.5%	18.6%	18.4%	18.2%	17.9%	17.6%	17.4%	15.3%	13.2%	11.3%	8.3%
Income $45,000 to $59,999	15.2%	17.0%	17.4%	17.7%	18.0%	18.3%	18.6%	20.1%	20.1%	18.3%	13.8%
Income $60,000 to $74,999	9.6%	10.8%	11.1%	11.3%	11.5%	11.7%	11.9%	13.7%	16.0%	18.7%	20.4%
Income $75,000 to $99,999	8.9%	9.9%	10.2%	10.3%	10.5%	10.7%	10.9%	12.5%	14.7%	17.4%	23.7%
Income $100,000 or more	6.9%	7.8%	8.0%	8.1%	8.2%	8.4%	8.5%	9.7%	11.4%	13.4%	18.2%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 6 parishes in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-30

Demographic and Employment Baseline Projections for Economic Impact Area LA-2

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	558.39	587.88	593.59	599.38	605.23	611.14	617.10	647.47	678.54	709.79	772.62
Age Under 19 years	29.9%	28.9%	28.8%	28.7%	28.5%	28.5%	28.4%	28.2%	27.7%	27.0%	25.6%
Age 20 to 34	21.0%	22.0%	22.1%	22.0%	21.8%	21.5%	21.0%	19.5%	18.7%	18.6%	18.8%
Age 35 to 49	21.6%	19.1%	18.7%	18.4%	18.3%	18.3%	18.5%	19.3%	20.2%	19.5%	18.0%
Age 50 to 64	15.9%	18.0%	18.4%	18.6%	18.8%	18.9%	18.9%	18.4%	16.7%	16.5%	18.4%
Age 65 and over	11.6%	12.0%	12.1%	12.3%	12.6%	12.8%	13.1%	14.7%	16.7%	18.4%	19.1%
Median Age of Population (in years)	35	35	35	35	35	35	36	37	38	39	40
White Population (in thousands)	69.1%	68.3%	68.2%	68.1%	68.0%	67.9%	67.8%	67.2%	66.6%	66.0%	64.6%
Black Population (in thousands)	27.7%	28.0%	28.0%	28.0%	28.1%	28.1%	28.2%	28.4%	28.6%	28.8%	29.4%
Native American Population (in thousands)	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Asian and Pacific Islander Population (in thousands)	1.2%	1.2%	1.3%	1.3%	1.3%	1.3%	1.3%	1.5%	1.6%	1.7%	1.9%
Hispanic or Latino Population (in thousands)	1.7%	2.2%	2.2%	2.3%	2.3%	2.4%	2.4%	2.7%	2.9%	3.2%	3.8%
Male Population (in thousands)	48.6%	48.7%	48.7%	48.7%	48.8%	48.8%	48.8%	48.9%	48.9%	48.9%	48.8%
Total Employment (in thousands of jobs)	297.51	321.93	330.21	334.03	337.89	341.78	345.70	365.76	386.61	408.21	453.71
Farm Employment	1.9%	1.8%	1.8%	1.8%	1.7%	1.7%	1.7%	1.6%	1.5%	1.4%	1.3%
Forestry, Fishing, Related Activities	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Mining	6.9%	8.3%	8.3%	8.3%	8.2%	8.2%	8.2%	8.0%	7.8%	7.6%	7.2%
Utilities	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%
Construction	6.7%	6.8%	6.8%	6.8%	6.7%	6.7%	6.7%	6.5%	6.3%	6.2%	5.8%
Manufacturing	6.1%	5.9%	5.8%	5.7%	5.6%	5.6%	5.5%	5.1%	4.8%	4.4%	3.8%
Wholesale Trade	3.7%	3.6%	3.6%	3.5%	3.5%	3.5%	3.5%	3.4%	3.4%	3.3%	3.2%
Retail Trade	11.5%	11.2%	11.2%	11.2%	11.1%	11.1%	11.1%	10.9%	10.7%	10.5%	10.0%
Transportation and Warehousing	3.5%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
Information Employment	1.5%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%
Finance and Insurance	3.4%	3.2%	3.2%	3.2%	3.2%	3.1%	3.1%	3.1%	3.0%	3.0%	2.8%
Real Estate / Rental and Lease	4.0%	3.4%	3.4%	3.4%	3.4%	3.4%	3.4%	3.3%	3.3%	3.3%	3.2%
Professional and Technical Services	4.7%	5.2%	5.2%	5.3%	5.3%	5.3%	5.4%	5.5%	5.6%	5.8%	6.0%
Management	1.1%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	1.0%	1.0%	1.0%
Administrative and Waste Services	4.6%	4.9%	4.9%	4.9%	4.9%	5.0%	5.0%	5.2%	5.3%	5.4%	5.7%
Educational Services	1.2%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Health Care and Social Assistance	11.2%	12.0%	12.1%	12.3%	12.5%	12.6%	12.8%	13.6%	14.4%	15.2%	17.0%
Arts, Entertainment, and Recreation	1.5%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.5%	1.5%	1.5%	1.6%
Accommodation and Food Services	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.5%	6.5%	6.6%	6.6%
Other Services, Except Public Administration	7.0%	7.0%	7.1%	7.1%	7.2%	7.2%	7.3%	7.6%	8.0%	8.3%	9.0%
Federal Civilian Government	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%
Federal Military	0.9%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.6%	0.6%	0.5%
State and Local Government	10.8%	10.2%	10.2%	10.1%	10.1%	10.0%	9.9%	9.7%	9.4%	9.1%	8.6%

Table 4-30. Demographic and Employment Baseline Projections for Economic Impact Area LA-2 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	11,484.00	12,782.07	13,132.04	13,420.62	13,715.20	14,015.87	14,322.73	15,953.99	17,757.47	19,748.33	24,357.40
Farm Employment	0.8%	1.5%	1.3%	1.3%	1.3%	1.2%	1.2%	1.1%	1.0%	0.9%	0.8%
Forestry, Fishing, Related Activities	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%
Mining	13.7%	17.7%	17.7%	17.8%	17.9%	18.0%	18.1%	18.7%	19.3%	19.9%	21.0%
Utilities	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
Construction	7.1%	6.0%	6.3%	6.2%	6.1%	6.0%	5.9%	5.4%	4.9%	4.5%	3.8%
Manufacturing	7.5%	7.6%	7.7%	7.6%	7.5%	7.4%	7.3%	6.8%	6.3%	5.9%	5.1%
Wholesale Trade	4.7%	4.8%	5.0%	4.9%	4.9%	4.9%	4.9%	4.9%	4.8%	4.7%	4.5%
Retail Trade	7.9%	7.7%	7.8%	7.7%	7.7%	7.6%	7.5%	7.3%	7.0%	6.7%	6.2%
Transportation and Warehousing	4.6%	3.8%	3.7%	3.7%	3.7%	3.7%	3.7%	3.6%	3.6%	3.6%	3.5%
Information Employment	1.7%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.2%
Finance and Insurance	4.1%	2.9%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
Real Estate / Rental and Lease	3.5%	2.6%	2.6%	2.6%	2.7%	2.7%	2.7%	2.7%	2.7%	2.8%	2.8%
Professional and Technical Services	6.0%	6.1%	6.1%	6.1%	6.1%	6.2%	6.2%	6.3%	6.4%	6.5%	6.7%
Management	1.6%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.5%	1.5%	1.6%	1.7%
Administrative and Waste Services	3.1%	2.9%	2.9%	2.9%	3.0%	3.0%	3.0%	3.1%	3.2%	3.2%	3.4%
Educational Services	0.7%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.7%	0.7%
Health Care and Social Assistance	11.3%	11.6%	11.7%	11.8%	12.0%	12.1%	12.2%	12.9%	13.6%	14.3%	15.7%
Arts, Entertainment, and Recreation	0.6%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Accommodation and Food Services	2.5%	2.6%	2.7%	2.7%	2.7%	2.6%	2.6%	2.6%	2.6%	2.6%	2.5%
Other Services, Except Public Administration	4.5%	4.1%	4.1%	4.2%	4.2%	4.2%	4.2%	4.4%	4.5%	4.7%	4.9%
Federal Civilian Government	1.2%	1.2%	1.2%	1.2%	1.2%	1.1%	1.1%	1.1%	1.1%	1.0%	0.9%
Federal Military	0.9%	0.9%	0.7%	0.7%	0.7%	0.7%	0.6%	0.6%	0.6%	0.6%	0.6%
State and Local Government	11.3%	11.3%	11.2%	11.1%	11.1%	11.1%	11.0%	10.8%	10.6%	10.4%	9.9%
Total Personal Income (in millions of 2005 dollars)											
Total Personal Income Per Capita (in 2005 dollars)	28,507	30,706	30,852	31,247	31,645	32,047	32,456	34,618	37,001	39,634	45,589
Woods & Poole Economics Wealth Index (U.S. = 100)	72.7	78.6	77.7	77.7	77.8	77.8	77.8	77.8	77.7	77.7	77.5
Persons Per Household (in number of people)	2.7	2.7	2.7	2.7	2.6	2.6	2.6	2.6	2.6	2.6	2.7
Mean Household Total Personal Income (in 2005 dollars)	68,505	75,359	75,338	76,021	76,720	77,445	78,201	82,488	87,604	93,623	108,360
Total Number of Households (in thousands)	208.17	220.47	222.77	225.63	228.48	231.29	234.07	247.40	259.85	271.19	290.47
Income < $10,000 (thousands of households, 2000 dollars)	15.9%	14.1%	13.9%	13.7%	13.4%	13.2%	13.0%	11.8%	10.4%	8.9%	6.5%
Income $10,000 to $19,999	15.2%	13.6%	13.3%	13.1%	12.9%	12.7%	12.6%	11.3%	10.0%	8.6%	6.3%
Income $20,000 to $29,999	12.9%	11.7%	11.5%	11.3%	11.2%	11.0%	10.8%	9.8%	8.7%	7.5%	5.5%
Income $30,000 to $44,999	18.2%	18.4%	18.3%	18.3%	18.2%	18.1%	18.0%	17.0%	15.5%	13.7%	9.9%
Income $45,000 to $59,999	14.1%	15.8%	16.1%	16.3%	16.5%	16.7%	17.0%	18.2%	18.8%	18.9%	16.5%
Income $60,000 to $74,999	9.1%	10.2%	10.4%	10.6%	10.7%	10.9%	11.0%	12.3%	14.0%	16.2%	19.4%
Income $75,000 to $99,999	7.4%	8.3%	8.5%	8.6%	8.8%	8.9%	9.0%	10.1%	11.5%	13.4%	18.4%
Income $100,000 or more	7.1%	7.9%	8.0%	8.2%	8.3%	8.4%	8.5%	9.6%	11.0%	12.8%	17.5%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 7 parishes in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-31

Demographic and Employment Baseline Projections for Economic Impact Area LA-3

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	1,039.88	1,126.87	1,140.44	1,154.15	1,167.97	1,181.91	1,195.92	1,266.99	1,339.29	1,411.83	1,557.29
Age Under 19 years	29.7%	28.8%	28.6%	28.4%	28.3%	28.1%	28.1%	27.9%	27.6%	27.2%	26.3%
Age 20 to 34	22.4%	23.1%	23.4%	23.5%	23.5%	23.5%	23.1%	21.7%	20.6%	20.2%	20.3%
Age 35 to 49	21.4%	19.2%	18.7%	18.3%	18.0%	17.9%	17.9%	18.4%	19.4%	19.7%	18.1%
Age 50 to 64	16.2%	17.8%	18.1%	18.2%	18.3%	18.3%	18.3%	17.7%	16.3%	15.5%	17.3%
Age 65 and over	10.3%	11.1%	11.3%	11.6%	11.9%	12.2%	12.5%	14.3%	16.1%	17.5%	18.0%
Median Age of Population (in years)	35	35	35	35	35	36	36	37	38	39	40
White Population (in thousands)	65.7%	64.0%	63.7%	63.5%	63.3%	63.1%	62.9%	61.8%	60.7%	59.6%	57.2%
Black Population (in thousands)	29.6%	30.6%	30.7%	30.8%	30.9%	31.0%	31.1%	31.6%	32.0%	32.5%	33.4%
Native American Population (in thousands)	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.1%	1.1%	1.1%	1.1%
Asian and Pacific Islander Population (in thousands)	1.4%	1.4%	1.5%	1.5%	1.5%	1.5%	1.5%	1.6%	1.7%	1.8%	2.0%
Hispanic or Latino Population (in thousands)	2.3%	3.0%	3.1%	3.2%	3.3%	3.4%	3.5%	3.9%	4.4%	5.0%	6.2%
Male Population (in thousands)	48.7%	48.8%	48.8%	48.8%	48.8%	48.8%	48.8%	48.8%	48.9%	48.8%	48.9%
Total Employment (in thousands of jobs)	606.81	663.02	680.63	689.17	697.80	706.51	715.33	760.83	808.81	859.36	968.53
Farm Employment	0.7%	0.7%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%
Forestry, Fishing, Related Activities	0.8%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
Mining	1.5%	1.9%	1.9%	1.9%	1.9%	1.8%	1.8%	1.7%	1.6%	1.5%	1.2%
Utilities	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%	0.3%
Construction	9.8%	9.3%	9.3%	9.3%	9.4%	9.4%	9.5%	9.6%	9.8%	10.0%	10.3%
Manufacturing	6.8%	6.1%	6.1%	6.0%	5.9%	5.8%	5.7%	5.3%	5.0%	4.6%	4.0%
Wholesale Trade	3.2%	2.8%	2.8%	2.8%	2.8%	2.7%	2.7%	2.6%	2.4%	2.3%	2.1%
Retail Trade	10.9%	10.1%	10.0%	10.0%	10.0%	10.0%	10.0%	9.9%	9.7%	9.6%	9.3%
Transportation and Warehousing	4.4%	4.6%	4.5%	4.5%	4.5%	4.5%	4.5%	4.4%	4.3%	4.3%	4.1%
Information Employment	1.4%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.1%	1.1%	1.1%	1.0%
Finance and Insurance	3.5%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.2%	3.1%	3.1%	2.9%
Real Estate / Rental and Lease	3.6%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.8%	3.8%	3.8%	3.8%
Professional and Technical Services	4.8%	5.6%	5.6%	5.7%	5.7%	5.7%	5.8%	6.0%	6.1%	6.3%	6.6%
Management	1.0%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.0%	1.0%	0.9%	0.8%
Administrative and Waste Services	5.8%	6.1%	6.1%	6.2%	6.3%	6.4%	6.5%	7.1%	7.6%	8.2%	9.4%
Educational Services	1.1%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.6%	1.7%	1.9%	2.1%
Health Care and Social Assistance	8.8%	10.0%	10.1%	10.1%	10.2%	10.3%	10.3%	10.6%	10.9%	11.2%	11.7%
Arts, Entertainment, and Recreation	1.3%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.5%	1.5%	1.5%
Accommodation and Food Services	6.6%	6.7%	6.7%	6.8%	6.8%	6.8%	6.8%	6.9%	7.0%	7.1%	7.3%
Other Services, Except Public Administration	6.7%	6.6%	6.7%	6.7%	6.7%	6.8%	6.8%	7.0%	7.2%	7.4%	7.8%
Federal Civilian Government	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.6%	0.6%	0.6%
Federal Military	0.8%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.6%	0.6%	0.6%	0.5%
State and Local Government	15.6%	15.0%	14.9%	14.8%	14.7%	14.5%	14.4%	13.8%	13.3%	12.7%	11.6%

Table 4-31. Demographic and Employment Baseline Projections for Economic Impact Area LA-3 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	24,055.56	27,529.09	28,679.63	29,248.86	29,828.55	30,418.91	31,020.09	34,194.93	37,669.23	41,468.73	50,154.87
Farm Employment	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Forestry, Fishing, Related Activities	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Mining	2.6%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%
Utilities	0.7%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
Construction	10.3%	11.0%	12.0%	11.9%	11.9%	11.8%	11.7%	11.4%	11.1%	10.8%	10.1%
Manufacturing	12.4%	11.2%	11.3%	11.2%	11.1%	10.9%	10.8%	10.1%	9.5%	8.9%	7.7%
Wholesale Trade	4.4%	3.7%	3.8%	3.7%	3.7%	3.7%	3.7%	3.6%	3.5%	3.4%	3.2%
Retail Trade	7.2%	6.4%	6.4%	6.3%	6.3%	6.3%	6.3%	6.2%	6.1%	6.0%	5.8%
Transportation and Warehousing	6.0%	6.7%	6.7%	6.7%	6.7%	6.6%	6.6%	6.6%	6.5%	6.4%	6.3%
Information Employment	1.7%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%
Finance and Insurance	4.3%	3.6%	3.5%	3.5%	3.5%	3.5%	3.5%	3.6%	3.7%	3.8%	4.0%
Real Estate / Rental and Lease	2.1%	1.8%	1.7%	1.7%	1.7%	1.8%	1.8%	1.8%	1.9%	2.0%	2.1%
Professional and Technical Services	6.0%	6.9%	6.8%	6.9%	6.9%	7.0%	7.0%	7.3%	7.6%	7.9%	8.4%
Management	1.4%	1.9%	1.9%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Administrative and Waste Services	3.5%	3.9%	3.8%	3.9%	4.0%	4.1%	4.2%	4.7%	5.2%	5.7%	7.0%
Educational Services	0.6%	0.6%	0.6%	0.6%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	1.0%
Health Care and Social Assistance	9.2%	9.4%	9.3%	9.3%	9.4%	9.5%	9.6%	9.9%	10.3%	10.6%	11.2%
Arts, Entertainment, and Recreation	0.7%	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.5%	0.5%	0.5%
Accommodation and Food Services	2.7%	2.6%	2.5%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.7%	2.7%
Other Services, Except Public Administration	4.1%	3.6%	3.5%	3.5%	3.6%	3.6%	3.6%	3.7%	3.8%	3.9%	4.1%
Federal Civilian Government	1.2%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.6%	1.6%	1.7%
Federal Military	0.9%	0.9%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
State and Local Government	17.5%	17.8%	17.4%	17.3%	17.3%	17.2%	17.2%	16.9%	16.6%	16.3%	15.6%
Total Personal Income Per Capita (in 2005 dollars)	30,731	32,203	32,690	33,093	33,505	33,924	34,352	36,628	39,151	41,951	48,338
Woods & Poole Economics Wealth Index (U.S. = 100)	79.2	85.3	85.7	85.7	85.8	85.9	86.0	86.4	86.8	87.2	88.0
Persons Per Household (in number of people)	2.7	2.7	2.7	2.7	2.7	2.6	2.6	2.6	2.6	2.6	2.6
Mean Household Total Personal Income (in 2005 dollars)	77,923	83,219	84,664	85,438	86,256	87,115	88,016	93,155	99,279	106,460	124,061
Total Number of Households (in thousands)	385.14	421.32	426.92	433.61	440.27	446.88	453.43	485.13	515.26	543.37	593.15
Income < $10,000 (thousands of households, 2000 dollars)	12.4%	11.3%	11.1%	10.9%	10.7%	10.6%	10.4%	9.3%	8.2%	7.1%	5.3%
Income $10,000 to $19,999	13.2%	12.1%	11.8%	11.7%	11.5%	11.3%	11.1%	10.0%	8.8%	7.6%	5.7%
Income $20,000 to $29,999	12.1%	11.1%	10.8%	10.7%	10.5%	10.4%	10.2%	9.2%	8.1%	7.0%	5.2%
Income $30,000 to $44,999	17.5%	16.6%	16.3%	16.1%	15.9%	15.7%	15.5%	14.1%	12.4%	10.8%	8.0%
Income $45,000 to $59,999	14.7%	16.0%	16.3%	16.5%	16.7%	16.9%	17.0%	17.3%	16.7%	15.3%	11.7%
Income $60,000 to $74,999	11.1%	12.1%	12.4%	12.7%	12.9%	13.1%	13.3%	15.0%	17.1%	19.0%	19.1%
Income $75,000 to $99,999	10.0%	10.9%	11.1%	11.3%	11.5%	11.7%	11.9%	13.3%	15.3%	17.7%	24.2%
Income $100,000 or more	9.1%	9.8%	10.0%	10.1%	10.3%	10.4%	10.6%	11.8%	13.4%	15.4%	20.8%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 10 parishes in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-32

Demographic and Employment Baseline Projections for Economic Impact Area LA-4

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	1,378.12	1,267.52	1,278.34	1,289.31	1,300.40	1,311.64	1,322.96	1,380.77	1,439.98	1,499.47	1,618.89
Age Under 19 years	28.1%	26.3%	26.2%	26.1%	26.1%	26.1%	26.1%	26.5%	26.3%	25.9%	25.1%
Age 20 to 34	20.7%	20.7%	20.6%	20.5%	20.4%	20.1%	19.9%	18.1%	17.4%	17.5%	18.6%
Age 35 to 49	22.0%	20.1%	19.7%	19.4%	19.2%	19.0%	18.8%	19.1%	19.5%	19.0%	17.2%
Age 50 to 64	17.5%	20.5%	20.8%	20.9%	20.9%	21.0%	20.9%	19.8%	18.0%	17.2%	18.4%
Age 65 and over	11.6%	12.5%	12.7%	13.1%	13.4%	13.8%	14.2%	16.5%	18.8%	20.3%	20.7%
Median Age of Population (in years)	36	36	37	37	37	37	37	38	39	40	41
White Population (in thousands)	54.4%	55.5%	55.3%	55.1%	54.9%	54.8%	54.6%	53.7%	52.8%	51.9%	50.1%
Black Population (in thousands)	37.7%	35.0%	35.0%	35.0%	35.0%	35.1%	35.1%	35.2%	35.3%	35.3%	35.4%
Native American Population (in thousands)	0.4%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Asian and Pacific Islander Population (in thousands)	2.4%	2.7%	2.7%	2.8%	2.8%	2.8%	2.9%	3.1%	3.3%	3.5%	3.7%
Hispanic or Latino Population (in thousands)	5.1%	6.4%	6.5%	6.6%	6.7%	6.9%	7.0%	7.5%	8.1%	8.8%	10.2%
Male Population (in thousands)	48.0%	48.2%	48.2%	48.2%	48.2%	48.2%	48.2%	48.2%	48.2%	48.1%	48.2%
Total Employment (in thousands of jobs)	740.50	728.32	745.53	752.64	759.77	766.93	774.11	810.24	846.71	883.43	957.04
Farm Employment	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%
Forestry, Fishing, Related Activities	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
Mining	1.3%	1.5%	1.4%	1.4%	1.4%	1.3%	1.3%	1.2%	1.1%	1.0%	0.8%
Utilities	0.4%	0.4%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Construction	6.2%	7.4%	7.4%	7.5%	7.6%	7.6%	7.7%	8.1%	8.5%	8.9%	9.8%
Manufacturing	5.6%	5.6%	5.5%	5.5%	5.4%	5.3%	5.3%	4.9%	4.6%	4.4%	3.8%
Wholesale Trade	3.6%	3.1%	3.1%	3.1%	3.1%	3.1%	3.1%	3.0%	3.0%	2.9%	2.8%
Retail Trade	10.0%	10.2%	10.2%	10.3%	10.3%	10.3%	10.3%	10.5%	10.6%	10.7%	10.9%
Transportation and Warehousing	4.1%	3.8%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%	3.6%	3.6%	3.4%
Information Employment	1.6%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.3%	1.3%	1.2%
Finance and Insurance	3.9%	3.5%	3.5%	3.4%	3.4%	3.4%	3.4%	3.3%	3.2%	3.1%	2.9%
Real Estate / Rental and Lease	4.0%	3.9%	3.9%	3.9%	3.9%	4.0%	4.0%	4.0%	4.0%	4.1%	4.1%
Professional and Technical Services	5.7%	6.3%	6.3%	6.3%	6.2%	6.2%	6.2%	6.2%	6.1%	6.1%	5.9%
Management	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.0%	1.0%	1.0%	1.0%	0.9%
Administrative and Waste Services	6.4%	6.1%	6.2%	6.2%	6.3%	6.3%	6.3%	6.5%	6.7%	6.8%	7.1%
Educational Services	3.1%	3.2%	3.2%	3.2%	3.2%	3.1%	3.1%	3.1%	3.0%	3.0%	2.8%
Health Care and Social Assistance	8.8%	9.6%	9.7%	9.7%	9.8%	9.8%	9.9%	10.1%	10.4%	10.7%	11.1%
Arts, Entertainment, and Recreation	2.5%	2.4%	2.4%	2.4%	2.4%	2.5%	2.5%	2.5%	2.6%	2.6%	2.7%
Accommodation and Food Services	8.8%	9.1%	9.0%	8.9%	8.9%	8.8%	8.8%	8.4%	8.1%	7.8%	7.3%
Other Services, Except Public Administration	6.5%	6.3%	6.4%	6.4%	6.4%	6.4%	6.5%	6.6%	6.8%	6.9%	7.1%
Federal Civilian Government	2.1%	1.7%	1.7%	1.7%	1.7%	1.6%	1.6%	1.6%	1.5%	1.4%	1.3%
Federal Military	1.4%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.0%	1.0%	0.9%	0.8%
State and Local Government	11.9%	11.7%	11.7%	11.7%	11.8%	11.8%	11.8%	11.9%	11.9%	11.9%	12.0%

Table 4-32. Demographic and Employment Baseline Projections for Economic Impact Area LA-4 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	33,666.07	33,632.01	34,709.10	35,337.46	35,974.63	36,620.67	37,275.64	40,686.08	44,326.90	48,203.33	56,678.49
Farm Employment	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Forestry, Fishing, Related Activities	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Mining	4.4%	4.9%	4.8%	4.8%	4.8%	4.7%	4.7%	4.6%	4.5%	4.4%	4.1%
Utilities	1.2%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.2%	1.2%	1.2%
Construction	6.5%	6.2%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.7%	6.6%
Manufacturing	8.6%	9.0%	9.2%	9.1%	9.0%	8.9%	8.8%	8.2%	7.8%	7.3%	6.5%
Wholesale Trade	5.3%	4.9%	5.0%	5.0%	5.0%	5.0%	5.0%	4.9%	4.9%	4.9%	4.8%
Retail Trade	6.2%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%
Transportation and Warehousing	5.1%	4.9%	4.8%	4.8%	4.8%	4.7%	4.7%	4.6%	4.5%	4.4%	4.2%
Information Employment	1.7%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.4%	1.4%	1.4%
Finance and Insurance	5.1%	4.2%	4.2%	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%
Real Estate / Rental and Lease	2.6%	1.1%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.3%	1.3%	1.4%
Professional and Technical Services	8.0%	9.0%	8.9%	8.9%	8.9%	8.9%	8.9%	8.9%	8.9%	8.8%	8.8%
Management	1.8%	1.7%	1.6%	1.6%	1.6%	1.7%	1.7%	1.7%	1.7%	1.8%	1.8%
Administrative and Waste Services	4.0%	3.9%	4.0%	4.1%	4.1%	4.1%	4.2%	4.4%	4.6%	4.8%	5.1%
Educational Services	2.2%	2.5%	2.5%	2.5%	2.5%	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%
Health Care and Social Assistance	8.7%	9.8%	9.7%	9.8%	9.9%	9.9%	10.0%	10.3%	10.6%	10.9%	11.6%
Arts, Entertainment, and Recreation	2.1%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.1%	2.1%	2.2%	2.2%
Accommodation and Food Services	4.4%	4.8%	4.7%	4.6%	4.6%	4.6%	4.5%	4.3%	4.2%	4.0%	3.7%
Other Services, Except Public Administration	3.7%	3.6%	3.6%	3.6%	3.6%	3.6%	3.6%	3.7%	3.8%	3.9%	4.0%
Federal Civilian Government	4.2%	4.0%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.8%	3.8%
Federal Military	1.8%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%
State and Local Government	12.1%	13.0%	12.9%	12.9%	13.0%	13.0%	13.1%	13.4%	13.7%	14.0%	14.5%
Total Personal Income Per Capita (in 2005 dollars)	32,677	35,414	35,829	36,225	36,628	37,038	37,456	39,644	42,012	44,580	50,228
Woods & Poole Economics Wealth Index (U.S. = 100)	79.1	91.9	91.0	90.8	90.7	90.5	90.4	89.9	89.4	88.9	87.7
Persons Per Household (in number of people)	2.6	2.6	2.6	2.6	2.6	2.6	2.5	2.5	2.5	2.5	2.5
Mean Household Total Personal Income (in 2005 dollars)	77,994	87,207	87,276	87,772	88,333	88,946	89,614	93,616	98,555	104,400	118,602
Total Number of Households (in thousands)	530.24	491.36	496.01	501.93	507.80	513.61	519.34	546.73	572.34	595.76	635.83
Income < $10,000 (thousands of households, 2000 dollars)	12.7%	10.8%	10.6%	10.5%	10.3%	10.1%	9.9%	9.2%	8.2%	7.2%	5.5%
Income $10,000 to $19,999	13.5%	11.9%	11.7%	11.5%	11.3%	11.1%	10.9%	10.1%	9.1%	8.0%	6.2%
Income $20,000 to $29,999	12.9%	11.4%	11.2%	11.1%	10.9%	10.8%	10.6%	9.7%	8.7%	7.8%	6.1%
Income $30,000 to $44,999	17.6%	15.5%	15.3%	15.2%	15.0%	14.8%	14.6%	13.6%	12.2%	10.8%	8.4%
Income $45,000 to $59,999	13.7%	15.1%	15.3%	15.4%	15.5%	15.6%	15.7%	15.5%	14.9%	14.0%	11.2%
Income $60,000 to $74,999	10.1%	11.7%	11.9%	12.0%	12.2%	12.4%	12.6%	13.8%	15.2%	16.2%	15.7%
Income $75,000 to $99,999	9.3%	11.3%	11.5%	11.7%	11.9%	12.1%	12.3%	13.6%	15.3%	17.4%	22.5%
Income $100,000 or more	10.2%	12.3%	12.5%	12.6%	12.8%	13.1%	13.3%	14.5%	16.4%	18.6%	24.3%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 9 parishes in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-33

Demographic and Employment Baseline Projections for Economic Impact Area MS-1

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	476.88	470.61	474.64	478.72	482.85	487.02	491.23	512.71	534.70	556.77	601.05
Age Under 19 years	28.6%	28.0%	27.9%	27.8%	27.6%	27.6%	27.5%	27.5%	27.3%	26.8%	25.7%
Age 20 to 34	20.2%	20.3%	20.4%	20.5%	20.6%	20.5%	20.2%	19.6%	18.7%	18.5%	19.0%
Age 35 to 49	21.7%	19.8%	19.4%	19.1%	18.8%	18.5%	18.5%	18.3%	18.9%	19.0%	18.0%
Age 50 to 64	17.4%	19.0%	19.3%	19.3%	19.3%	19.4%	19.5%	18.9%	17.6%	16.8%	17.7%
Age 65 and over	12.1%	12.8%	13.0%	13.4%	13.7%	14.0%	14.3%	15.7%	17.5%	18.9%	19.6%
Median Age of Population (in years)	36	36	36	36	37	37	37	37	38	39	40
White Population (in thousands)	75.5%	74.0%	73.8%	73.7%	73.5%	73.4%	73.2%	72.5%	71.8%	71.1%	70.0%
Black Population (in thousands)	19.2%	19.8%	19.8%	19.9%	19.9%	19.9%	20.0%	20.3%	20.5%	20.8%	21.3%
Native American Population (in thousands)	0.5%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%	0.5%
Asian and Pacific Islander Population (in thousands)	2.0%	2.1%	2.1%	2.2%	2.2%	2.2%	2.2%	2.3%	2.3%	2.3%	2.3%
Hispanic or Latino Population (in thousands)	2.8%	3.6%	3.7%	3.8%	3.8%	3.9%	4.0%	4.4%	4.8%	5.2%	5.9%
Male Population (in thousands)	49.6%	49.6%	49.6%	49.6%	49.6%	49.5%	49.5%	49.5%	49.6%	49.6%	49.6%
Total Employment (in thousands of jobs)	238.83	243.91	249.36	251.56	253.76	255.98	258.22	269.62	281.38	293.52	318.92
Farm Employment	1.4%	1.3%	1.3%	1.3%	1.3%	1.2%	1.2%	1.2%	1.1%	1.0%	0.9%
Forestry, Fishing, Related Activities	0.8%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%
Mining	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Utilities	0.9%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
Construction	7.5%	7.2%	7.2%	7.2%	7.2%	7.3%	7.3%	7.4%	7.5%	7.7%	7.9%
Manufacturing	9.5%	10.2%	10.2%	10.1%	10.0%	9.9%	9.8%	9.4%	9.0%	8.6%	7.9%
Wholesale Trade	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.3%	1.3%	1.2%	1.1%
Retail Trade	10.9%	10.2%	10.1%	10.1%	10.1%	10.1%	10.0%	9.9%	9.8%	9.7%	9.4%
Transportation and Warehousing	2.4%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.6%	2.6%	2.6%
Information Employment	1.4%	0.8%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	1.0%	1.0%	1.1%
Finance and Insurance	2.5%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%
Real Estate / Rental and Lease	3.1%	3.5%	3.5%	3.5%	3.6%	3.6%	3.6%	3.8%	3.9%	4.0%	4.3%
Professional and Technical Services	3.8%	4.1%	4.2%	4.2%	4.2%	4.3%	4.3%	4.5%	4.8%	5.0%	5.4%
Management	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%	0.3%
Administrative and Waste Services	5.4%	6.0%	6.1%	6.1%	6.2%	6.3%	6.4%	6.8%	7.2%	7.6%	8.4%
Educational Services	0.5%	0.8%	0.8%	0.9%	0.9%	0.9%	0.9%	1.0%	1.1%	1.2%	1.4%
Health Care and Social Assistance	6.2%	6.8%	6.9%	6.9%	6.9%	7.0%	7.0%	7.1%	7.2%	7.3%	7.5%
Arts, Entertainment, and Recreation	2.2%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%
Accommodation and Food Services	12.1%	10.3%	10.3%	10.3%	10.2%	10.2%	10.2%	10.0%	9.8%	9.6%	9.3%
Other Services, Except Public Administration	5.5%	5.5%	5.6%	5.6%	5.6%	5.7%	5.7%	5.9%	6.1%	6.3%	6.7%
Federal Civilian Government	3.9%	4.0%	4.0%	3.9%	3.9%	3.9%	3.8%	3.7%	3.5%	3.4%	3.1%
Federal Military	5.7%	5.3%	5.3%	5.2%	5.2%	5.1%	5.1%	4.8%	4.6%	4.3%	3.9%
State and Local Government	12.3%	13.4%	13.4%	13.4%	13.4%	13.4%	13.3%	13.3%	13.2%	13.1%	13.0%

Table 4-33. Demographic and Employment Baseline Projections for Economic Impact Area MS-1 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	9,318.99	9,816.16	10,180.77	10,354.51	10,530.94	10,710.09	10,892.03	11,844.59	12,872.19	13,979.85	16,456.60
Farm Employment	0.3%	0.0%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%
Forestry, Fishing, Related Activities	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%
Mining	0.2%	0.4%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Utilities	2.1%	1.6%	1.6%	1.6%	1.6%	1.6%	1.7%	1.7%	1.8%	1.9%	2.0%
Construction	6.0%	5.4%	6.0%	6.0%	5.9%	5.9%	5.8%	5.7%	5.5%	5.3%	5.0%
Manufacturing	15.4%	17.3%	17.7%	17.5%	17.4%	17.3%	17.1%	16.5%	15.8%	15.1%	13.9%
Wholesale Trade	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.5%	1.5%	1.4%	1.3%
Retail Trade	7.0%	6.1%	6.1%	6.0%	6.0%	6.0%	5.9%	5.8%	5.7%	5.5%	5.3%
Transportation and Warehousing	2.3%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Information Employment	1.4%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.9%	0.9%	1.0%	1.1%
Finance and Insurance	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.3%	2.4%	2.5%	2.6%
Real Estate / Rental and Lease	1.0%	0.7%	0.8%	0.8%	0.8%	0.8%	0.8%	0.9%	0.9%	1.0%	1.1%
Professional and Technical Services	4.6%	5.1%	5.1%	5.2%	5.3%	5.3%	5.4%	5.7%	6.0%	6.3%	6.9%
Management	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
Administrative and Waste Services	3.1%	3.4%	3.4%	3.5%	3.5%	3.6%	3.6%	3.9%	4.2%	4.5%	5.2%
Educational Services	0.3%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.6%	0.6%	0.7%	0.9%
Health Care and Social Assistance	6.7%	6.9%	6.9%	6.9%	6.9%	7.0%	7.0%	7.1%	7.3%	7.4%	7.6%
Arts, Entertainment, and Recreation	1.5%	1.1%	1.1%	1.1%	1.1%	1.1%	1.0%	1.0%	1.0%	1.0%	0.9%
Accommodation and Food Services	8.0%	5.9%	5.8%	5.8%	5.7%	5.7%	5.7%	5.6%	5.4%	5.3%	5.1%
Other Services, Except Public Administration	3.4%	3.5%	3.4%	3.4%	3.5%	3.5%	3.5%	3.6%	3.8%	3.9%	4.1%
Federal Civilian Government	8.4%	8.8%	8.6%	8.6%	8.6%	8.6%	8.6%	8.6%	8.5%	8.5%	8.4%
Federal Military	10.2%	10.2%	10.1%	10.0%	10.0%	10.0%	9.9%	9.8%	9.6%	9.5%	9.2%
State and Local Government	13.2%	15.3%	15.0%	15.0%	15.1%	15.1%	15.2%	15.4%	15.5%	15.7%	16.1%
Total Personal Income Per Capita (in 2005 dollars)	27,815	29,510	29,900	30,216	30,539	30,868	31,204	32,989	34,961	37,140	42,045
Woods & Poole Economics Wealth Index (U.S. = 100)	68.6	73.6	73.5	73.4	73.4	73.3	73.2	72.8	72.4	72.0	71.2
Persons Per Household (in number of people)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.5	2.5	2.6
Mean Household Total Personal Income (in 2005 dollars)	65,960	67,129	67,940	68,417	68,918	69,445	70,003	73,247	77,212	81,941	93,603
Total Number of Households (in thousands)	180.00	179.76	181.51	183.72	185.92	188.09	190.24	200.49	210.03	218.68	233.44
Income < $10,000 (thousands of households, 2000 dollars)	10.8%	9.8%	9.7%	9.5%	9.4%	9.2%	9.1%	8.4%	7.4%	6.4%	4.6%
Income $10,000 to $19,999	122.2%	122.3%	122.3%	122.3%	122.3%	122.3%	122.3%	122.5%	122.6%	122.8%	122.9%
Income $20,000 to $29,999	103.6%	102.5%	102.4%	102.4%	102.4%	102.4%	102.4%	101.9%	101.3%	101.1%	100.9%
Income $30,000 to $44,999	148.8%	154.6%	155.9%	156.8%	157.6%	158.3%	158.9%	161.1%	162.6%	163.1%	163.2%
Income $45,000 to $59,999	79.1%	92.0%	94.5%	96.5%	98.6%	100.9%	103.3%	115.9%	132.2%	147.5%	162.6%
Income $60,000 to $74,999	65.2%	66.6%	66.8%	66.9%	67.1%	67.3%	67.4%	71.0%	80.1%	94.1%	134.9%
Income $75,000 to $99,999	83.1%	82.9%	82.9%	82.9%	82.9%	82.8%	82.8%	82.7%	82.7%	84.6%	103.1%
Income $100,000 or more	81.1%	81.1%	81.2%	81.2%	81.2%	81.2%	81.2%	81.2%	81.2%	81.0%	81.1%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 7 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-34

Demographic and Employment Baseline Projections for Economic Impact Area AL-1

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	691.71	725.48	731.11	736.83	742.62	748.49	754.41	784.68	815.74	846.94	909.54
Age Under 19 years	28.1%	27.4%	27.2%	27.1%	26.9%	26.8%	26.7%	26.5%	26.1%	25.6%	24.6%
Age 20 to 34	19.2%	19.5%	19.6%	19.6%	19.5%	19.3%	19.1%	18.3%	17.7%	17.3%	17.6%
Age 35 to 49	21.1%	19.3%	18.9%	18.6%	18.5%	18.4%	18.4%	18.5%	18.8%	18.6%	17.8%
Age 50 to 64	18.0%	19.5%	19.7%	19.8%	19.8%	19.8%	19.8%	19.0%	17.6%	17.1%	17.9%
Age 65 and over	13.6%	14.4%	14.6%	14.9%	15.3%	15.6%	16.0%	17.7%	19.8%	21.3%	22.1%
Median Age of Population (in years)	38	39	39	40	40	40	40	41	42	42	44
White Population (in thousands)	66.6%	66.0%	65.9%	65.9%	65.8%	65.7%	65.7%	65.3%	64.9%	64.4%	63.7%
Black Population (in thousands)	29.6%	29.4%	29.4%	29.4%	29.3%	29.3%	29.3%	29.3%	29.3%	29.3%	29.1%
Native American Population (in thousands)	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	1.0%	1.0%	1.0%
Asian and Pacific Islander Population (in thousands)	1.2%	1.5%	1.5%	1.5%	1.6%	1.6%	1.6%	1.7%	1.9%	2.0%	2.3%
Hispanic or Latino Population (in thousands)	1.6%	2.2%	2.3%	2.3%	2.4%	2.4%	2.5%	2.7%	3.0%	3.3%	4.0%
Male Population (in thousands)	48.2%	48.3%	48.3%	48.3%	48.3%	48.3%	48.4%	48.4%	48.5%	48.5%	48.6%
Total Employment (in thousands of jobs)	363.84	353.63	362.59	366.69	370.81	374.97	379.15	400.55	422.75	445.72	493.98
Farm Employment	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.3%	1.2%	1.2%	1.1%
Forestry, Fishing, Related Activities	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	0.9%	0.9%	0.9%	0.8%	0.8%
Mining	0.3%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Utilities	0.4%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%
Construction	8.5%	7.5%	7.6%	7.6%	7.6%	7.6%	7.6%	7.7%	7.7%	7.7%	7.8%
Manufacturing	8.7%	7.6%	7.6%	7.5%	7.4%	7.3%	7.2%	6.9%	6.5%	6.2%	5.5%
Wholesale Trade	3.5%	3.1%	3.0%	3.0%	3.0%	3.0%	2.9%	2.8%	2.7%	2.6%	2.4%
Retail Trade	12.4%	11.9%	11.8%	11.8%	11.7%	11.6%	11.5%	11.1%	10.7%	10.3%	9.5%
Transportation and Warehousing	3.7%	3.9%	3.9%	3.8%	3.8%	3.8%	3.8%	3.6%	3.5%	3.4%	3.2%
Information Employment	1.3%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	0.9%	0.9%
Finance and Insurance	3.4%	3.7%	3.7%	3.7%	3.7%	3.6%	3.6%	3.5%	3.4%	3.2%	3.0%
Real Estate / Rental and Lease	4.4%	4.6%	4.7%	4.7%	4.7%	4.7%	4.8%	4.9%	5.0%	5.2%	5.4%
Professional and Technical Services	4.4%	4.6%	4.7%	4.7%	4.7%	4.8%	4.8%	5.0%	5.2%	5.4%	5.7%
Management	0.2%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
Administrative and Waste Services	6.4%	6.4%	6.5%	6.5%	6.6%	6.7%	6.7%	7.0%	7.3%	7.6%	8.3%
Educational Services	1.4%	1.6%	1.7%	1.7%	1.7%	1.7%	1.7%	1.8%	1.9%	2.0%	2.2%
Health Care and Social Assistance	8.5%	9.4%	9.4%	9.5%	9.6%	9.6%	9.7%	10.1%	10.4%	10.7%	11.4%
Arts, Entertainment, and Recreation	1.3%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Accommodation and Food Services	6.8%	7.6%	7.6%	7.7%	7.7%	7.7%	7.8%	8.0%	8.2%	8.4%	8.9%
Other Services, Except Public Administration	7.7%	7.9%	7.9%	8.0%	8.0%	8.1%	8.1%	8.4%	8.7%	8.9%	9.4%
Federal Civilian Government	0.9%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.7%	0.7%	0.6%
Federal Military	1.3%	1.1%	1.1%	1.1%	1.0%	1.0%	1.0%	1.0%	0.9%	0.8%	0.7%
State and Local Government	12.0%	12.0%	12.0%	11.9%	11.9%	11.9%	11.8%	11.6%	11.4%	11.1%	10.7%

Table 4-34. Demographic and Employment Baseline Projections for Economic Impact Area AL-1 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	12,930.79	13,040.20	13,381.74	13,639.05	13,900.74	14,166.88	14,437.55	15,860.94	17,407.25	19,085.19	22,872.66
Farm Employment	0.8%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%	0.5%	0.4%
Forestry, Fishing, Related Activities	1.0%	1.0%	1.0%	0.9%	0.9%	0.9%	0.9%	0.9%	0.8%	0.8%	0.7%
Mining	0.4%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.7%	0.7%	0.7%	0.8%
Utilities	1.0%	1.4%	1.1%	1.1%	1.1%	1.1%	1.1%	1.2%	1.2%	1.2%	1.2%
Construction	8.9%	7.9%	8.6%	8.5%	8.4%	8.4%	8.3%	8.0%	7.7%	7.4%	6.8%
Manufacturing	13.6%	12.2%	12.6%	12.5%	12.4%	12.3%	12.2%	11.7%	11.2%	10.7%	9.8%
Wholesale Trade	5.1%	4.6%	4.7%	4.7%	4.6%	4.6%	4.6%	4.5%	4.4%	4.3%	4.0%
Retail Trade	8.9%	8.4%	8.5%	8.4%	8.3%	8.3%	8.2%	7.9%	7.5%	7.2%	6.5%
Transportation and Warehousing	4.8%	5.7%	5.6%	5.6%	5.6%	5.5%	5.5%	5.3%	5.1%	4.9%	4.6%
Information Employment	1.6%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.3%	1.3%	1.3%	1.3%
Finance and Insurance	4.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	3.8%
Real Estate / Rental and Lease	2.3%	1.7%	1.8%	1.8%	1.8%	1.8%	1.8%	2.0%	2.1%	2.2%	2.5%
Professional and Technical Services	5.5%	6.1%	6.1%	6.2%	6.2%	6.3%	6.4%	6.7%	7.0%	7.3%	7.9%
Management	0.3%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.7%	0.7%	0.7%	0.8%
Administrative and Waste Services	3.7%	3.6%	3.7%	3.7%	3.7%	3.8%	3.8%	4.1%	4.3%	4.6%	5.1%
Educational Services	0.9%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.1%	1.1%	1.2%	1.3%
Health Care and Social Assistance	9.8%	11.0%	11.1%	11.2%	11.3%	11.4%	11.5%	11.9%	12.4%	12.9%	13.8%
Arts, Entertainment, and Recreation	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
Accommodation and Food Services	3.2%	3.5%	3.5%	3.5%	3.5%	3.6%	3.6%	3.7%	3.7%	3.8%	4.0%
Other Services, Except Public Administration	4.8%	4.9%	4.9%	4.9%	4.9%	5.0%	5.0%	5.2%	5.4%	5.5%	5.8%
Federal Civilian Government	2.2%	2.5%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Federal Military	1.8%	1.8%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.2%	1.2%	1.2%
State and Local Government	13.8%	15.2%	15.1%	15.1%	15.1%	15.1%	15.2%	15.2%	15.2%	15.2%	15.1%
Total Personal Income Per Capita (in 2005 dollars)	26,961	28,132	28,252	28,605	28,964	29,329	29,701	31,665	33,826	36,202	41,511
Woods & Poole Economics Wealth Index (U.S. = 100)	69.0	71.9	71.2	71.2	71.3	71.3	71.4	71.6	71.8	72.0	72.2
Persons Per Household (in number of people)	2.6	2.6	2.6	2.6	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Mean Household Total Personal Income (in 2005 dollars)	61,397	63,756	63,690	64,304	64,944	65,612	66,308	70,242	74,885	80,263	93,095
Total Number of Households (in thousands)	267.98	283.15	285.62	288.82	292.00	295.14	298.23	312.96	326.65	339.07	360.09
Income < \$10,000 (thousands of households, 2000 dollars)	13.3%	11.9%	11.7%	11.6%	11.4%	11.2%	11.0%	10.0%	8.6%	7.4%	5.4%
Income \$10,000 to \$19,999	14.5%	13.2%	13.0%	12.8%	12.7%	12.5%	12.3%	11.2%	9.7%	8.3%	6.2%
Income \$20,000 to \$29,999	13.0%	11.9%	11.8%	11.6%	11.5%	11.3%	11.2%	10.2%	8.9%	7.7%	5.7%
Income \$30,000 to \$44,999	18.8%	18.5%	18.4%	18.2%	18.1%	17.9%	17.8%	16.5%	14.6%	12.6%	9.4%
Income \$45,000 to \$59,999	14.8%	16.4%	16.6%	16.8%	17.0%	17.2%	17.4%	18.7%	19.5%	18.8%	14.8%
Income \$60,000 to \$74,999	9.6%	10.6%	10.7%	10.9%	11.0%	11.2%	11.3%	12.5%	14.4%	16.8%	19.9%
Income \$75,000 to \$99,999	8.4%	9.3%	9.4%	9.5%	9.7%	9.8%	9.9%	11.0%	12.7%	14.9%	20.1%
Income \$100,000 or more	7.5%	8.4%	8.5%	8.6%	8.7%	8.9%	9.0%	10.0%	11.6%	13.5%	18.4%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 8 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-35

Demographic and Employment Baseline Projections for Economic Impact Area FL-1

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	865.12	896.10	911.70	927.40	943.19	959.08	975.02	1,055.59	1,137.26	1,219.22	1,383.66
Age Under 19 years	26.1%	25.0%	24.8%	24.7%	24.6%	24.5%	24.5%	24.9%	24.7%	24.2%	23.1%
Age 20 to 34	20.5%	21.5%	21.7%	21.8%	21.9%	21.9%	21.5%	19.9%	18.5%	18.2%	18.9%
Age 35 to 49	22.0%	19.5%	19.0%	18.5%	18.1%	17.7%	17.7%	18.2%	19.5%	19.7%	17.0%
Age 50 to 64	17.9%	19.4%	19.6%	19.7%	19.7%	19.8%	19.8%	18.8%	16.9%	15.5%	17.2%
Age 65 and over	13.4%	14.6%	14.8%	15.3%	15.7%	16.1%	16.4%	18.2%	20.4%	22.4%	23.8%
Median Age of Population (in years)	39	39	40	40	40	40	40	40	41	42	43
White Population (in thousands)	79.2%	77.6%	77.4%	77.2%	77.1%	76.9%	76.7%	75.8%	74.9%	74.1%	72.6%
Black Population (in thousands)	13.8%	14.3%	14.3%	14.3%	14.4%	14.4%	14.4%	14.6%	14.7%	14.8%	14.9%
Native American Population (in thousands)	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.8%
Asian and Pacific Islander Population (in thousands)	2.4%	2.6%	2.6%	2.6%	2.7%	2.7%	2.7%	2.8%	2.8%	2.8%	2.6%
Hispanic or Latino Population (in thousands)	3.7%	4.6%	4.7%	4.8%	5.0%	5.1%	5.2%	5.9%	6.6%	7.4%	9.0%
Male Population (in thousands)	49.8%	50.0%	50.1%	50.1%	50.2%	50.2%	50.2%	50.4%	50.5%	50.7%	51.1%
Total Employment (in thousands of jobs)	487.45	489.82	504.24	512.13	520.13	528.26	536.52	579.78	626.48	676.88	789.79
Farm Employment	0.5%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%
Forestry, Fishing, Related Activities	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Mining	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%
Utilities	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%
Construction	9.0%	5.6%	5.6%	5.7%	5.7%	5.7%	5.7%	5.7%	5.8%	5.8%	5.9%
Manufacturing	3.4%	3.0%	3.0%	3.0%	3.0%	3.0%	2.9%	2.8%	2.7%	2.6%	2.4%
Wholesale Trade	2.6%	2.1%	2.1%	2.1%	2.0%	2.0%	2.0%	1.9%	1.8%	1.8%	1.6%
Retail Trade	12.0%	11.8%	11.8%	11.7%	11.7%	11.7%	11.7%	11.5%	11.4%	11.3%	10.9%
Transportation and Warehousing	1.8%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	1.9%	1.9%
Information Employment	1.9%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.7%	1.7%	1.7%	1.6%
Finance and Insurance	3.6%	3.9%	3.9%	3.9%	3.9%	3.9%	3.9%	4.0%	4.1%	4.1%	4.2%
Real Estate / Rental and Lease	5.5%	5.6%	5.6%	5.6%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%	5.7%
Professional and Technical Services	5.2%	5.7%	5.7%	5.8%	5.9%	5.9%	6.0%	6.4%	6.8%	7.1%	8.0%
Management	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%
Administrative and Waste Services	7.0%	6.4%	6.4%	6.5%	6.5%	6.6%	6.7%	6.9%	7.2%	7.4%	7.9%
Educational Services	1.0%	1.1%	1.1%	1.1%	1.1%	1.2%	1.2%	1.2%	1.3%	1.3%	1.4%
Health Care and Social Assistance	8.9%	10.8%	10.9%	11.0%	11.1%	11.2%	11.3%	11.8%	12.4%	12.9%	14.0%
Arts, Entertainment, and Recreation	1.7%	1.9%	1.9%	1.9%	1.9%	1.9%	1.9%	1.9%	2.0%	2.0%	2.0%
Accommodation and Food Services	8.8%	9.2%	9.2%	9.2%	9.2%	9.2%	9.2%	9.1%	9.1%	9.1%	9.0%
Other Services, Except Public Administration	6.2%	6.3%	6.3%	6.3%	6.3%	6.3%	6.4%	6.5%	6.5%	6.6%	6.7%
Federal Civilian Government	3.5%	3.7%	3.7%	3.7%	3.6%	3.6%	3.5%	3.3%	3.1%	2.9%	2.5%
Federal Military	6.9%	7.3%	7.2%	7.1%	7.0%	6.9%	6.8%	6.2%	5.7%	5.2%	4.4%
State and Local Government	9.1%	9.7%	9.7%	9.6%	9.6%	9.6%	9.5%	9.3%	9.1%	8.9%	8.4%

Table 4-35. Demographic and Employment Baseline Projections for Economic Impact Area FL-1 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	19,144.97	18,366.21	19,090.88	19,571.64	20,064.69	20,570.39	21,089.01	23,888.71	27,067.17	30,676.87	39,438.19
Farm Employment	0.1%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Forestry, Fishing, Related Activities	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Mining	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Utilities	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Construction	8.1%	4.4%	4.8%	4.8%	4.7%	4.7%	4.6%	4.4%	4.2%	4.0%	3.7%
Manufacturing	4.8%	4.7%	4.8%	4.8%	4.8%	4.8%	4.7%	4.6%	4.5%	4.4%	4.2%
Wholesale Trade	3.0%	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%	2.3%	2.2%	2.2%	2.0%
Retail Trade	7.9%	7.3%	7.3%	7.3%	7.2%	7.2%	7.2%	7.0%	6.9%	6.7%	6.4%
Transportation and Warehousing	1.8%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.1%	2.1%	2.1%
Information Employment	2.4%	2.0%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%
Finance and Insurance	3.9%	3.6%	3.6%	3.6%	3.7%	3.7%	3.8%	4.0%	4.2%	4.4%	4.9%
Real Estate / Rental and Lease	3.1%	2.0%	2.0%	2.1%	2.1%	2.1%	2.1%	2.2%	2.3%	2.4%	2.5%
Professional and Technical Services	6.6%	6.8%	6.8%	6.9%	7.0%	7.1%	7.2%	7.7%	8.2%	8.8%	9.9%
Management	0.8%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%
Administrative and Waste Services	4.5%	3.7%	3.8%	3.8%	3.9%	3.9%	3.9%	4.2%	4.4%	4.6%	5.1%
Educational Services	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.9%	0.9%
Health Care and Social Assistance	10.0%	12.0%	12.0%	12.2%	12.3%	12.5%	12.6%	13.3%	14.0%	14.7%	16.2%
Arts, Entertainment, and Recreation	0.6%	0.6%	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Accommodation and Food Services	4.6%	4.4%	4.4%	4.4%	4.4%	4.4%	4.3%	4.3%	4.3%	4.3%	4.2%
Other Services, Except Public Administration	4.4%	4.3%	4.2%	4.2%	4.3%	4.3%	4.3%	4.4%	4.4%	4.5%	4.6%
Federal Civilian Government	6.8%	7.8%	7.6%	7.6%	7.5%	7.5%	7.4%	7.1%	6.8%	6.6%	6.0%
Federal Military	14.5%	18.2%	18.0%	17.8%	17.6%	17.4%	17.2%	16.3%	15.4%	14.5%	12.8%
State and Local Government	10.5%	11.2%	11.1%	11.1%	11.0%	11.0%	11.0%	11.0%	10.9%	10.7%	10.4%
Total Personal Income Per Capita (in 2005 dollars)	30,955	31,238	31,611	31,972	32,345	32,728	33,123	35,252	37,665	40,392	46,766
Woods & Poole Economics Wealth Index (U.S. = 100)	86.0	86.1	85.9	86.0	86.0	86.1	86.2	86.6	87.2	87.8	89.2
Persons Per Household (in number of people)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.4	2.4	2.5
Mean Household Total Personal Income (in 2005 dollars)	70,630	68,775	69,464	70,092	70,758	71,474	72,225	76,569	81,867	88,167	103,926
Total Number of Households (in thousands)	339.50	355.60	362.19	369.74	377.31	384.77	392.23	428.80	464.20	497.98	559.96
Income < $10,000 (thousands of households, 2000 dollars)	8.7%	8.1%	7.9%	7.8%	7.7%	7.5%	7.4%	6.6%	5.7%	4.9%	3.5%
Income $10,000 to $19,999	12.4%	11.6%	11.3%	11.1%	11.0%	10.8%	10.6%	9.4%	8.1%	7.0%	5.1%
Income $20,000 to $29,999	13.8%	12.9%	12.6%	12.4%	12.2%	12.0%	11.8%	10.4%	9.1%	7.8%	5.7%
Income $30,000 to $44,999	19.7%	18.9%	18.6%	18.3%	18.1%	17.8%	17.5%	15.6%	13.6%	11.7%	8.5%
Income $45,000 to $59,999	16.5%	17.4%	17.8%	18.0%	18.2%	18.3%	18.5%	19.1%	18.7%	17.1%	12.7%
Income $60,000 to $74,999	11.2%	12.0%	12.3%	12.5%	12.7%	13.0%	13.2%	15.0%	17.3%	19.3%	20.1%
Income $75,000 to $99,999	9.2%	9.8%	10.1%	10.2%	10.4%	10.6%	10.8%	12.3%	14.2%	16.5%	22.7%
Income $100,000 or more	8.6%	9.2%	9.5%	9.6%	9.8%	10.0%	10.2%	11.6%	13.4%	15.7%	21.7%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 7 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-36

Demographic and Employment Baseline Projections for Economic Impact Area FL-2

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	613.83	657.40	666.76	676.21	685.71	695.29	704.90	753.56	802.95	852.48	951.77
Age Under 19 years	25.8%	24.6%	24.3%	24.2%	24.0%	23.9%	24.0%	24.2%	24.0%	23.7%	22.9%
Age 20 to 34	24.5%	25.3%	25.6%	25.8%	25.9%	25.9%	25.5%	22.8%	20.4%	19.9%	20.2%
Age 35 to 49	20.7%	18.9%	18.5%	18.1%	17.8%	17.5%	17.4%	18.7%	20.7%	21.4%	17.3%
Age 50 to 64	17.1%	18.2%	18.4%	18.3%	18.3%	18.3%	18.3%	17.6%	16.4%	15.2%	18.4%
Age 65 and over	11.9%	12.9%	13.2%	13.6%	14.0%	14.4%	14.8%	16.7%	18.5%	19.8%	21.2%
Median Age of Population (in years)	37	38	38	38	39	39	39	40	41	42	43
White Population (in thousands)	66.6%	65.2%	65.0%	64.8%	64.6%	64.4%	64.2%	63.2%	62.2%	61.2%	59.5%
Black Population (in thousands)	27.1%	27.5%	27.6%	27.6%	27.7%	27.7%	27.8%	28.2%	28.5%	28.9%	29.5%
Native American Population (in thousands)	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%
Asian and Pacific Islander Population (in thousands)	1.3%	1.5%	1.5%	1.5%	1.6%	1.6%	1.6%	1.7%	1.9%	2.0%	2.2%
Hispanic or Latino Population (in thousands)	4.5%	5.3%	5.4%	5.5%	5.6%	5.8%	5.9%	6.4%	6.9%	7.5%	8.4%
Male Population (in thousands)	50.3%	50.8%	50.8%	50.9%	50.9%	51.0%	51.0%	51.2%	51.3%	51.4%	51.6%
Total Employment (in thousands of jobs)	322.62	330.09	338.56	342.74	346.98	351.28	355.62	378.16	402.13	427.62	483.55
Farm Employment	2.6%	3.0%	3.0%	3.0%	2.9%	2.9%	2.9%	2.7%	2.5%	2.4%	2.1%
Forestry, Fishing, Related Activities	1.3%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.3%	1.3%	1.3%	1.3%
Mining	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%
Utilities	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%
Construction	6.5%	4.7%	4.7%	4.8%	4.8%	4.8%	4.8%	4.9%	5.0%	5.0%	5.1%
Manufacturing	4.6%	3.6%	3.6%	3.6%	3.5%	3.5%	3.5%	3.3%	3.2%	3.1%	2.8%
Wholesale Trade	2.1%	1.9%	1.9%	1.9%	1.9%	1.8%	1.8%	1.7%	1.7%	1.6%	1.4%
Retail Trade	11.0%	10.3%	10.2%	10.2%	10.2%	10.2%	10.2%	10.0%	9.9%	9.8%	9.5%
Transportation and Warehousing	1.6%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.6%
Information Employment	1.8%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.6%	1.5%	1.5%	1.3%
Finance and Insurance	3.2%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.6%
Real Estate / Rental and Lease	3.1%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%	3.3%	3.3%	3.4%	3.4%
Professional and Technical Services	5.8%	6.2%	6.3%	6.4%	6.5%	6.6%	6.7%	7.1%	7.6%	8.1%	9.1%
Management	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Administrative and Waste Services	4.8%	4.8%	4.8%	4.9%	4.9%	4.9%	5.0%	5.1%	5.3%	5.4%	5.7%
Educational Services	1.1%	1.6%	1.6%	1.6%	1.7%	1.7%	1.7%	1.9%	2.0%	2.2%	2.6%
Health Care and Social Assistance	8.6%	10.3%	10.4%	10.5%	10.7%	10.8%	10.9%	11.4%	12.0%	12.5%	13.6%
Arts, Entertainment, and Recreation	1.2%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.6%	1.6%	1.7%	1.7%
Accommodation and Food Services	6.7%	6.8%	6.8%	6.9%	6.9%	6.9%	6.9%	7.0%	7.2%	7.3%	7.5%
Other Services, Except Public Administration	6.2%	6.1%	6.1%	6.1%	6.2%	6.2%	6.2%	6.3%	6.3%	6.4%	6.5%
Federal Civilian Government	1.2%	1.3%	1.3%	1.3%	1.2%	1.2%	1.2%	1.1%	1.1%	1.0%	0.8%
Federal Military	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%
State and Local Government	25.3%	25.0%	24.8%	24.6%	24.4%	24.2%	24.0%	23.0%	22.0%	21.0%	19.2%

Table 4-36. Demographic and Employment Baseline Projections for Economic Impact Area FL-2 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	11,927.62	11,506.58	11,863.49	12,113.72	12,369.19	12,629.96	12,896.15	14,312.49	15,882.28	17,622.00	21,685.31
Farm Employment	1.3%	1.2%	1.3%	1.2%	1.2%	1.2%	1.2%	1.1%	1.0%	0.9%	0.7%
Forestry, Fishing, Related Activities	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.2%	1.2%	1.1%	1.1%	1.0%
Mining	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Utilities	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.9%	0.9%	0.9%	1.0%
Construction	6.4%	4.2%	4.5%	4.4%	4.4%	4.4%	4.4%	4.2%	4.1%	3.9%	3.6%
Manufacturing	5.9%	5.3%	5.5%	5.4%	5.4%	5.4%	5.4%	5.2%	5.1%	4.9%	4.6%
Wholesale Trade	2.7%	2.3%	2.4%	2.4%	2.4%	2.4%	2.3%	2.3%	2.2%	2.1%	1.9%
Retail Trade	7.2%	7.0%	7.0%	7.0%	6.9%	6.9%	6.9%	6.7%	6.6%	6.4%	6.1%
Transportation and Warehousing	1.5%	1.6%	1.7%	1.7%	1.7%	1.7%	1.6%	1.6%	1.6%	1.5%	1.5%
Information Employment	2.4%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.2%	2.1%	2.0%	1.9%
Finance and Insurance	4.2%	4.5%	4.6%	4.6%	4.7%	4.7%	4.8%	5.0%	5.2%	5.4%	5.9%
Real Estate / Rental and Lease	1.1%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	1.0%	1.0%
Professional and Technical Services	7.9%	8.1%	8.1%	8.2%	8.3%	8.4%	8.6%	9.2%	9.8%	10.4%	11.7%
Management	0.4%	0.5%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.7%	0.7%
Administrative and Waste Services	2.7%	2.7%	2.7%	2.7%	2.8%	2.8%	2.8%	2.9%	3.0%	3.1%	3.4%
Educational Services	0.5%	0.8%	0.8%	0.8%	0.8%	0.8%	0.9%	0.9%	1.0%	1.1%	1.4%
Health Care and Social Assistance	9.6%	11.6%	11.7%	11.8%	12.0%	12.1%	12.2%	12.9%	13.5%	14.1%	15.4%
Arts, Entertainment, and Recreation	0.4%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Accommodation and Food Services	2.7%	2.8%	2.7%	2.7%	2.7%	2.8%	2.8%	2.8%	2.8%	2.8%	2.9%
Other Services, Except Public Administration	5.2%	5.4%	5.3%	5.3%	5.3%	5.3%	5.4%	5.4%	5.5%	5.5%	5.6%
Federal Civilian Government	2.7%	3.2%	3.2%	3.2%	3.1%	3.1%	3.1%	3.0%	2.9%	2.8%	2.6%
Federal Military	0.5%	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
State and Local Government	32.3%	32.2%	31.6%	31.4%	31.2%	31.0%	30.8%	29.9%	28.9%	27.9%	26.0%
Total Personal Income Per Capita (in 2005 dollars)	27,200	26,656	26,811	27,063	27,321	27,585	27,856	29,328	31,005	32,905	37,298
Woods & Poole Economics Wealth Index (U.S. = 100)	67.0	66.8	66.7	66.6	66.5	66.4	66.3	65.9	65.6	65.4	64.9
Persons Per Household (in number of people)	2.6	2.6	2.6	2.6	2.6	2.5	2.5	2.5	2.5	2.5	2.5
Mean Household Total Personal Income (in 2005 dollars)	57,688	56,795	57,352	57,724	58,116	58,529	58,970	61,586	64,884	68,883	78,850
Total Number of Households (in thousands)	236.50	255.39	259.32	263.92	268.49	273.05	277.56	299.51	320.40	339.91	374.75
Income < $10,000 (thousands of households, 2000 dollars)	13.6%	12.8%	12.6%	12.4%	12.2%	12.1%	11.9%	11.0%	10.1%	8.9%	6.6%
Income $10,000 to $19,999	14.3%	13.6%	13.4%	13.2%	13.0%	12.8%	12.6%	11.7%	10.7%	9.4%	7.0%
Income $20,000 to $29,999	14.0%	13.3%	13.1%	12.9%	12.7%	12.5%	12.4%	11.5%	10.5%	9.3%	6.9%
Income $30,000 to $44,999	18.7%	18.8%	18.8%	18.8%	18.7%	18.6%	18.5%	17.9%	16.8%	14.9%	11.1%
Income $45,000 to $59,999	14.2%	14.9%	15.2%	15.4%	15.6%	15.8%	16.1%	17.2%	18.3%	19.3%	17.8%
Income $60,000 to $74,999	9.4%	9.9%	10.0%	10.2%	10.3%	10.5%	10.6%	11.5%	12.5%	14.3%	18.6%
Income $75,000 to $99,999	8.2%	8.6%	8.7%	8.8%	8.9%	9.1%	9.2%	9.9%	10.8%	12.4%	16.6%
Income $100,000 or more	7.8%	8.1%	8.3%	8.4%	8.5%	8.6%	8.7%	9.4%	10.2%	11.6%	15.4%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 15 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-37

Demographic and Employment Baseline Projections for Economic Impact Area FL-3

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	3,416.04	3,624.88	3,675.05	3,725.64	3,776.58	3,827.91	3,879.47	4,140.64	4,405.96	4,672.19	5,206.25
Age Under 19 years	24.0%	23.4%	23.3%	23.2%	23.2%	23.1%	23.1%	23.1%	23.2%	23.1%	23.0%
Age 20 to 34	18.9%	19.4%	19.7%	19.8%	19.9%	19.9%	19.8%	19.2%	18.6%	18.3%	18.6%
Age 35 to 49	21.2%	19.6%	19.2%	18.8%	18.5%	18.2%	18.1%	17.9%	18.4%	18.8%	17.8%
Age 50 to 64	18.1%	19.5%	19.8%	19.8%	19.8%	19.9%	19.9%	19.1%	17.5%	16.2%	16.5%
Age 65 and over	17.8%	18.0%	18.1%	18.4%	18.6%	18.9%	19.1%	20.6%	22.3%	23.7%	24.1%
Median Age of Population (in years)	41	41	42	42	42	42	42	43	43	44	44
White Population (in thousands)	74.5%	71.2%	70.7%	70.1%	69.6%	69.1%	68.5%	65.9%	63.3%	60.7%	55.4%
Black Population (in thousands)	11.3%	11.8%	11.9%	12.0%	12.0%	12.1%	12.1%	12.3%	12.5%	12.6%	12.7%
Native American Population (in thousands)	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%
Asian and Pacific Islander Population (in thousands)	2.5%	2.9%	3.0%	3.0%	3.1%	3.2%	3.3%	3.6%	4.0%	4.4%	5.3%
Hispanic or Latino Population (in thousands)	11.4%	13.7%	14.1%	14.5%	14.9%	15.3%	15.8%	17.8%	19.9%	22.0%	26.4%
Male Population (in thousands)	48.7%	48.9%	49.0%	49.0%	49.1%	49.2%	49.2%	49.4%	49.5%	49.6%	49.7%
Total Employment (in thousands of jobs)	1,944.16	1,868.77	1,922.79	1,951.29	1,980.12	2,009.31	2,038.85	2,192.00	2,354.46	2,526.62	2,901.49
Farm Employment	1.0%	1.2%	1.1%	1.1%	1.1%	1.1%	1.1%	1.0%	1.0%	0.9%	0.8%
Forestry, Fishing, Related Activities	0.5%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%	0.5%	0.5%
Mining	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Utilities	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%	0.3%	0.3%
Construction	7.3%	4.8%	4.8%	4.9%	4.9%	4.9%	4.9%	5.0%	5.0%	5.1%	5.2%
Manufacturing	5.0%	4.4%	4.3%	4.3%	4.2%	4.1%	4.0%	3.7%	3.4%	3.1%	2.6%
Wholesale Trade	3.4%	3.4%	3.3%	3.3%	3.3%	3.3%	3.3%	3.2%	3.1%	3.1%	2.9%
Retail Trade	11.4%	11.1%	11.1%	11.0%	11.0%	11.0%	11.0%	10.8%	10.6%	10.4%	10.0%
Transportation and Warehousing	2.3%	2.5%	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%
Information Employment	2.2%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	1.9%	1.9%	1.8%	1.7%
Finance and Insurance	5.8%	5.9%	5.9%	5.9%	5.9%	5.8%	5.8%	5.7%	5.7%	5.6%	5.4%
Real Estate / Rental and Lease	4.5%	4.4%	4.5%	4.5%	4.5%	4.5%	4.5%	4.6%	4.6%	4.7%	4.8%
Professional and Technical Services	6.4%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.3%	7.4%	7.4%	7.3%
Management	0.8%	1.2%	1.2%	1.2%	1.2%	1.3%	1.3%	1.3%	1.4%	1.4%	1.6%
Administrative and Waste Services	10.8%	7.8%	7.9%	8.0%	8.1%	8.2%	8.2%	8.7%	9.2%	9.6%	10.6%
Educational Services	1.3%	1.7%	1.7%	1.8%	1.8%	1.8%	1.8%	2.0%	2.1%	2.2%	2.5%
Health Care and Social Assistance	10.3%	13.0%	13.1%	13.2%	13.4%	13.5%	13.6%	14.2%	14.8%	15.4%	16.7%
Arts, Entertainment, and Recreation	2.0%	2.4%	2.4%	2.4%	2.4%	2.4%	2.3%	2.3%	2.3%	2.3%	2.2%
Accommodation and Food Services	6.8%	7.0%	7.0%	7.0%	6.9%	6.9%	6.8%	6.6%	6.4%	6.2%	5.8%
Other Services, Except Public Administration	5.9%	6.2%	6.2%	6.2%	6.2%	6.2%	6.2%	6.1%	6.1%	6.0%	5.9%
Federal Civilian Government	1.3%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.4%	1.4%	1.3%
Federal Military	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.6%	0.6%	0.5%	0.5%
State and Local Government	9.9%	10.3%	10.3%	10.2%	10.2%	10.1%	10.1%	9.9%	9.6%	9.4%	8.9%

Table 4-37. Demographic and Employment Baseline Projections for Economic Impact Area FL-3 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	79,115.35	72,699.32	75,523.98	77,335.32	79,187.57	81,081.56	83,018.17	93,371.74	104,929.66	117,819.11	148,161.00
Farm Employment	0.5%	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%	0.2%
Forestry, Fishing, Related Activities	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Mining	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.4%	0.4%	0.4%	0.4%
Utilities	0.9%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.9%
Construction	7.5%	4.4%	4.8%	4.8%	4.7%	4.7%	4.7%	4.5%	4.3%	4.1%	3.8%
Manufacturing	6.8%	6.0%	6.1%	6.0%	5.9%	5.8%	5.8%	5.3%	4.9%	4.5%	3.8%
Wholesale Trade	4.9%	4.8%	4.9%	4.8%	4.8%	4.8%	4.8%	4.7%	4.6%	4.6%	4.4%
Retail Trade	8.3%	7.7%	7.7%	7.6%	7.6%	7.5%	7.5%	7.3%	7.0%	6.8%	6.3%
Transportation and Warehousing	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.2%	2.2%	2.1%	2.1%
Information Employment	3.3%	3.1%	3.0%	3.0%	3.0%	3.0%	3.0%	2.9%	2.9%	2.8%	2.7%
Finance and Insurance	8.0%	7.2%	7.2%	7.2%	7.3%	7.3%	7.3%	7.4%	7.5%	7.6%	7.7%
Real Estate / Rental and Lease	2.3%	1.5%	1.5%	1.6%	1.6%	1.6%	1.6%	1.7%	1.7%	1.8%	1.9%
Professional and Technical Services	8.1%	9.2%	9.1%	9.1%	9.1%	9.1%	9.1%	9.1%	9.1%	9.1%	9.0%
Management	1.6%	2.4%	2.4%	2.5%	2.5%	2.6%	2.6%	2.8%	3.0%	3.3%	3.7%
Administrative and Waste Services	7.1%	4.8%	4.9%	4.9%	5.0%	5.1%	5.1%	5.4%	5.8%	6.1%	6.9%
Educational Services	0.8%	1.1%	1.1%	1.1%	1.2%	1.2%	1.2%	1.3%	1.4%	1.5%	1.7%
Health Care and Social Assistance	12.1%	15.5%	15.4%	15.6%	15.7%	15.9%	16.0%	16.7%	17.4%	18.1%	19.5%
Arts, Entertainment, and Recreation	1.5%	2.0%	2.0%	2.0%	1.9%	1.9%	1.9%	1.9%	1.8%	1.7%	1.6%
Accommodation and Food Services	3.9%	4.2%	4.1%	4.1%	4.0%	4.0%	4.0%	3.8%	3.6%	3.5%	3.2%
Other Services, Except Public Administration	4.0%	4.2%	4.1%	4.1%	4.1%	4.1%	4.1%	4.0%	4.0%	3.9%	3.8%
Federal Civilian Government	2.7%	3.5%	3.4%	3.4%	3.4%	3.4%	3.4%	3.5%	3.5%	3.5%	3.5%
Federal Military	1.2%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.4%	1.4%	1.3%	1.2%
State and Local Government	11.8%	12.8%	12.6%	12.6%	12.5%	12.5%	12.5%	12.3%	12.2%	12.0%	11.6%
Total Personal Income Per Capita (in 2005 dollars)	33,224	31,323	31,639	32,001	32,373	32,754	33,144	35,240	37,593	40,226	46,260
Woods & Poole Economics Wealth Index (U.S. = 100)	79.5	77.2	77.2	77.2	77.1	77.1	77.1	77.0	77.0	77.0	77.0
Persons Per Household (in number of people)	2.4	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Mean Household Total Personal Income (in 2005 dollars)	64,512	62,252	63,029	63,502	63,992	64,509	65,058	68,279	72,269	77,062	88,938
Total Number of Households (in thousands)	1,449.40	1,546.55	1,568.95	1,595.36	1,621.62	1,647.70	1,673.53	1,798.54	1,917.25	2,027.90	2,223.65
Income < $10,000 (thousands of households, 2000 dollars)	9.1%	8.7%	8.6%	8.4%	8.3%	8.1%	8.0%	7.2%	6.3%	5.5%	4.1%
Income $10,000 to $19,999	13.8%	13.4%	13.1%	12.9%	12.6%	12.4%	12.1%	11.0%	9.7%	8.4%	6.2%
Income $20,000 to $29,999	14.7%	14.2%	13.9%	13.7%	13.5%	13.2%	12.9%	11.7%	10.3%	8.9%	6.6%
Income $30,000 to $44,999	19.6%	19.5%	19.3%	19.2%	19.0%	18.7%	18.5%	17.1%	15.3%	13.3%	9.9%
Income $45,000 to $59,999	15.1%	15.7%	16.0%	16.3%	16.6%	16.8%	17.1%	18.0%	18.6%	18.4%	15.2%
Income $60,000 to $74,999	9.7%	10.1%	10.3%	10.5%	10.7%	10.9%	11.1%	12.4%	14.2%	16.1%	18.7%
Income $75,000 to $99,999	8.4%	8.7%	8.9%	9.0%	9.2%	9.4%	9.6%	10.7%	12.2%	13.9%	18.7%
Income $100,000 or more	9.4%	9.7%	9.9%	10.1%	10.2%	10.4%	10.7%	11.9%	13.5%	15.4%	20.5%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 12 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-38

Demographic and Employment Baseline Projections for Economic Impact Area FL-4

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Population (in thousands)	5,960.39	6,210.44	6,294.73	6,379.76	6,465.42	6,551.79	6,638.56	7,078.51	7,525.98	7,975.38	8,877.71
Age Under 19 years	24.7%	24.0%	23.9%	23.7%	23.6%	23.6%	23.5%	23.5%	23.2%	23.0%	22.8%
Age 20 to 34	18.5%	18.6%	18.6%	18.7%	18.7%	18.8%	18.8%	18.2%	17.8%	17.5%	17.4%
Age 35 to 49	22.1%	20.8%	20.4%	20.1%	19.7%	19.3%	19.0%	18.3%	18.2%	18.3%	17.2%
Age 50 to 64	17.5%	18.9%	19.1%	19.3%	19.4%	19.6%	19.7%	19.3%	18.3%	16.7%	16.1%
Age 65 and over	17.2%	17.8%	18.0%	18.2%	18.5%	18.8%	19.1%	20.7%	22.5%	24.4%	26.5%
Median Age of Population (in years)	44	45	45	45	45	45	45	46	46	46	46
White Population (in thousands)	46.6%	43.3%	42.7%	42.1%	41.5%	40.9%	40.4%	37.7%	35.3%	32.9%	28.5%
Black Population (in thousands)	16.5%	16.5%	16.6%	16.6%	16.6%	16.7%	16.7%	16.8%	16.9%	17.0%	16.9%
Native American Population (in thousands)	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%
Asian and Pacific Islander Population (in thousands)	1.9%	2.1%	2.1%	2.2%	2.2%	2.2%	2.3%	2.5%	2.6%	2.8%	3.2%
Hispanic or Latino Population (in thousands)	34.8%	37.9%	38.5%	39.0%	39.5%	40.0%	40.5%	42.8%	45.0%	47.2%	51.2%
Male Population (in thousands)	48.8%	49.0%	49.1%	49.1%	49.1%	49.1%	49.1%	49.2%	49.2%	49.2%	49.0%
Total Employment (in thousands of jobs)	3,395.35	3,329.05	3,426.96	3,479.99	3,533.68	3,588.03	3,643.04	3,928.30	4,230.99	4,551.70	5,249.44
Farm Employment	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%	0.4%
Forestry, Fishing, Related Activities	0.4%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
Mining	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%
Utilities	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Construction	8.0%	5.0%	5.0%	5.0%	5.0%	5.1%	5.1%	5.3%	5.4%	5.6%	5.9%
Manufacturing	3.6%	2.9%	2.9%	2.9%	2.8%	2.8%	2.7%	2.5%	2.4%	2.2%	1.9%
Wholesale Trade	4.5%	4.3%	4.3%	4.2%	4.2%	4.2%	4.1%	3.9%	3.8%	3.6%	3.3%
Retail Trade	11.2%	11.1%	11.1%	11.0%	11.0%	10.9%	10.9%	10.7%	10.5%	10.3%	9.8%
Transportation and Warehousing	3.8%	3.9%	3.9%	3.9%	3.9%	3.8%	3.8%	3.7%	3.7%	3.6%	3.4%
Information Employment	2.0%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.6%	1.6%	1.5%	1.4%
Finance and Insurance	5.0%	4.9%	4.9%	4.8%	4.8%	4.8%	4.8%	4.7%	4.5%	4.4%	4.1%
Real Estate / Rental and Lease	6.0%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.0%	6.0%	5.9%
Professional and Technical Services	6.5%	6.8%	6.8%	6.8%	6.8%	6.9%	6.9%	7.0%	7.1%	7.1%	7.3%
Management	0.7%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.9%	0.9%	1.0%
Administrative and Waste Services	9.0%	7.9%	8.0%	8.0%	8.1%	8.2%	8.2%	8.6%	9.0%	9.3%	10.1%
Educational Services	1.8%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.6%	2.7%	2.8%	2.9%
Health Care and Social Assistance	9.1%	11.4%	11.5%	11.6%	11.7%	11.8%	11.8%	12.3%	12.8%	13.2%	14.2%
Arts, Entertainment, and Recreation	2.2%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.4%	2.4%
Accommodation and Food Services	7.2%	7.4%	7.3%	7.3%	7.3%	7.3%	7.2%	7.1%	7.0%	6.8%	6.5%
Other Services, Except Public Administration	7.7%	8.4%	8.4%	8.4%	8.4%	8.4%	8.5%	8.6%	8.7%	8.7%	8.9%
Federal Civilian Government	1.0%	1.1%	1.1%	1.1%	1.0%	1.0%	1.0%	1.0%	1.0%	0.9%	0.8%
Federal Military	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%
State and Local Government	9.0%	9.6%	9.6%	9.5%	9.5%	9.5%	9.4%	9.3%	9.1%	9.0%	8.6%

Table 4-38. Demographic and Employment Baseline Projections for Economic Impact Area FL-4 (continued).

	2005	2010	2011	2012	2013	2014	2015	2020	2025	2030	2040
Total Earnings (in millions of 2005 dollars)	146,349.28	133,109.32	138,104.63	141,438.36	144,845.84	148,328.48	151,887.81	170,888.07	192,042.06	215,564.73	270,666.64
Farm Employment	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%
Forestry, Fishing, Related Activities	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Mining	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Utilities	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Construction	9.4%	5.2%	5.6%	5.6%	5.6%	5.5%	5.5%	5.4%	5.3%	5.2%	4.9%
Manufacturing	4.4%	3.6%	3.7%	3.7%	3.6%	3.6%	3.5%	3.3%	3.1%	2.9%	2.5%
Wholesale Trade	6.8%	6.7%	6.9%	6.8%	6.8%	6.7%	6.7%	6.4%	6.2%	5.9%	5.4%
Retail Trade	8.5%	8.4%	8.4%	8.3%	8.3%	8.2%	8.2%	7.9%	7.7%	7.4%	6.9%
Transportation and Warehousing	4.0%	4.0%	3.9%	3.9%	3.9%	3.9%	3.8%	3.7%	3.6%	3.5%	3.2%
Information Employment	3.6%	3.4%	3.4%	3.4%	3.4%	3.3%	3.3%	3.3%	3.2%	3.1%	3.0%
Finance and Insurance	6.9%	6.2%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.1%	6.0%
Real Estate / Rental and Lease	3.7%	2.4%	2.4%	2.4%	2.4%	2.4%	2.5%	2.5%	2.5%	2.6%	2.7%
Professional and Technical Services	8.3%	9.2%	9.1%	9.1%	9.1%	9.2%	9.2%	9.4%	9.5%	9.6%	9.9%
Management	1.3%	1.9%	1.9%	2.0%	2.0%	2.1%	2.1%	2.3%	2.5%	2.7%	3.2%
Administrative and Waste Services	6.2%	4.9%	4.9%	5.0%	5.0%	5.1%	5.1%	5.4%	5.6%	5.9%	6.5%
Educational Services	1.5%	2.2%	2.2%	2.2%	2.2%	2.2%	2.2%	2.3%	2.4%	2.5%	2.7%
Health Care and Social Assistance	9.5%	12.2%	12.1%	12.2%	12.3%	12.4%	12.5%	13.0%	13.5%	14.1%	15.1%
Arts, Entertainment, and Recreation	1.6%	1.9%	1.9%	1.9%	1.9%	1.9%	1.9%	1.8%	1.8%	1.8%	1.7%
Accommodation and Food Services	4.3%	4.6%	4.5%	4.5%	4.5%	4.5%	4.4%	4.3%	4.2%	4.1%	3.9%
Other Services, Except Public Administration	4.2%	4.6%	4.5%	4.5%	4.6%	4.6%	4.6%	4.6%	4.7%	4.7%	4.7%
Federal Civilian Government	2.2%	2.7%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%	2.6%
Federal Military	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.6%	0.6%
State and Local Government	11.8%	14.0%	13.8%	13.8%	13.8%	13.8%	13.8%	13.8%	13.7%	13.6%	13.5%
Total Personal Income Per Capita (in 2005 dollars)	37,332	35,529	35,954	36,438	36,933	37,438	37,957	40,740	43,871	47,389	55,589
Woods & Poole Economics Wealth Index (U.S. = 100)	119.1	113.4	113.6	113.8	114.0	114.2	114.5	115.7	117.1	118.5	121.7
Persons Per Household (in number of people)	2.5	2.6	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Mean Household Total Personal Income (in 2005 dollars)	92,182	86,404	87,645	88,598	89,600	90,651	91,754	98,070	105,688	114,735	137,497
Total Number of Households (in thousands)	2,337.90	2,434.13	2,469.25	2,510.68	2,551.90	2,592.85	2,633.43	2,830.25	3,017.88	3,193.31	3,504.05
Income < $10,000 (thousands of households, 2000 dollars)	9.2%	8.8%	8.7%	8.5%	8.4%	8.2%	8.1%	7.2%	6.4%	5.6%	4.4%
Income $10,000 to $19,999	12.1%	11.7%	11.5%	11.4%	11.2%	11.0%	10.7%	9.6%	8.5%	7.5%	5.8%
Income $20,000 to $29,999	12.6%	12.3%	12.1%	11.9%	11.7%	11.5%	11.2%	10.0%	8.9%	7.9%	6.1%
Income $30,000 to $44,999	17.3%	17.0%	16.8%	16.5%	16.3%	16.0%	15.7%	14.0%	12.4%	11.0%	8.6%
Income $45,000 to $59,999	14.9%	15.3%	15.5%	15.6%	15.8%	15.9%	16.0%	16.2%	15.5%	14.1%	11.0%
Income $60,000 to $74,999	10.6%	11.0%	11.2%	11.4%	11.6%	11.8%	12.0%	13.5%	15.1%	16.3%	15.8%
Income $75,000 to $99,999	10.0%	10.3%	10.5%	10.7%	10.9%	11.1%	11.3%	12.8%	14.4%	16.4%	20.7%
Income $100,000 or more	13.1%	13.5%	13.8%	14.0%	14.3%	14.5%	14.8%	16.7%	18.8%	21.4%	27.6%

Notes: Median age, wealth index, and mean household income is the average of the original Woods & Poole values for the 9 counties in the EIA; income per capita calculated using personal income/total population for the EIA; persons per household calculated using total population/number of households for the EIA.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-39

Baseline Population Projections (in thousands) by Economic Impact Area

Model Year	Calendar Year	AL-1	MS-1	LA-1	LA-2	LA-3	LA-4	TX-1	TX-2	TX-3	FL-1	FL-2	FL-3	FL-4
	2010	725.48	470.61	334.72	587.88	1,126.87	1,267.52	1,771.25	626.33	6,192.43	896.10	657.40	3,624.88	6,210.44
	2011	731.11	474.64	336.53	593.59	1,140.44	1,278.34	1,807.15	634.39	6,299.99	911.70	666.76	3,675.05	6,294.73
1	2012	736.83	478.72	338.39	599.38	1,154.15	1,289.31	1,843.24	642.51	6,408.25	927.40	676.21	3,725.64	6,379.76
2	2013	742.62	482.85	340.27	605.23	1,167.97	1,300.40	1,879.50	650.70	6,517.13	943.19	685.71	3,776.58	6,465.42
3	2014	748.49	487.02	342.20	611.14	1,181.91	1,311.64	1,915.95	658.94	6,626.68	959.08	695.29	3,827.91	6,551.79
4	2015	754.41	491.23	344.15	617.10	1,195.92	1,322.96	1,952.51	667.23	6,736.63	975.02	704.90	3,879.47	6,638.56
5	2016	760.38	495.47	346.12	623.10	1,210.00	1,334.37	1,989.19	675.55	6,847.01	991.02	714.55	3,931.27	6,725.77
6	2017	766.41	499.75	348.12	629.15	1,224.17	1,345.89	2,026.02	683.92	6,957.91	1,007.10	724.26	3,983.37	6,813.50
7	2018	772.47	504.05	350.13	635.22	1,238.39	1,357.45	2,062.92	692.31	7,069.08	1,023.22	734.00	4,035.62	6,901.51
8	2019	778.57	508.38	352.16	641.34	1,252.68	1,369.10	2,099.94	700.73	7,180.66	1,039.39	743.77	4,088.08	6,989.92
9	2020	784.68	512.71	354.20	647.47	1,266.99	1,380.77	2,137.01	709.17	7,292.42	1,055.59	753.56	4,140.64	7,078.51
10	2021	790.89	517.11	356.28	653.68	1,281.45	1,392.61	2,174.35	717.69	7,405.11	1,071.93	763.44	4,193.71	7,168.00
11	2022	797.15	521.54	358.38	659.95	1,296.07	1,404.55	2,212.34	726.31	7,519.54	1,088.51	773.44	4,247.45	7,258.63
12	2023	803.46	526.02	360.48	666.29	1,310.86	1,416.60	2,251.00	735.03	7,635.74	1,105.36	783.58	4,301.88	7,350.40
13	2024	809.82	530.53	362.60	672.68	1,325.83	1,428.75	2,290.33	743.85	7,753.73	1,122.46	793.85	4,357.01	7,443.33
14	2025	815.74	534.70	364.61	678.54	1,339.29	1,439.98	2,323.71	751.75	7,855.87	1,137.26	802.95	4,405.96	7,525.98
15	2026	821.98	539.11	366.70	684.79	1,353.80	1,451.87	2,361.17	760.29	7,968.97	1,153.65	812.85	4,459.20	7,615.86
16	2027	828.26	543.56	368.81	691.09	1,368.46	1,463.87	2,399.24	768.92	8,083.69	1,170.28	822.88	4,513.09	7,706.81
17	2028	834.60	548.05	370.92	697.46	1,383.29	1,475.96	2,437.91	777.65	8,200.07	1,187.15	833.03	4,567.63	7,798.85
18	2029	840.98	552.58	373.05	703.88	1,398.27	1,488.16	2,477.21	786.48	8,318.13	1,204.26	843.31	4,622.84	7,891.99
19	2030	846.94	556.77	375.07	709.79	1,411.83	1,499.47	2,511.01	794.43	8,421.37	1,219.22	852.48	4,672.19	7,975.38
20	2031	853.17	561.19	377.17	716.05	1,426.34	1,511.37	2,548.50	802.95	8,534.58	1,235.62	862.38	4,725.46	8,065.35
21	2032	859.46	565.63	379.27	722.36	1,440.99	1,523.36	2,586.55	811.57	8,649.31	1,252.25	872.41	4,779.34	8,156.35
22	2033	865.79	570.12	381.39	728.73	1,455.80	1,535.45	2,625.17	820.28	8,765.59	1,269.10	882.54	4,833.83	8,248.36
23	2034	872.17	574.64	383.51	735.16	1,470.76	1,547.64	2,664.37	829.09	8,883.43	1,286.17	892.80	4,888.94	8,341.42
24	2035	878.13	578.84	385.53	741.09	1,484.37	1,558.97	2,698.47	837.06	8,987.43	1,301.24	902.01	4,938.54	8,425.26
25	2036	884.41	583.28	387.64	747.40	1,498.95	1,570.96	2,736.13	845.63	9,101.21	1,317.72	911.96	4,992.08	8,515.75
26	2037	890.74	587.76	389.77	753.76	1,513.68	1,583.03	2,774.31	854.28	9,216.42	1,334.42	922.03	5,046.20	8,607.21
27	2038	897.11	592.27	391.90	760.17	1,528.55	1,595.20	2,813.03	863.02	9,333.09	1,351.32	932.20	5,100.91	8,699.66
28	2039	903.53	596.82	394.04	766.64	1,543.57	1,607.46	2,852.29	871.85	9,451.24	1,368.44	942.49	5,156.22	8,793.09
29	2040	909.54	601.05	396.08	772.62	1,557.29	1,618.89	2,886.77	879.89	9,556.30	1,383.66	951.77	5,206.25	8,877.71
30	2041	916.04	605.67	398.25	779.20	1,572.59	1,631.33	2,927.06	888.89	9,677.28	1,401.19	962.28	5,262.70	8,973.06
31	2042	922.60	610.31	400.43	785.83	1,588.03	1,643.87	2,967.91	897.99	9,799.78	1,418.94	972.89	5,319.75	9,069.43
32	2043	929.20	615.00	402.62	792.52	1,603.64	1,656.50	3,009.33	907.18	9,923.84	1,436.92	983.63	5,377.43	9,166.84
33	2044	935.84	619.72	404.83	799.26	1,619.39	1,669.23	3,051.33	916.46	10,049.47	1,455.12	994.48	5,435.73	9,265.29
34	2045	942.54	624.47	407.04	806.06	1,635.30	1,682.06	3,093.91	925.84	10,176.68	1,473.56	1,005.45	5,494.66	9,364.80
35	2046	949.28	629.27	409.27	812.92	1,651.37	1,694.99	3,137.09	935.31	10,305.51	1,492.22	1,016.55	5,554.23	9,465.38
36	2047	956.07	634.09	411.51	819.84	1,667.59	1,708.02	3,180.87	944.88	10,435.97	1,511.13	1,027.76	5,614.45	9,567.04
37	2048	962.91	638.96	413.76	826.82	1,683.97	1,721.15	3,225.27	954.55	10,568.08	1,530.27	1,039.10	5,675.32	9,669.80
38	2049	969.80	643.86	416.03	833.86	1,700.52	1,734.37	3,270.28	964.32	10,701.87	1,549.66	1,050.57	5,736.85	9,773.65
39	2050	976.73	648.81	418.30	840.95	1,717.22	1,747.70	3,315.92	974.19	10,837.34	1,569.29	1,062.16	5,799.05	9,878.62
40	2051	983.72	653.78	420.59	848.11	1,734.09	1,761.14	3,362.20	984.16	10,974.54	1,589.17	1,073.88	5,861.92	9,984.72

Notes: Actual Woods & Poole data for 2010 through 2020, 2025, 2030, 2035, and 2040. Missing estimates through 2040 calculated using average annual growth rate for the 5-year period; projections after 2040 calculated using the average annual growth rate from 2035 to 2040.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-40

Baseline Employment Projections (in Thousands) by Coastal Subarea

Model Year	Calendar Year	AL-1	MS-1	LA-1	LA-2	LA-3	LA-4	TX-1	TX-2	TX-3	FL-1	FL-2	FL-3	FL-4
	2010	353.63	243.91	177.73	321.93	663.02	728.32	840.00	309.97	3,596.00	489.82	330.09	1,868.77	3,329.05
	2011	362.59	249.36	182.05	330.21	680.63	745.53	864.86	317.96	3,700.61	504.24	338.56	1,922.79	3,426.96
1	2012	366.69	251.56	183.91	334.03	689.17	752.64	878.23	321.85	3,758.99	512.13	342.74	1,951.29	3,479.99
2	2013	370.81	253.76	185.81	337.89	697.80	759.77	891.81	325.78	3,818.15	520.13	346.98	1,980.12	3,533.68
3	2014	374.97	255.98	187.70	341.78	706.51	766.93	905.55	329.76	3,878.09	528.26	351.28	2,009.31	3,588.03
4	2015	379.15	258.22	189.62	345.70	715.33	774.11	919.48	333.78	3,938.83	536.52	355.62	2,038.85	3,643.04
5	2016	383.37	260.47	191.54	349.65	724.23	781.30	933.58	337.82	4,000.39	544.90	360.02	2,068.76	3,698.74
6	2017	387.62	262.73	193.50	353.63	733.24	788.52	947.87	341.92	4,062.77	553.43	364.46	2,099.03	3,755.10
7	2018	391.90	265.01	195.46	357.65	742.34	795.74	962.34	346.07	4,125.95	562.07	368.98	2,129.66	3,812.15
8	2019	396.21	267.30	197.44	361.69	751.53	802.98	977.00	350.24	4,189.99	570.86	373.54	2,160.65	3,869.88
9	2020	400.55	269.62	199.43	365.76	760.83	810.24	991.85	354.48	4,254.86	579.78	378.16	2,192.00	3,928.30
10	2021	404.99	271.97	201.47	369.93	770.43	817.53	1,007.28	358.83	4,322.32	589.12	382.95	2,224.49	3,988.84
11	2022	409.48	274.34	203.54	374.15	780.14	824.89	1,022.95	363.24	4,390.84	598.61	387.81	2,257.47	4,050.31
12	2023	414.02	276.74	205.62	378.41	789.98	832.32	1,038.87	367.71	4,460.45	608.25	392.73	2,290.93	4,112.73
13	2024	418.61	279.15	207.73	382.73	799.95	839.81	1,055.03	372.22	4,531.17	618.06	397.71	2,324.89	4,176.11
14	2025	422.75	281.38	209.65	386.61	808.81	846.71	1,069.01	376.26	4,592.14	626.48	402.13	2,354.46	4,230.99
15	2026	427.35	283.81	211.77	390.93	818.92	854.06	1,085.44	380.83	4,664.06	636.56	407.23	2,388.90	4,295.13
16	2027	431.99	286.26	213.92	395.30	829.16	861.46	1,102.12	385.46	4,737.10	646.80	412.39	2,423.83	4,360.25
17	2028	436.69	288.73	216.09	399.71	839.52	868.93	1,119.07	390.14	4,811.29	657.21	417.62	2,459.28	4,426.35
18	2029	441.43	291.22	218.28	404.18	850.02	876.47	1,136.27	394.88	4,886.64	667.78	422.92	2,495.24	4,493.45
19	2030	445.72	293.52	220.27	408.21	859.36	883.43	1,151.17	399.12	4,951.73	676.88	427.62	2,526.62	4,551.70
20	2031	450.47	296.02	222.48	412.68	870.01	890.79	1,168.65	403.92	5,028.34	687.75	433.04	2,563.07	4,619.55
21	2032	455.27	298.55	224.71	417.21	880.78	898.22	1,186.39	408.78	5,106.13	698.79	438.53	2,600.03	4,688.42
22	2033	460.12	301.09	226.97	421.78	891.69	905.70	1,204.41	413.70	5,185.13	710.01	444.09	2,637.53	4,758.32
23	2034	465.02	303.66	229.25	426.41	902.73	913.25	1,222.69	418.67	5,265.35	721.41	449.72	2,675.58	4,829.26
24	2035	469.47	306.03	231.32	430.59	912.57	920.25	1,238.56	423.13	5,334.78	731.22	454.72	2,708.83	4,890.99
25	2036	474.37	308.61	233.62	435.21	923.76	927.61	1,257.14	428.15	5,416.31	742.93	460.49	2,747.36	4,962.68
26	2037	479.32	311.21	235.94	439.89	935.09	935.02	1,275.99	433.24	5,499.10	754.83	466.32	2,786.44	5,035.42
27	2038	484.33	313.83	238.28	444.61	946.56	942.50	1,295.13	438.38	5,583.14	766.92	472.24	2,826.08	5,109.23
28	2039	489.39	316.47	240.64	449.38	958.16	950.04	1,314.56	443.59	5,668.48	779.21	478.22	2,866.28	5,184.12
29	2040	493.98	318.92	242.80	453.71	968.53	957.04	1,331.45	448.26	5,742.46	789.79	483.55	2,901.49	5,249.44
30	2041	499.14	321.61	245.21	458.58	980.40	964.70	1,351.41	453.58	5,830.23	802.44	489.67	2,942.76	5,326.39
31	2042	504.35	324.31	247.64	463.51	992.42	972.41	1,371.68	458.97	5,919.33	815.29	495.88	2,984.61	5,404.46
32	2043	509.62	327.05	250.10	468.48	1,004.59	980.19	1,392.26	464.42	6,009.81	828.36	502.17	3,027.07	5,483.67
33	2044	514.94	329.80	252.58	473.52	1,016.91	988.02	1,413.14	469.94	6,101.66	841.63	508.53	3,070.12	5,564.05
34	2045	520.32	332.58	255.09	478.60	1,029.38	995.93	1,434.33	475.52	6,194.92	855.11	514.98	3,113.79	5,645.61
35	2046	525.76	335.38	257.62	483.74	1,042.00	1,003.89	1,455.85	481.17	6,289.60	868.81	521.51	3,158.08	5,728.36
36	2047	531.25	338.20	260.17	488.94	1,054.78	1,011.92	1,477.68	486.88	6,385.73	882.72	528.12	3,203.00	5,812.32
37	2048	536.80	341.05	262.75	494.19	1,067.71	1,020.01	1,499.84	492.66	6,483.33	896.87	534.81	3,248.56	5,897.52
38	2049	542.40	343.92	265.36	499.49	1,080.81	1,028.17	1,522.34	498.52	6,582.42	911.23	541.59	3,294.77	5,983.96
39	2050	548.07	346.82	267.99	504.86	1,094.06	1,036.39	1,545.17	504.44	6,683.02	925.83	548.46	3,341.64	6,071.67
40	2051	553.79	349.74	270.65	510.28	1,107.48	1,044.68	1,568.35	510.43	6,785.16	940.66	555.41	3,389.17	6,160.67

Notes: Actual Woods & Poole data for 2010 through 2020, 2025, 2030, 2035, and 2040. Missing estimates through 2040 calculated using average annual growth rate for the 5 year period; projections after 2040 calculated using the average annual growth rate from 2035 to 2040.

Source: Woods & Poole Economics, Inc., 2010.

Table 4-41

Liquid Waste Collected from the *Deepwater Horizon* Event

Landfill Name and Location	Percentage
Newpark Environmental Services — Fourchon Site Code 2913	29.67%
River Birch Industries Landfill	17.60%
Apex Environmental Services	17.44%
Liquid Environmental Solutions	13.07%
Tidewater Landfill LLC (Environmental Operations) Coast Guard Road Sanitary Landfill	11.08%
Newpark Environmental Mud Facility — Venice	11.08%
MBO LLC (Lacassine Oilfield Services)	3.20%
Newpark Environmental Services — Morgan City Site Code 5102	2.84%
Chemical Waste Management	1.04%
Aaron Oil	0.89%
Waste Water	0.83%
Intergulf	0.58%
Cliff Berry, Inc. — Tampa/ Miami	0.55%
Clearview Landfill	0.46%
Newpark Environmental Intercoastal City	0.27%
Vacco Marine	0.16%
Oil Recovery Company	0.08%
Vacco Marine/River Birch	0.03%
City of Tampa Treatment Plant	0.01%
Bealine	0.00%
SWS	0.00%
Gulf Coast Water Authority	0.00%
M.A. Norden Company	0.00%
WH Chastang Landfill	0.00%
Geocycle/Holcim	0.00%
Sunbelt Crushing	0.00%
Baldwin County Magnolia Landfill	0.00%
Tarpon Recycling	0.00%
Covanta-Huntsville	0.00%
WM Springhill Regional Landfill	0.00%
Fort Walton Transfer	0.00%
Gulf West Landfill (Texas)	0.00%
Allied Waste/BFI Colonial Landfill	0.00%
Jefferson Parish Waste Management	0.00%
Allied Waste Jefferson Davis Parish	0.00%
Allied Waste Recycling Center	0.00%
Newpark Environmental Services — Cameron Site Code 1205	0.00%
Advanced Disposal Services	0.00%
WM Pecan Grove	0.00%
Coastal Plains — Waste Management	0.00%

Table 4-42

Solid Waste Collected from the *Deepwater Horizon* Event

Landfill Name and Location	Percentage
WM Springhill Regional Landfill	26.11%
Allied Waste/BFI Colonial Landfill	25.12%
Baldwin County Magnolia Landfill	11.31%
Clearview Landfill	8.66%
Newpark Environmental Services — Fourchon Site Code 2913	7.99%
River Birch Industries Landfill	7.70%
WH Chastang Landfill	6.81%
Jefferson Parish Waste Management	6.56%
Newpark Environmental Services — Cameron Site Code 1205	4.60%
WM Pecan Grove	3.82%
Covanta-Huntsville	0.78%
Tidewater Landfill LLC (Environmental Operations) Coast Guard Road Sanitary Landfill	0.50%
Sunbelt Crushing	0.34%
M.A. Norden Company	0.17%
Tarpon Recycling	0.07%
Coastal Plains — Waste Management	0.06%
Allied Waste Recycling Center	0.03%
Gulf West Landfill (Texas)	0.03%
Fort Walton Transfer	0.02%
Advanced Disposal Services	0.00%
Intergulf	0.00%
Aaron Oil	0.00%
Geocycle/Holcim	0.00%
Apex Environmental Services	0.00%
Liquid Environmental Solutions	0.00%
Chemical Waste Management	0.00%
Oil Recovery Company	0.00%
City of Tampa Treatment Plant	0.00%
Cliff Berry, Inc. — Tampa/ Miami	0.00%
Vacco Marine	0.00%
Vacco Marine/River Birch	0.00%
Gulf Coast Water Authority	0.00%
Waste Water	0.00%
Allied Waste Jefferson Davis Parish	0.00%
Newpark Environmental Mud Facility — Venice	0.00%
Newpark Environmental Services — Morgan City Site Code 5102	0.00%
Newpark Environmental Intercoastal City	0.00%
MBO LLC (Lacassine Oilfield Services)	0.00%
Bealine	0.00%
SWS	0.00%

Table 4-43

Deepwater Horizon Waste Destination Communities

Landfill Name and Location	Percent Minority living within 1-Mile Radius of Site	Total Population living within 1-Mile Radius of Site (2000 Census)	Percentage of Total DWH Liquid Waste Collected	Percentage of Total DWH Solid Waste Collected
Liquid Environmental Solutions, Mobile, AL	95.80%	4,257	13.17%	0.00%
Oil Recovery Company, Mobile, AL	93.90%	3,238	0.08%	0.00%
Cliff Berry, Inc. – Miami, FL	92.80%	24,768	>0.58%	0.00%
River Birch Industries Landfill Avondale, LA	92.20%	167	16.99%	8.67%
Jefferson Parish Waste Management, Avondale, LA	91.40%	120	0.00%	0.02%
Sunbelt Crushing, Mobile, AL	76.80%	3,173	0.00%	0.29%
Chemical Waste Management, Emelle, LA	75.20%	33	1.02%	0.00%
WM Springhill Regional Landfill, Campbelton, FL	74.30%	109	0.00%	23.67%
Allied Waste/BFI Colonial Landfill, Sorrento, LA	74.10%	153	0.00%	21.98%
Allied Waste Recycling Center, Metairie, LA	63.50%	14,420	0.00%	0.06%
WH Chastang Landfill, Mount Vernon, AL	62.50%	123	0.00%	8.93%
Clearview Landfill Lake, MS	50.90%	55	0.44%	14.92%
Cliff Berry, Inc. – Tampa, FL	50.50%	1,817	>0.58%	0.00%
Apex Environmental Services, Theodore, AL	50.40%	383	17.44%	0.00%
Newpark Environmental Services Site Code 5102 Morgan City, LA	35.90%	4,237	2.74%	0.00%
Landfill Name and Location	Percent Below Poverty Living within a 1-Mile Radius of Site	Total Population Living within a 1-Mile Radius of Site (2000 Census)	Percentage of Total DWH Event Liquid Waste Collected	Percentage of Total DWH Event Solid Waste Collected
Liquid Environmental Solutions, Mobile, AL	63.30%	4,257	13.17%	0.00%
Newpark Environmental Mud Facility - Venice, LA	50.00%	2	10.90%	0.00%
Oil Recovery Company, Mobile, AL	41.70%	3,238	0.08%	0.00%
Chemical Waste Management, Emelle, LA	36.40%	33	1.02%	0.00%
Newpark Environmental Services Site Code 2913, Fourchon, LA	33.30%	3	30.14%	0.00%
Vacco Marine, Houma, LA	29.20%	525	0.16%	0.00%
River Birch Industries Landfill, Avondale, LA	28.10%	167	16.99%	8.67%
Jefferson Parish Waste Management, Avondale, LA	26.70%	120	0.00%	0.02%
Apex Environmental Services, Theodore, AL	26.20%	383	17.44%	0.00%
Allied Waste/BFI Colonial Landfill, Sorrento, LA	25.00%	153	0.00%	21.98%
WM Pecan Grove, Pass Christian, MS	14.40%	290	0.00%	3.28%
Baldwin County Magnolia Landfill	13.70%	446	0.00%	11.18%
MBO LLC (Lacassine Oilfield Services)	12.90%	85	3.82%	0.00%
Coast Guard Rd Sanitary Landfill	0.00%	0	0.00%	8.05%

Table 4-44

Gulf Coast Claims Facility — *Deepwater Horizon* Claimant Data by State

Alabama Claimant Status	No. of Claimants
TOTAL GCCF Claimants to Date *(Claimants may have one or more Claim Type)*	66,129
1. Claimants Paid and Approved for Payment	26,815
2. Claimants Requiring Additional Information or Documentation (Claimants providing no documentation: 7,503)	10,913
3. Claimants Referred to Government, Moratorium and Real Estate Funds	1
4. Denied Claimants	22,080
5. Claimants Under Review (Emergency Advance Payment)	4,561
6. Claimants Under Review (for Final Claim Only)	1,759

State	Claims for Emergency or Final Payment *(includes Individual and Business)*	Claims Submitted	Number of Claims Paid	Amount Paid
Alabama	1. Removal and Cleanup Costs	394	0	$0
	2. Real or Personal Property	1,201	35	$364,463
	3. Lost Earnings or Profits	65,655	26,380	$426,205,265
	4. Loss of Subsistence Use of Natural Resources	4,119	3	$9,000
	5. Physical Injury/Death	745	5	$1,300
Alabama Total	Total to Date	72,114	55,166	$426,580,028

Florida Claimant Status	No. of Claimants
TOTAL GCCF Claimants to Date *(Claimants may have one or more Claim Type)*	151,760
1. Claimants Paid and Approved for Payment	63,578
2. Claimants Requiring Additional Information or Documentation (Claimants providing no documentation: 7,503)	20,557
3. Claimants Referred to Government, Moratorium and Real Estate Funds	0
4. Denied Claimants	50,858
5. Claimants Under Review (Emergency Advance Payment)	12,093
6. Claimants Under Review (for Final Claim Only)	4,674

State	Claims for Emergency or Final Payment *(includes Individual and Business)*	Claims Submitted	Number of Claims Paid	Amount Paid
Florida	1. Removal and Cleanup Costs	573	0	$0
	2. Real or Personal Property	2,319	23	$71,400
	3. Lost Earnings or Profits	153,118	62,362	$848,846,576
	4. Loss of Subsistence Use of Natural Resources	2,473	0	$0
	5. Physical Injury/Death	552	0	$0
Florida Total	Total to Date	159,035	62,385	$848,917,976

Table 4-44. Gulf Coast Claims Facility — *Deepwater Horizon* Claimant Data by State (continued).

Louisiana Claimant Status	No. of Claimants
TOTAL GCCF Claimants to Date *(Claimants may have one or more Claim Type)*	187,476
1. Claimants Paid and Approved for Payment	56,308
2. Claimants Requiring Additional Information or Documentation (Claimants providing no documentation: 7,503)	38,906
3. Claimants Referred to Government, Moratorium and Real Estate Funds	8
4. Denied Claimants	75,495
5. Claimants Under Review (Emergency Advance Payment)	12,136
6. Claimants Under Review (for Final Claim Only)	4,623

State	Claims for Emergency or Final Payment *(includes Individual and Business)*	Claims Submitted	Number of Claims Paid	Amount Paid
Louisiana	1. Removal and Cleanup Costs	1,155	0	$0
	2. Real or Personal Property	2,876	39	$421,400
	3. Lost Earnings or Profits	173,632	55,120	$817,551,315
	4. Loss of Subsistence Use of Natural Resources	16,553	1	$3,000
	5. Physical Injury/Death	6,043	6	$7,800
Louisiana Total	Total to Date	200,259	55,166	$817,983,515

Mississippi Claimant Status	No. of Claimants
TOTAL GCCF Claimants to Date *(Claimants may have one or more Claim Type)*	49,879
1. Claimants Paid and Approved for Payment	14,218
2. Claimants Requiring Additional Information or Documentation (Claimants providing no documentation: 7,503)	6,963
3. Claimants Referred to Government, Moratorium and Real Estate Funds	5
4. Denied Claimants	24,143
5. Claimants Under Review (Emergency Advance Payment)	3,155
6. Claimants Under Review (for Final Claim Only)	1,395

State	Claims for Emergency or Final Payment *(includes Individual and Business)*	Claims Submitted	Number of Claims Paid	Amount Paid
Mississippi	1. Removal and Cleanup Costs	282	0	$0
	2. Real or Personal Property	1,040	13	$63,500
	3. Lost Earnings or Profits	44,793	13,978	$202,514,200
	4. Loss of Subsistence Use of Natural Resources	6,299	1	$1,000
	5. Physical Injury/Death	844	4	$4,737
Mississippi Total	Total to Date	53,258	13,996	$202,583,437

Table 4-44. Gulf Coast Claims Facility — Deepwater Horizon Claimant Data by State (continued).

Texas Claimant Status	No. of Claimants
TOTAL GCCF Claimants to Date *(Claimants may have one or more Claim Type)*	9,583
1. Claimants Paid and Approved for Payment	2,657
2. Claimants Requiring Additional Information or Documentation (Claimants providing no documentation: 7,503)	587
3. Claimants Referred to Government, Moratorium and Real Estate Funds	0
4. Denied Claimants	5,412
5. Claimants Under Review (Emergency Advance Payment)	537
6. Claimants Under Review (for Final Claim Only)	390

State	Claims for Emergency or Final Payment *(includes Individual and Business)*	Claims Submitted	Number of Claims Paid	Amount Paid
Texas	1. Removal and Cleanup Costs	79	0	$0
	2. Real or Personal Property	167	4	$50,000
	3. Lost Earnings or Profits	9,371	2,618	$81,394,000
	4. Loss of Subsistence Use of Natural Resources	301	0	$0
	5. Physical Injury/Death	277	1	$100
Texas Total	Total to Date	10,195	2,623	$81,444,100

Sources: Gulf Coast Claims Facility, 2010a and 2010b.

Table 5-1

Scoping Comments

<table>
<tr><th>Name and Affiliation</th><th>Concerns</th></tr>
<tr><td>Defenders of Wildlife
Washington, DC</td><td>
Ensure the reanalysis of baseline conditions is woven into the Agency's decision-making process.
The Supplemental EIS should include impacts to threatened and endangered species, target and nontarget fish species, water quality, seafloor conditions, and any other natural resources affected by the Deepwater Horizon spill.
The BOEMRE must closely examine the types of basic information about the Gulf marine environment that were not analyzed prior to the spill.
The reassessment of risk for future oil spills has two primary components. First, BOEMRE must reexamine the risk of oil spills in general. Second, BOEMRE must reexamine the risk of oil spills in the particular locations and conditions at issue in a particular NEPA analysis.
As BOEMRE examines the risk of future oil spills occurring, BOEMRE also must look closely at the likely impact of such spills.
The BOEMRE must ensure that its use of categorical exclusions and environmental assessments that tier to the Multisale EIS are on solid footing by taking a precautionary approach that reexamines the environmental impacts of a range of oil and gas activities that have not been analyzed adequately, or in some cases analyzed at all.
In examining ways to maximize avoidance and minimize impacts to environmental resources, BOEMRE should begin with analyzing additional measures to address safety and well control issues for both deep and shallow-water operations.
The Supplemental EIS also should examine options for improving offshore inspections and safety procedures, enforcing stronger cementing and well control protocols, and requiring improvements in the reliability factor of blowout prevention technology in any water depth.
Defenders of Wildlife further recommends that BOEMRE enact a hiatus in future permits and approvals for floating offshore storage and processing vessels due to the spill threat posed by these facilities and the demonstrated lack of effective response capabilities for large oil releases evidenced during the Deepwater Horizon event, and we request that this limitation on future permitting be analyzed in the Supplemental EIS.
In addition to the regulatory suggestions listed above, the Supplemental EIS should also assess the impact of requiring the following measures to increase worker safety, protect sensitive ecosystems and marine and intertidal habitats, and ensure a more adequate, rapid response to future OCS disasters: (1) research, development, and implementation of a new type of fail-safe backup valve, shut-in device that would reliably preclude loss of well control in the event of the failure of the blowout preventer in any water depth; measures beyond a future requirement of a second blind shear ram will likely be necessary; (2) predeployment of a rig capable of drilling a relief well at the appropriate water depth in a location within a certain reasonable response time of every drilling site; (3) strict requirements that oil spill contingency plans be certified by the U.S. Government as capable of immediate response in the event of a "worst case" well blowout, riser break, damaged floating storage vessel, tankship spill, or other cause of a major hydrocarbon release into the marine environment; (4) research and development of new types of biodegradable dispersants, their comprehensive testing and certification by USEPA for use in mass quantities under predefined
</td></tr>
</table>

Table 5-1. Scoping Comments (continued).

Name and Affiliation	Concerns
Defenders of Wildlife Washington, DC	appropriate conditions, their manufacture in commercial quantities, and their predeployment at locations of possible future need; (5) engineering and development of large ship-scaled oil skimmers for use in realistic wind, wave, and ocean current conditions, to be certified by the U.S. Coast Guard and built and operated by the petroleum industry; (6) immediate development and manufacture of more effective oil spill containment technologies and sorbent booms, and their predeployment in storage facilities in geographic areas of likely future need; (7) required testing of spill response technology in real world conditions and mandatory certification as to the measurable response impact of response equipment and plans; (8) a minimum requirement for response capacity onsite or within reasonable distance such that operators have capacity to recover a certain minimum percentage of oil spilled; and (9) bonding requirements sufficient to cover the cost of response and cleanup in the event of a blowout or other spill are necessary. • The No Action alternative of canceling the remaining lease sales should receive robust consideration in order to guarantee maximum protection for the resources that have been damaged by the *Deepwater Horizon* event. • The Defenders of Wildlife further reiterate that no activities in reliance on the previous inadequate Gulf Multisale EIS should move forward until the Supplemental EIS is complete, including all analyses that tier to the previous EIS to justify use of an environmental assessment or categorical exclusion. • The Supplemental EIS should also strongly consider exclusion of sensitive areas and possible recommendations for Gulf marine protected areas.
Center for Biological Diversity San Francisco, CA	• In determining the scope of the environmental impacts of OCS drilling in the GOM, BOEMRE should take into account the fact that many of the species move in and throughout the GOM. • It should also take into account all aspects of drilling including spills – both large and small, seismic activities – both noise impacts and vessel strikes, impacts to fisheries, tourism, and other industries that rely on the health of the GOM. • It is unclear at this time, and may be for some time, the entire impact of the spill on the flora and fauna of the GOM; therefore, BOEMRE should employ precautionary principles in its estimates of the harm as well as its assumptions about future spills. • The BOEMRE must also take into account the already degraded status of the Gulf of Mexico in its assessment of the environmental baseline, as well as the effect of these persistent stressors. • The BOEMRE should include detailed assessments of (1) areas of high seismic risk or seismicity, relatively untested deep water, or remote areas; or (2) activities within the boundary of a proposed or established marine sanctuary, and/or within or near the boundary of a proposed or established wildlife refuge or areas of high biological sensitivity; or (3) activities in areas of hazardous natural bottom conditions; or (4) utilizing new or unusual technology. • The BOEMRE should analyze and review areas and activities in the GOM OCS program that (a) have significant impacts on public health or safety; (b) have significant impacts on such natural resources and unique geographic characteristics as historic or cultural resources; park, recreation, or refuge lands; wilderness areas; wetlands (Executive Order 11990); floodplains (Executive Order 11988); national monuments; migratory birds; and other ecologically significant or critical areas;

Table 5-1. Scoping Comments (continued).

Name and Affiliation	Concerns
Center for Biological Diversity San Francisco, CA	(c) have highly controversial environmental effects or involve unresolved conflicts concerning alternative uses of available resources [NEPA Section 102(2)(E)]; (d) have highly uncertain and potentially significant environmental effects or involve unique or unknown environmental risks; . . . . (h) have significant impacts on species listed, or proposed to be listed, on the List of Endangered or Threatened Species or have significant impacts on designated Critical Habitat for these species; (i) violate a Federal law, or a State, local, or tribal law or requirement imposed for the protection of the environment. • The BOEMRE should also address the following significant issues in its Supplemental EIS: (1) environmental impacts or worst-case scenario oil spills and cumulative oil spills, including response activities and the use of dispersants; (2) the direct, indirect, and cumulative climate change impacts of the action, including the greenhouse gas emissions from the produced oil and gas, and the influence of those climate change impacts on the affected environment; (3) the impacts of the action on special status species such as those protected under the Endangered Species Act and Marine Mammal Protection Act and sensitive habitat areas, including but not limited to critical habitat, essential fish habitat, marine protected areas; (4) a reasonable range of alternatives that would avoid or minimize environmental impacts; (5) broader cumulative impacts analysis which take into consideration the incremental impacts of the action when considered in conjunction with past, present, and reasonably foreseeable future actions in the Gulf; (6) at lease sale and exploration stages, each EIS should contain site-specific analyses, smaller in scale than a typical multisale EIS, though not so narrowly focused as to result in impermissible segmentation of the project; (7) at exploration and drilling stages, specific focus on time and place of activity, keeping in mind seasonal shifts in migratory patterns and habitat composition.
Chevron North America Exploration and Production Company Houston, TX	• The Supplemental EIS should be confined to truly new information and focus on impacts of accidental events and to a lesser extent, cumulative impacts. • The BOEMRE must heed its own finding that a catastrophic spill remains a very low probability. • The planned Supplemental EIS must proceed with the supplemental analyses based upon information available at a certain date and cannot rely on speculative information and not await a series of new GOM studies. • When there are gaps in data and knowledge, BOEMRE must identify the information that is not known in the Supplemental EIS. • The BOEMRE must carefully review all new information and ensure its reliability before inclusion in the Supplemental EIS. • The BOEMRE must consider recent, significant improvements in safety and response capacity in the Supplemental EIS. • Chevron encourages BOEMRE to consider a reasonable range of clearly defined proposed alternatives and each alternative should be concise with no ambiguity. • Future NEPA analysis should tier to this Supplemental EIS. • The BOEMRE must review any suggestions for new and additional mitigation measures very carefully and have sufficient information to support their adoption. • There is no evidence that certain activities at a particular water depth are inherently more dangerous than others.

Table 5-1. Scoping Comments (continued).

Name and Affiliation	Concerns
Dean Peeler Alabama Petroleum Council (APC) Mobile, AL	• It is prudent to update the baseline conditions and potential environmental effects of oil and natural gas leasing. • The BOEMRE should use any currently new information that helps evaluate the defined impacts of the lease sales. • Proposed Lease Sales 216, 218, and 222 should be held with no reduction in the acreage traditionally offered in areawide lease sales. • The Supplemental EIS development should complement other environmental analyses by BOEMRE on the 2012-2017 5-Year Program.
Andy Radford American Petroleum Institute (API)	• Lease Sales 216, 218, and 222 should be held with no reduction in the acreage traditionally offered in areawide lease sales. • The scope of the Supplemental EIS should be focused specifically on new information that is readily available during the drafting of the Supplemental EIS and should limit the Supplemental EIS to an analysis of this new information as it exists at this time. • The BOEMRE must consider the extensive safety improvements implemented since the *Deepwater Horizon* event and consider the possibility of a catastrophic oil spill remains a very low probability. • The implementation of new drilling and environmental safeguards by industry since the *Deepwater Horizon* event should be considered and analyzed in the Supplemental EIS. • The possibility of another catastrophic spill will be reduced even further since implementation of the extensive safety improvements. • The Supplemental EIS should be designed specifically to be used as a reference for tiering in the future.
Marine Mammal Commission Bethesda, MD	• The BOEMRE should develop a set of standards for baseline information needed to assess the effects of oil and gas operations on marine mammals and their environment, initiate research on these topics prior to the resumption of lease sales in the Gulf of Mexico, and consider ways to improve oil-spill prevention and response capabilities.
U.S. Fish and Wildlife Service Lafayette, LA	• The Supplemental EIS should evaluate direct, indirect, and cumulative oil spill impacts from MC 252 to wetlands, migratory birds, endangered and threatened species, and designated critical habitat, as well as any impacts to those FWS trust resources from potential future spills. • Any possible correlations of the MC 252 spill and potential future spills to climate change should also be discussed. • The Supplemental EIS should include an assessment of potential direct, indirect, and cumulative impacts (including global climate change) to FWS trust resources from oil and gas industry exploration, development and response activities. • The FWS requests that BOEMRE discuss the relative risk of exploration and production wells leaking oil on the continental shelf versus those located on the continental slope and deepwater Gulf of Mexico. The BOEMRE should revise spill probabilities and model different sized spills, including catastrophic or multiday spills for the Gulf of Mexico for sources of spills in offshore and nearshore environments. • Any new safety regulations or revised permit review processes should be evaluated in the proposed Supplemental EIS for their impact to FWS trust resources. Changes to spill contingency planning, spill response, and restoration actions should also be described and their effects on FWS trust resources assessed.

Table 5-1. Scoping Comments (continued).

Name and Affiliation	Concerns
International Association of Geophysical Contractors (IAGC) Houston, TX	• Any analysis of alternatives should recognize and take into account the improved regulatory management, oversight, and enforcement enacted since the blowout of the Macondo well and the resulting oil spill. • The BOEMRE should analyze an alternative that includes the holding of all remaining scheduled lease sales for the entire Western and Central Planning Areas. • The IAGC believes that there should be no discrimination between areas within the Western and Central Planning Areas in regard to geophysical, leasing, drilling, and production activities based upon popular political goals or environmental opinions that cannot be substantiated. • The IAGC strongly recommends that the final Supplemental EIS clearly provide for and facilitate new geophysical data acquisition and subsequent analysis of the hydrocarbon production of the Western and Central Planning Areas. • In developing the Supplemental EIS, BOEMRE should only rely on the best available scientific information and knowledge. • The IAGC also encourages BOEMRE to consider the environmental and socioeconomic information gathered and analyzed, and the conclusions made as part of this process to be utilized in the Supplemental EIS to be developed for the next 5-Year OCS Program.
Stone Energy Lafayette, LA	• Stone Energy recommends that BOEMRE incorporate consideration of all new regulations and requirements put in place post-Macondo.
Consumer Energy Alliance Houston, TX	• The BOEMRE should proceed with the Supplemental EIS in an expedited and efficient manner, and consider thoroughly the socioeconomic impacts of oil and gas development on coastal communities.
National Oceanic and Atmospheric Administration, National Marine Fisheries Service St. Petersburg, FL	• The BOEMRE should consider the understatement of frequency and magnitude of oil spills, understatement of potential environmental impacts of oil spills, the need to better evaluate the potential adverse impacts that a spill could have on the seafood industry and markets, the need to better evaluate modeling of spills, and the need to address cumulative impacts on wetlands. • The Supplemental EIS should provide an analysis of the potential social, economic, and environmental impacts of a major oil event to fish stocks and to commercial and recreational fisheries in the Gulf of Mexico. Additionally, the Supplemental EIS should include an analysis of the potential effects of a major spill event to seafood, including wild-caught finfish and shellfish and aquaculture products that are important components of the Nation's food supply. These analyses should consider fishery closures, impacts to food safety, and contamination by hydrocarbon compounds and dispersants. • The Environmental Sensitivity Index used in past programs does not consider the sensitivity of marine habitats in the OCS to oil spills or other activities associated with oil and gas exploration, development, or production. The NOAA suggests that BOEMRE broaden the scope of its analysis to consider the impacts of all activities, including potential oil-spills and the use of chemical dispersants in any oil spill response efforts, to EFH and other vulnerable deepwater habitats such as deep-sea corals. The NOAA also suggests that BOEMRE evaluate the potential impacts to EFH for each life stage of each managed species, as well as impacts to other vulnerable habitats, from a worst-case scenario spill, including impacts to benthic and pelagic coastal and offshore habitats and prepare proposed mitigation requirements for such a spill. • The NOAA provided a list of 14 habitat areas of particular concern, which are designated within the Western and Central Planning Areas.

Table 5-1. Scoping Comments (continued).

Name and Affiliation	Concerns
National Oceanic and Atmospheric Administration, National Marine Fisheries Service St. Petersburg, FL	• The EFH section of the Supplemental EIS should reflect the current EFH identifications and descriptions by the Gulf of Mexico Fishery Management Council in 2005 for Council-managed species and by NMFS for highly migratory species in 2009. • The NOAA recommends a recalculation of the likelihood of a major oil-spill event and an analysis of the effects from oil spills that utilize the flow rates and quantities identified in the "Oil Budget Calculator Deepwater Horizon Technical Documentation." Additionally, the Supplemental EIS should reanalyze the effects of dispersant application and in-situ burning. • If the proposed activity may affect a listed species or designated critical habitat, BOEMRE must initiate consultation with NMFS pursuant to Section 7 of the ESA. • The NMFS would like to work with BOEMRE to enhance, refine, or develop new oil-spill analyses to improve the understanding of the effects of oil spills on listed species and to improve the Section 7 consultation. The NMFS recommends that spill probabilities and modeling of different sized spills, including catastrophic spills, be provided for sources of spills in offshore and nearshore environment and for surface and deepwater sources. The NMFS also asks BOEMRE to provide additional information regarding the relative risk of exploration and production wells leaking oil on the continental shelf versus those located on the continental slope and deepwater Gulf of Mexico. • The NOAA recommends that revised spill probabilities and modeling of different sized spills, including catastrophic spills for the Gulf of Mexico for sources of spills in offshore and nearshore environments be conducted. These models must include both surface and deepwater sources, as well as the effects of oil-spill response plans (e.g., dispersants) on the fate of the oil in the models. The Supplemental EIS should consider the variety and magnitude of effects associated with the chance of an oil spill taking listed species and adversely modifying or destroying critical habitat. • Please describe any changes to the proposed action resulting from the Deepwater Horizon event, including safety, spill contingency planning, spill response, and restoration actions. Also include any new programs and safeguards to reduce the likelihood of spills occurring in the future and provide an analysis of any new information and the potential for impacts to occur on listed species and critical habitat. • The Supplemental EIS should define the proposed lease sale areas, air permit requirements, and types of operations that fall under the jurisdictions of both BOEMRE and USEPA. The USEPA may be included as a co-agency in the biological opinion for air emissions for lease areas under their jurisdiction and should be included in any such request for ESA consultation. • The NMFS recommends that BOEMRE conduct a study to better understand the cumulative effects of noise from oil and gas construction and development activities on the OCS. This recommendation includes characterizing all aspects of noise-producing construction and operation activities such as pile driving during well construction and platform installation, and other common OCS activities. Major noise-producing activities (>120 dB re 1 μPa_{rms}) should be identified, and measurements of noise from these activities should be reported in appropriate units of measurement to estimate the acoustic footprint on the environment, duration, frequency, and relative contribution to ambient noise levels in the Gulf of Mexico. • The BOEMRE should consider a data collection program for the protected species observer program in coordination with NMFS, and include the program in the Supplemental EIS as appropriate.

Table 5-1. Scoping Comments (continued).

Name and Affiliation	Concerns
National Oceanic and Atmospheric Administration, National Marine Fisheries Service St. Petersburg, FL	• Pipeline construction may affect habitats important to listed species and should be considered in the Supplemental EIS. • The BOEMRE should continue to work with NMFS and the Offshore Operators Committee to provide informational materials to the offshore oil and gas workers, require annual training, and continue to develop best management practices to reduce the release of debris into the marine environment. The BOEMRE should work with NMFS to update the Marine Debris Notice to Lessees (NTL) 2003-G11 and apply this to other geographic areas/regions as appropriate. • The NOAA recommends that the Vessel Strike Avoidance Measures and Reporting for Mariners be applied throughout approved lease areas. • The Supplemental EIS should characterize all noise sources with source levels above 120 dB re 1 μPa_{rms} as the potential to affect marine mammals and other listed species. • Many general impacts associated with the construction and operation of oil and gas structures should be considered in the Supplemental EIS. Habitat alterations to water quality may result from accidental spills, turbidity during terminal an pipeline construction, wastewater discharges, and warming water outflow. Habitat effects may also occur from propeller wash, benthic impacts from pipeline and terminal construction, and discharges of marine debris. • In the event that any aspect of a proposed oil and gas operation will result in a "take," the oil and gas applicant, or the lead agency acting on behalf of the applicant, would be required to obtain an incidental take authorization from NOAA. • The NOAA had two primary comments on the Supplemental EIS related to national marine sanctuaries: (1) NOAA requests that BOEMRE review the designation of all No-Activity Zones associated with all of the topographic features in the Central and Western Planning Area, and re-establish these areas based on current bathymetric and biological data; and (2) NOAA requests that BOEMRE require the shunting of material from all wells drilled within the specified buffer zones around the No-Activity Zones. • As BOEMRE considers scoping for the Supplemental EIS, BOEMRE should consider the following issues: (1) potential and cumulative impacts on the mesophotic and deep-sea communities during the development of oil and gas resources; (2) potential and cumulative impacts on mesophotic and deep-sea coral communities in the siting of undersea pipelines; (3) potential and cumulative impacts on mesophotic and deep-sea coral communities in the event of a major spill; recent findings from research conducted to assess impacts from the *Deepwater Horizon* spill on deep-sea coral communities should be helpful in considering these impacts; (4) potential and cumulative impacts on shallow coral reef, mesophotic and deep-sea coral communities connected by prevailing ocean currents to the lease sites; and (5) potential and cumulative socioeconomic impacts to communities dependent on recreational and commercial fishing in the lease areas, as well as communities dependent on coastal and ocean tourism and fishing in places connected by prevailing ocean currents.

REFERENCES

Alonso-Alvarez, C., I. Munilla, M. Lòpez-Alonso, and A. Velando. 2007. Sublethal toxicity of the Prestige oil spill on yellow-legged gulls. Environment International 33:773-781.

Anderson, C.M. and R.P. LaBelle. 2000. Update of comparative occurrence rates for offshore oil spills. Spill Science and Technology Bulletin 6(5/6):302-321.

Atkins, M., T. Edward, D. Johnson, and M. Dance. 2007. Pipeline damage assessment from Hurricanes Katrina and Rita in the Gulf of Mexico. U.S. Dept. of the Interior, Minerals Management Service, Herndon, VA. TA&R 581.

Banks, A.N., W.G. Sanderson, B. Hughes, P.A. Cranswick, L.E. Smith, S. Whitehead, A.J. Musgrove, B. Haycock, and N.P. Fairney. 2008. The *Sea Empress* oil spill (Wales, UK): Effects on common scoter *Melanitta nigra* in Carmarthen Bay and status ten years later. Marine Pollution Bulletin 56:895-902.

British Petroleum. 2011a. Waste disposal and recoverable facilities (current and potential locations). Internet website: http://usresponse.bp.com/external/content/document/2911/995083/1/Waste_Disposal_Locations%20%2012511.pdf. Accessed March 20, 2011.

British Petroleum. 2011b. MC 252 weekly waste tracking cumulative report by disposal facility: Report for the weeks of 04/04/2011 to 04/10/11; consolidated report. 22 pp. Internet website: http://usresponse.bp.com/external/content/document/2911/1066495/1/Consolidated_Weekly_Report_04102011_Disposal_Facility.pdf. Accessed March 20, 2011.

Burger, A.E. 1993. Estimating the mortality of seabirds following oil spills: Effects of spill volume. Marine Pollution Bulletin 26:140-143.

Byrd, G.V., J.H. Reynolds, and P.L. Flint. 2009. Persistence rates and detection probabilities of bird carcasses on beaches of Unalaska Island, Alaska, following the wreck of the M/V *Selendang Ayu*. Marine Ornithology 37:197-204.

Cadiou, B., L. Riffaut, K.D. McCoy, J. Cabelguen, M. Fortin, G. Gélinaud, A. Le Roch, C. Tirard, and T. Boulinier. 2004. Ecological impact of the "*Erika*" oil spill: Determination of the geographic origin of the affected common guillemots. Aquatic Living Resources 17:369-377.

Camphuysen, K., M. Heubeck, S.L. Cox, R. Bao, D. Humple, C. Abraham, and A. Sandoval. 2002. The *Prestige* oil spill in Spain. Atlantic Birds 4:131-140.

Canadian Center for Energy Information. 2010. What are oil sands and heavy oil? Internet website: http://www.centreforenergy.com/AboutEnergy/ONG/OilsandsHeavyOil/Overview.asp?page=1. Accessed September 27, 2010.

Castège, I., G. Hèmery, N. Roux, J. D'Elbèe, Y. Lalanne, F. D'Amico, and C. Mouchès. 2004. Changes in abundance and at-sea distribution of seabirds in the Bay of Biscay prior to, and following the "Erika" oil spill. Aquatic Living Resources 17:369-377.

Castège, I., Y. Lalanne, V. Gouriou, G. Hèmery, M. Girin, F. D'Amico, C. Mouchès, J. D'Elbèe, L. Soulier, J. Pensu, D. Lafitte, and F. Pautrizel. 2007. Estimating the actual seabirds mortality at sea and relationship with oil spills: Lesson from the "Prestige" oil spill in Aquitaine (France). Ardeola 54:289-307.

Chapman, B.R. 1981. Effects of *Ixtoc I* oil spill on Texas shorebird populations. In: Proceedings of the 7th International Oil Spill Conference, Atlanta, GA. Washington, DC: American Petroleum Institute. Pp. 461-465.

Chapman, B.R. 1984. Seasonal abundance and habitat-use patterns of coastal bird populations on Padre and Mustang Island barrier beaches (following the *Ixtoc I* oil spill). U.S. Dept. of the Interior, Fish and Wildlife Service, Washington, DC. FWS/OBS-83/31. 73 pp. Internet website: http://www.gomr.boemre.gov/PI/PDFImages/ESPIS/3/3850.pdf.

Dean Runyan Associates. 2010. The economic impact of travel on Texas. Prepared for Texas Tourism, Office of the Governor, Texas Economic Development and Tourism. 141 pp.

Dickey, D. 2006. Personal communication. U.S. Dept. of Transportation, Coast Guard. Headquarters Office of Compliance and Analysis, Washington DC. June 28, 2006.

Dickey, D. 2010. Personal communication. U.S. Dept. of Transportation, Coast Guard. Headquarters Office of Compliance and Analysis, Washington DC. April 26, 2010.

Dismukes, D.E. In preparation. Fact book: OCS-related energy infrastructure and post-hurricane impact assessment. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA.

D.K. Shifflet and Associates. 2010a. Texas destinations 2006-2009. Prepared for the Office of the Governor, Economic Development Tourism Division, McLean, VA. 124 pp.

D.K. Shifflet and Associates. 2010b. 2009-2010 destination attractions. Prepared for the Office of the Governor, Economic Development Tourism Division, McLean, VA. 21 pp.

Energo Engineering. 2010. Assessment of damage and failure mechanisms for offshore structures and pipelines in Hurricanes Gustav and Ike. U.S. Dept. of the Interior, Minerals Management Service, Herndon, VA. TA&R 642.

Federal Register. 2010. Increased safety measures for energy development on the outer continental shelf. 75 FR 198, 63346-63377. Internet website: http://www.gpo.gov/fdsys/pkg/FR-2010-10-14/pdf/2010-25256.pdf.

Fisher, M. 2011. Personal communication. Top species landed and angler effort in Texas. Texas Parks and Wildlife Department, Austin, TX.

Flint, P.L. and A.C. Fowler. 1998. A drift experiment to assess the influence of wind on recovery of oiled seabird on St. Paul Island, Alaska. Marine Pollution Bulletin 36:165-166.

Flint, P.L., A.C. Fowler, and R.F. Rockwell. 1999. Modeling bird mortality associated with the M/V *Citrus* oil spill off St. Paul Island, Alaska. Ecological Modelling 117:261-267.

Flint, P.L., E.W. Lance, K.M. Sowl, and T.F. Donnelly. 2010. Estimating carcass persistence and scavenging bias in a human-influenced landscape in western Alaska. Journal of Field Ornithology 81:206-214.

Ford, R.G., M.L. Bonnell, D.H. Varoujean, G.W. Page, H.R. Carter, B.E. Sharp, D. Heinemann, and J.L. Casey. 1996. Total direct mortality of seabirds from the *Exxon Valdez* oil spill. American Fisheries Society Symposium 18:684-711.

Fowler, A.C. and P.L. Flint. 1997. Persistence rates and detection probabilities of oiled king eider carcasses on St. Paul Island, Alaska. Marine Pollution Bulletin 34:522-526.

Gulf Coast Claims Facility. 2010. Frequently asked questions. Internet website: http://gulfcoastclaimsfacility.com/faq#Q11. Accessed January 23, 2011.

Gulf Coast Claims Facility. 2011. Statistics and overall summary, and state status reports (April 27, 2011). Internet website: http://www.gulfcoastclaimsfacility.com/reports. Accessed April 28, 2011.

Helm, R.C., R.G. Ford, and H.R. Carter. 2006. The Oil Pollution Act of 1990 and Natural Resources Damage Assessment. Marine Ornithology 34:99-108.

Helm, R.C., R.G. Ford, and H.R. Carter. 2008. Oil spills, seabirds, and NRDA: Differences between U.S. West, East, and Gulf Coasts. In: Proceedings of the 20th International Oil Spill Conference, Savannah, GA, USA. Washington, DC: American Petroleum Institute. Pp. 1131-1139. Internet website: http://www.iosc.org/papers/2008%20193.pdf.

Jernelöv, A. 2010. The threats from oil spills: Now, then, and in the future. Ambio 39:353-366. Internet website: http://www.springerlink.com/content/303223683645l54u/fulltext.pdf.

Kaplan, M.F. and C. Whitman. Unpublished. Measuring the economic impact of tourism and recreation industries on Gulf Coast communities—Relationship between OCS development and coastal resources (2008). U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. Contract No. 1435-01-99-CA-30951-18261. x + 164 pp.

King, J.G. and G.A. Sanger. 1979. Oil vulnerability index for marine oriented birds. In: Bartonek, J.C. and D.N. Nettleship, eds. Conservation of marine birds in North America. U.S. Dept. of the Interior, Fish and Wildlife Service, Washington, DC. Wildlife Research Report Number 11. Pp. 227-239. Internet website: http://www.archive.org/stream/conservationofma00naturich#page/n3/mode/2up. Accessed March 25, 2011.

Law, R.J. and C. Kelley. 2004. The impact of the "Sea Impress" oil spill. Aquatic Living Resources 17:389-394.

Louisiana Dept. of Natural Resources. 2010. Production information. SONRIS lite: Internet database. Internet website: http://sonris-www.dnr.state.la.us/www_root/sonris_portal_1.htm. Accessed October 6, 2010.

Michel, J. 1992. Chapter 2. Oil behavior and toxicity. In: Introduction to coastal habitats and biological resources for spill response. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Office of Response and Restoration. NOAA Report No. HMRAD 92-4. Internet website: http://response.restoration.noaa.gov/type_subtopic_entry.php?RECORD_KEY%28entry_subtopic_type%29=entry_id,subtopic_id,type_id&entry_id(entry_subtopic_type)=275&subtopic_id(entry_subtopic_type)=8&type_id(entry_subtopic_type)=2. Accessed March 22, 2011.

Munilla, I. and A. Velando. 2010. Oiling of live gulls as a tool to monitor acute oil spill effects on seabirds. Ibis 152:405-409.

National Academy of Engineering (NAE) and National Research Council (NRC). 2011. Blowout prevention: Analysis of the *Deepwater Horizon* explosion, fire, and oil spill. Internet website: http://sites.nationalacademies.org/BlowoutPrevention/index.htm. Accessed March 15, 2011.

National Archives and Records Administration. 2010. Electronic Code of Federal Regulations. Internet website: http://www.archives.gov/. Accessed January 27, 2011.

National Ocean Economics Program. 2006. Oil & gas production. Internet website: http://noep.csumb.edu/Minerals/oil_gas.asp. Accessed September 11, 2006.

Oil Spill Commission. 2010. The amount and fate of the oil. Staff Working Paper No. 3. National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. 29 pp. Internet website: http://www.oilspillcommission.gov/sites/default/files/documents/Working%20Paper.Amount%20and%20Fate.For%20Release.pdf.

Oil Spill Commission. 2011. Deep water: The Gulf oil disaster and the future of offshore drilling report to the President's National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. 398 pp. Internet website: http://www.oilspillcommission.gov/final-report. Accessed March 15, 2011.

Piatt, J.F. and R.G. Ford. 1996. How many seabirds were killed by the *Exxon Valdez* oil spill? American Fisheries Society Symposium 18:712-719.

Piatt, J.F., C.J. Lensink, W. Butler, M. Kendziorek, and D.R. Nysewander. 1990a. Immediate impact of the *Exxon Valdez* oil spill on seabirds. Auk 107:387-397.

Piatt, J.F., H.R. Carter, and D.N. Nettleship. 1990b. Effects of oil pollution in marine bird populations. In: White, J., ed. The effects of oil on wildlife: Research, rehabilitation and general concerns. Proceedings of the Oil Symposium, Herndon, VA, October 16-18, 1990. Hanover, PA: Sheridan Press. Pp. 125-141.

Railroad Commission of Texas. 2010. Texas crude oil production - offshore State waters. Internet website: http://www.rrc.state.tx.us/data/production/offshoreoil/index.php. Updated September 24, 2010. Accessed October 12, 2010.

RestoreTheGulf.gov. 2011. Transcripts and docs. Internet website: http://www.restorethegulf.gov/news/transcripts-docs. Accessed March 11, 2011.

Tan, L., M. Belanger, and C. Wittnich. 2010. Revisiting the correlation between estimated seabird mortality and oil spill size. Journal of Marine Animals and Their Ecology 3:20-26.

U.S. Dept of Agriculture. Forest Service. 2010. National survey on recreation and the environment, 2005-2009. U.S. Dept. of Agriculture, Forest Service, Southern Research Station.

U.S. Dept. of Commerce. Census Bureau. 2010. State and county quick facts. Internet website: http://quickfacts.census.gov/qfd/states/22000.html. Last revised November 4, 2010. Accessed April 2011.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010a. Deepwater Horizon oil: Characteristics and concerns. National Ocean Service. 2 pp. Internet website: http://sero.nmfs.noaa.gov/sf/deepwater_horizon/OilCharacteristics.pdf. Last revised May 15, 2010. Accessed August 27, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010b. National Hurricane Center, Miami, FL. Internet website: http://www.nhc.noaa.gov. Accessed November 16, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010c. Fisheries economics table. Internet website: http://www.st.nmfs.noaa.gov/st5/publication/fisheries_economics_2008.html. Accessed December 1, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2010d. Recreational fisheries statistics queries. Internet website: http://www.st.nmfs.noaa.gov/st1/recreational/queries/index.html. Accessed December 1, 2010.

U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. 2011. *Deepwater Horizon* MC 252 waste management sites. Internet website: http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/incident_response/STAGING/local_assets/downloads_pdfs/wastemgnt_7282010.pdf . Accessed May 16, 2011.

U.S. Dept. of Energy. Energy Information Administration. 2006. Petroleum and other liquids. Internet website: http://www.eia.doe.gov/oil_gas/petroleum/info_glance/petroleum.html. Accessed September 11, 2006.

U.S. Dept. of Labor. Bureau of Labor Statistics. 2010. Quarterly census of employment and wages. Internet website: http://www.bls.gov/cew/home.htm. Accessed December 1, 2010.

U.S. Dept. of Labor. Bureau of Labor Statistics. 2011. Quarterly census of employment and wages. Internet website: http://www.bls.gov/cew/home.htm. Accessed April 20, 2011.

U.S. Dept. of the Army. Corps of Engineers. 2011a. Amount of dredged material ocean disposed by year in cubic yards by single district. Internet website: http://el.erdc.usace.army.mil/odd/. Stated as current through 2008. Accessed January 27, 2011.

U.S. Dept. of the Army. Corps of Engineers. 2011b. United States of America ocean dumping report for calendar year 2008 dredged material. Headquarters, Washington, DC. Internet website: http://el.erdc.usace.army.mil/odd/file.htm. Stated as current through 2008. Accessed January 27, 2011.

U.S. Dept. of the Interior. 2010a. Increased safety measures for energy development on the outer continental shelf, May 27, 2010. U.S. Dept. of the Interior, Washington, DC. 44 pp. Internet website: http://www.doi.gov/deepwaterhorizon/loader.cfm?csModule=security/getfile&PageID=33598. Accessed March 13, 2011.

U.S. Dept. of the Interior. 2010b. Outer Continental Shelf Safety Oversight Board, report to Secretary of the Interior Ken Salazar. U.S. Dept. of the Interior, Washington, DC. September 1, 2010. 37 pp.

Internet website: http://www.doi.gov/news/pressreleases/loader.cfm?csModule=security/getfile&PageID=43677. Accessed March 13, 2011.

U.S. Dept. of the Interior. Fish and Wildlife Service. 2010. Bird impact data from DOI-ERDC database download 30 Nov. 2010: Weekly bird impact data and consolidated wildlife reports. 3 pp. Internet website: http://www.fws.gov/home/dhoilspill/pdfs/Bird%20Data%20Species%20Spreadsheet%2011302010.pdf.

U.S. Dept. of the Interior. Office of the Inspector General. 2010. A new horizon: Looking to the future of the Bureau of Ocean Energy Management, Regulation and Enforcement. No. CR-EV-MMS-0015-2010. Washington, DC. 82 pp. Internet website: http://www.doioig.gov/images/stories/reports/pdf/A%20New%20Horizon%20Public.pdf.

U.S. Dept. of Transportation. Coast Guard. 2001. Polluting incident compendium: Cumulative data and graphics for oil spills, 1973-2000. Internet website: http://www.uscg.mil/hq/g-m/nmc/response/stats/summary.htm.

U.S. Dept. of Transportation. Maritime Administration (MARAD). 2009. Vessel calls snapshot, 2009. 10 pp. Internet website: http://www.marad.dot.gov/documents/Vessel_Calls_at_US_Ports_Snapshot.pdf.

U.S. Environmental Protection Agency. 2008. National list of beaches. U.S. Environmental Protection Agency, Office of Water. EPA-823-R-08-004. 160 pp.

U.S. Environmental Protection Agency. 2011. 8-hour ozone nonattainment area/state/county report. Internet website: http://www.epa.gov/oaqps001/greenbk/gnca.html. Accessed April 28, 2011.

U.S. Environmental Protection Agency and British Petroleum. 2010. Unified Area Command Plan—Deepwater Horizon MC252: Waste and material tracking system and reporting plan. Internet website: http://www.epa.gov/bpspill/waste/bp_waste_tracking_plan.pdf. Issued August 20, 2010. Accessed October 8, 2010.

U.S. Travel Association. 2010. Economic impact of travel and tourism. The Power of Travel Data Center. Internet website: http://poweroftravel.org/statistics. Accessed December 14, 2010.

Velando, A., D. Álvarez, J. Mouriño, F. Arcos, and Á. Barros. 2005a. Population trends and reproductive success of the European shag *Phalocrocorax aristotelis* on the Iberian Peninsula following the *Prestige* oil spill. Journal of Ornithology 146:116-120.

Velando, A., I. Munilla, and P.M. Leyenda. 2005b. Short-term indirect effects of the *Prestige* oil spill on European shags: Changes in availability of prey. Marine Ecology Progress Series 302:263-274.

Waring, G.T., E. Josephson, K. Maze-Foley, and P.E. Rosel, eds. 2010. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments -- 2011. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration. NOAA Technical Memorandum NMFS NE 219. 598 pp.

Wiens, J.A., R.G. Ford, and D. Heinemann. 1984. Information needs and priorities for assessing the sensitivity of marine birds to oil spills. Biological Conservation 28:21-49.

Wiese, F.K. and I.L. Jones. 2001. Experimental support for a new drift block design to assess seabird mortality from oil pollution. Auk 118:1062-1068.

Wilhelm, S.I., G.J. Robertson, P.C. Ryan, and D.C. Schneider. 2007. Comparing an estimate of seabirds at risk to a mortality estimate from the November 2004 *Terra Nova* FPSO oil spill. Marine Pollution Bulletin 54:537-544.

Williams, J.M., M.L. Tasker, I.C. Carter, and A. Webb. 1995. A method of assessing seabird vulnerability to surface pollutants. Ibis 137:S147-S152.

Woods & Poole Economics, Inc. 2010. The 2011 complete economic and demographic data source (CEDDS) on CD-ROM.

APPENDIX B

CATASTROPHIC SPILL EVENT ANALYSIS

CATASTROPHIC SPILL EVENT ANALYSIS: HIGH-VOLUME, EXTENDED-DURATION OIL SPILL RESULTING FROM LOSS OF WELL CONTROL ON THE GULF OF MEXICO OUTER CONTINENTAL SHELF

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1. INTRODUCTION

In 1986, the Council on Environmental Quality (CEQ) regulations were amended to rescind the requirement to prepare a "worst-case analysis" for an environmental impact statement (EIS) (see 40 CFR 1502.22(b)(4)). The regulation, as amended, states that catastrophic, low-probability impacts must be analyzed if the analysis is "supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason."

The August 16, 2010, CEQ report, prepared following the *Deepwater Horizon* event and spill in the Gulf of Mexico (CEQ, 2010), recommended that the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), formerly the Minerals Management Service (MMS), should "ensure that NEPA documents provide decisionmakers with a robust analysis of reasonably foreseeable impacts, including an analysis of reasonably foreseeable impacts associated with low probability catastrophic spills for oil and gas activities on the Outer Continental Shelf" (CEQ, 2010). This analysis provides that robust analysis of the impacts of low-probability catastrophic spills for all applicable decisionmakers including, but not limited to, the Secretary of the Department of the Interior (USDOI) for the National 5-Year Program, the Assistant Secretary of Land Management for an oil and gas lease sale, or the Regional Supervisor of the Office of Field Operations for an exploration or development plan.

It should be noted that the analysis presented here is intended to be a general overview of potential effects of a catastrophic spill in the Gulf of Mexico. The analysis does not include detailed sale-specific or site-specific analyses nor is it intended to replace such analyses for individual resources in the Supplemental EIS. As such, the *Catastrophic Spill Event Analysis* should be read with the understanding that further detail about accidental oil impacts on a particular resource may be found in the Supplemental EIS analysis or previous relevant National Environmental Policy Act (NEPA) analyses (e.g., Multisale EIS).

1.1. WHAT IS A CATASTROPHIC EVENT?

As applicable to NEPA, Eccleston (2008) defines a catastrophic event as "large-scale damage involving destruction of species, ecosystems, infrastructure, or property with long-term effects, and/or major loss of human life." For oil and gas activities on the Outer Continental Shelf (OCS), a catastrophic event is a high-volume, long-duration oil spill regardless of the cause, whether natural disaster (i.e., hurricane) or manmade (i.e., human error and terrorism). This high-volume, long-duration oil spill, or catastrophic spill, has been further defined by the National Oil and Hazardous Substances Pollution Contingency Plan as a "spill of national significance" or "a spill which due to its severity, size, location, actual or potential impact on the public health and welfare or the environment, or the necessary response effort, is so complex that it requires extraordinary coordination of federal, state, local, and responsible party resources to contain and cleanup the discharge" (40 CFR 300, Appendix E).

Each oil-spill event is unique; its outcome depends on several factors, including time of year and location of release relative to winds, currents, land, and sensitive resources, specifics of the well (i.e., flow rates, hydrocarbon characteristics, and infrastructure damage), and response (i.e., speed and effectiveness). For this reason, the severity of impacts from of an oil spill cannot be predicted based on volume alone, although a minimum volume of oil must be spilled to reach catastrophic impacts.

Though large spills may result from a pipeline rupture, such events will not result in a catastrophic spill because the ability to detect leaks and shut off pipelines limits the amount of the spill to the contents of the pipeline. The largest, non-blowout-related spill on the Gulf of Mexico OCS occurred in 1967, a result of internal pipeline corrosion following initial damage by an anchor. In 13 days, 160,638 barrels of oil leaked (USDOI, BOEMRE, 2010a); however, no significant environmental impacts were recorded as a result of this spill.

Incidents such as the loss of well control create the volume and duration that produces a catastrophic oil spill. Although loss of well control is defined as the uncontrolled flow of reservoir fluid that may result in the release of gas, condensate, oil, drilling fluids, sand, or water, it is a broad term that includes very minor well control incidents as well as the most severe well control incidents. Historically, loss of well control incidents occurred during development drilling operations, but loss of well control incidents can occur during exploratory drilling, production, well completions, or workover operations. These loss of well control incidents may occur between zones in the wellbore or at the seafloor.

Blowouts are a more severe loss of well control incident that creates a great risk of a large oil spill and serious human injury. Two blowouts that resulted in catastrophic spills have occurred in U.S. and Mexican waters of the Gulf of Mexico. In 1979, the *Ixtoc* blowout in shallow water (164 feet [ft] 50 miles [mi] [50 meters [m] 80 kilometers [km]] offshore in the Bay of Campeche, Mexico) spilled 3.5 million barrels of oil in 10 months (USDOC, NOAA, Office of Response and Restoration, 2010a; USDOC, NOAA, Hazardous Materials Response and Assessment Division, 1992; ERCO, 1982). On April 20, 2010, the *Deepwater Horizon* event, in deep water (4,992 ft; 1,522 m) 48 mi (77 km) offshore in Mississippi Canyon Block 252, spilled an estimated 4.9 million barrels of oil until it was capped almost 3 months later.

Prior to the *Deepwater Horizon* event, the two largest spills resulting from a loss of well control in U.S. waters of the Gulf of Mexico occurred in 1970 and released 30,000 and 53,000 barrels of oil (USDOI, BOEMRE, 2010a). These incidents resulted in four human fatalities. Although these incidents occurred only 8-14 mi (13-26 km) from shore, there was minor shoreline contact (USDOC, NOAA, Office of Response and Restoration, 2010b and 2010c). In 1987, a blowout of the Mexican exploratory oil well, YUM II, resulted in a spill of 58,640 barrels and 75 mi of impacted shoreline (USDOC, NOAA, Hazardous Materials Response and Assessment Division, 1992). None of these spills met the definition of a catastrophic event or spill. For this reason, only the *Ixtoc* and *Deepwater Horizon* blowouts and spills are analyzed below.

1.2. METHODOLOGY

Two general approaches are utilized to analyze a catastrophic event under NEPA. The first approach is a bounding analysis for each individual resource category (e.g., marine mammals, sea turtles, etc.). A bounding analysis involves selecting and evaluating a different set of factors and scenarios for each resource in the context of a worst-case analysis. The second approach involves the selection of a single set of key circumstances that, when combined, result in catastrophic consequences. The second approach is used for a site-specific analysis and, consequently, its possible application is more limited. Accordingly, this analysis combines the two approaches, relying on a generalized scenario while identifying site-specific severity factors for individual resources. This combined approach allows for the scientific investigation of a range of possible, although not necessarily probable, consequences of a catastrophic blowout and oil spill in the Gulf of Mexico.

1.2.1. Geographic Scope

The Gulf of Mexico is a semi-enclosed basin with an extensive history of oil and gas activities and with unique environmental conditions and hydrocarbon reservoir properties; consequently, this analysis is only applicable to the Gulf of Mexico OCS and is not intended for other OCS regions.

When possible, this analysis distinguishes between shallow water (<1,000 ft; 305 m) and deep water (≥1,000 ft; 305 m).

1.2.2. Impact-Producing Factors and Scenario

A hypothetical, yet feasible, scenario was developed to provide a framework for identifying the impacts of an extended oil spill from an uncontrolled blowout in both shallow and deep water. Unless noted, this scenario is based on the larger magnitude, blowout-related oil spills that have occurred in the Gulf of Mexico (discussed in Section 1.1). As noted above, because each spill event is unique, its outcome depends on many factors. Therefore, the impacts from present or future spills cannot be predicted based on this scenario.

1.2.3. Environmental and Socioeconomic Impacts

This analysis evaluates the impacts to the Gulf of Mexico's coastal, marine, environmental, and socioeconomic resources from a catastrophic blowout, oil spill, and associated cleanup activities.

Although the most recent EIS's prepared by this Agency for oil and gas lease sales in the Gulf of Mexico analyze the potential impacts from smaller oil spills that are more reasonably foreseeable (USDOI, MMS, 2007 and 2008), the analysis below focuses on the most likely and most significant impacts created by a high-volume, extended-duration spill. Because catastrophic consequences may not occur for all resources, factors affecting the severity of impacts are identified by individual resource.

1.3. How to Use This Analysis

The purpose of this technical analysis is to assist BOEMRE in meeting CEQ requirements. The CEQ regulations address impacts with catastrophic consequences in the context of evaluating reasonably foreseeable significant adverse effects in an EIS when they address the issue of incomplete or unavailable information (40 CFR 1502.22). "'Reasonably foreseeable' impacts include impacts which have catastrophic consequences even if their probability of occurrence is low, provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason" (40 CFR 1502.22(b)(4)). Therefore, this analysis, based on credible scientific evidence, identifies the most likely and most significant impacts from a high-volume blowout and oil spill that continues for an extended period of time. The scenario and impacts discussed in this analysis should not be confused with the scenario and impacts anticipated to result from routine activities or more reasonably foreseeable accidental events of a proposed action.

This technical analysis is designed to be incorporated by reference in future NEPA documents and consultations. Therefore, factors that affect the severity of impacts of a high-volume, extended-duration spill are highlighted throughout the analysis for use in subsequent site-specific analyses.

To analyze a hypothetical catastrophic event in an area such as the Gulf of Mexico, several assumptions and generalizations were made. However, future project-specific analyses should also consider specific details such as potential flow rates for the specific proposed activity, the properties of the targeted reservoir, and distance to shore of the proposed activities.

The life cycle of a catastrophic blowout and spill is divided into four geographic areas and/or time periods, some of which may overlap:

- Phase 1: Initial event (Section 2)
- Phase 2: Offshore spill (Section 3)
- Phase 3: Onshore contact (Section 4)
- Phase 4: Post-spill, long-term recovery (Section 5)

Each phase of a catastrophic oil spill is addressed in this analysis. For each phase, the scenario is described, factors that could produce environmental impacts are listed, and the most likely and most significant impacts are discussed.

2. INITIAL EVENT (PHASE 1)

While most of the environmental and socioeconomic impacts of a catastrophic blowout would occur during the ensuing high-volume, extended-duration spill (see Sections 3, 4, and 5), it is important to acknowledge the deadly events that could occur in the initial phase of a catastrophic blowout. The following scenario was developed to provide a framework for identifying the most likely and most significant impacts during the initial phase.

2.1. Impact-Producing Factors and Scenario

Phase 1 of the scenario is the initiation of a catastrophic blowout incident. Impacts, response, and intervention depend on the spatial location of the blowout and leak. While there are several points where a blowout could occur, four major distinctions that are important to the analysis of impacts are described in Table 1 below.

For this analysis, an explosion and subsequent fire are assumed to occur. If a blowout associated with the drilling of a single exploratory well occurs, this could result in a fire that would burn for 1 or 2 days. If a blowout occurs on a production platform, other wells could feed the fire, allowing it to burn for over a month (USDOC, NOAA, Office of Response and Restoration, 2010c). The drilling rig or platform may sink. If the blowout occurs in shallow water, the sinking rig or platform may land in the immediate vicinity; if the blowout occurs in deep water, the rig or platform could land a great distance away, beyond avoidance zones. For example, the *Deepwater Horizon* drilling rig sank, landing 1,500 ft (457 m) away on the seafloor. Regardless of water depth, the immediate response would be from search and rescue vessels and aircraft, such as United States Coast Guard (USCG) cutters, helicopters, and rescue planes, and firefighting vessels.

Table 1

Blowout Scenarios and Key Differences in Impacts, Response, and/or Intervention

Location of Blowout and Leak	Key Differences in Impacts, Response, and/or Intervention
Blowout occurs at the sea surface (i.e., at the rig)	Offers the least chance for oil recovery due to the restricted access to the release point; therefore, greater impacts to coastal ecosystems. In addition to relief wells, there is potential for other intervention measures such as capping and possible manual activation of blowout-preventer (BOP) rams.
Blowout occurs along the riser anywhere from the seafloor to the sea surface. However, a severed riser would likely collapse, resulting in a leak at the seafloor.	In deep water, the use of subsea dispersants may reduce impacts to coastal ecosystems; however, their use may increase exposure of marine resources to oil. There is a possibility for limited recovery of oil at the source. In addition to relief wells, there is potential for other intervention measures, such as capping and possible manual activation of BOP rams.
At the seafloor, through leak paths on the BOP/wellhead	In deep water, the use of subsea dispersants may reduce impacts to coastal ecosystems; however, their use may increase exposure of deepwater marine resources to dispersed oil. With an intact subsea BOP, intervention may involve the use of drilling mud to kill the well. If the BOP and well stack are heavily compromised, the only intervention method may be relief wells. Greatest possibility for recovery of oil at the source, until the well is capped or killed.
Below the seafloor, outside the wellbore (i.e., broached)	Disturbance of a large amount of sediments resulting in the burial of benthic resources in the immediate vicinity of the blowout. The use of subsea dispersants would likely be more difficult (PCCI, 1999). Stopping this kind of blowout would probably involve relief wells. Any recovery of oil at the seabed would be very difficult.

2.2. Most Likely and Most Significant Impacts

Impacts during Phase 1 would be limited to environmental resources in the immediate vicinity of the blowout. The most recent EIS's prepared by this Agency for oil and gas lease sales in the Gulf of Mexico detail the potential impacts from reasonably foreseeable blowouts (USDOI, MMS, 2007 and 2008). In addition to the impacts described in those documents, the most likely and most significant impacts resulting from a catastrophic blowout outside the wellbore are described below.

2.2.1. Physical Resources

2.2.1.1. Air Quality

A catastrophic blowout close to the water surface would initially emit large amounts of methane and other gases into the atmosphere. If high concentrations of sulfur are present in the produced gas, hydrogen sulfide (H_2S) could present a hazard to personnel. The natural gas H_2S concentrations in the

Gulf of Mexico OCS are generally low; however, there are areas such as the Norphlet formation in the northeastern Gulf of Mexico, for example, that contain levels of H_2S up to 9 percent. Ignition of the blowout gas and subsequent fire would result in emissions of nitrogen oxides (NO_x), sulfur oxides (SO_x), carbon monoxide (CO), volatile organic compounds (VOC's), particulate matter (PM_{10}), and fine particulate matter ($PM_{2.5}$). The fire could also produce polycyclic aromatic hydrocarbons (PAH's), which are known to be hazardous to human health. The pollutant concentrations would decrease with downwind distance. A large plume of black smoke would be visible at the source and may extend a considerable distance downwind. However, with increasing distance from the fire, the gaseous pollutants would undergo chemical reactions, resulting in the formation of fine particulate matter ($PM_{2.5}$) that includes nitrates, sulfates, and organic matter. The $PM_{2.5}$ concentrations in the plume would have the potential to temporarily degrade visibility in any affected Prevention of Significant Deterioration (PSD) Class I areas (i.e., National Wilderness Areas and National Parks) and other areas where visibility is of significant value.

2.2.1.2. Offshore Water Quality

During the initial phase of a catastrophic blowout, water quality impacts include disturbance of sediments and release and suspension of oil and natural gas (methane) into the water column. These potential impacts are discussed below. As this section deals with the immediate effects of a blowout that would be located at least 3 nautical miles from shore, it is assumed that there would be no impacts on coastal water quality during this initial stage.

Disturbance of Sediments

A catastrophic blowout below the seafloor, outside the wellbore (Table 1) has the potential to resuspend sediments and disperse potentially large quantities of bottom sediments. Some sediment could travel several kilometers, depending on particle size and subsea current patterns. In the deep Gulf of Mexico, surficial sediments are mostly composed of silt and clay, and, if resuspended, could stay in the water column for several hours to even days. Bottom currents in the deep Gulf of Mexico have been measured to reach 30 centimeters/second (cm/sec) (12 inches/second [in/sec]) with mean flows of 1.5-2.5 cm/sec (0.6-0.9 in/sec) (Hamilton, 1990). At these mean flow rates, resuspended sediment could be transported 1.3-2.1 kilometers/day (0.8-1.3 miles/day). Sediment resuspension can lead to a temporary change in the oxidation-reduction chemistry in the water column, including a localized and temporal release of any formally sorbed metals, as well as nutrient recycling (Caetano et al., 2003; Fanning et al., 1982). Sediments also have the potential to become contaminated with oil components.

A subsea release also has the potential to destabilize the sediments and create slumping or larger scale sediment movements along depth gradients. These types of events would have the potential to move and/or damage any infrastructure in the affected area.

Release and Suspension of Oil into the Water Column

As the *Deepwater Horizon* event showed, a subsea release of hydrocarbons at a high flow rate has the potential to disperse and suspend plumes of oil droplets (chemically dispersed or otherwise) within the water column and to induce large patches of sheen and oil on the surface. These dispersed hydrocarbons may adsorb onto marine detritus (marine snow) or may be mixed with drilling mud and deposited near the source. Mitigation efforts such as burning may introduce hydrocarbon byproducts into the marine environment, which would be distributed by surface currents. The acute and chronic sublethal effects of these dilute suspended "plumes" are not well understood and require future research efforts.

Large quantities of oil put into offshore water may alter the chemistry of the sea with unforeseeable results. The VOC's, including benzene, can have acutely toxic effects. The components of crude oil that are water soluble are more available than some of the heavier components to exert a toxic effect on marine life. The PAH's are present in crude oil and include carcinogenic compounds and compounds that pose various risks to marine organisms and possibly to the higher trophic level species, including humans that feed on these organisms. The PAH's are also persistent in the environment. Impacts from the subsequent extended oil spill on offshore water quality are discussed further in Section 3.2.1.2.

Release of Natural Gas (Methane) into the Water Column

A catastrophic blowout could release natural gas into the water column; the amount of gas released is dependent upon the water depth, the natural gas content of the formation being drilled, and its pressure. Methane is the primary component of natural gas (NaturalGas.org, 2010). Methane may stay in the marine environment for long periods of time (Patin, 1999; p. 237), as methane is highly soluble in seawater at the high pressures and cold temperatures found in deepwater environments (NRC, 2003; p. 108). However, methane diffusing through the water column would likely be oxidized in the aerobic zone and would rarely reach the air-water interface (Mechalas, 1974; p. 23). In addition to methane, natural gas contains smaller percentages of other gases such as ethane and propane. It may also contain VOC's (including benzene, toluene, ethylbenzene, and xylene) and H_2S, which have individual toxic characteristics. Methane and other natural gas constituents are carbon sources, and their introduction into the marine environment could result in reducing the dissolved oxygen levels due to microbial degradation of the methane potentially creating hypoxic or "dead" zones. Depletion of dissolved oxygen in the Gulf of Mexico due to the release of natural gas from the Macondo well (*Deepwater Horizon* event) is currently being examined as a result of the *Deepwater Horizon* event (Schenkman, 2010). Unfortunately, little is known about methane toxicity in the marine environment, but there is concern as to how methane in the water column might affect fish (see Section 3.2.2.2).

2.2.2. Biological Resources

Impacts during the initial event would be limited to environmental resources in the immediate vicinity of the blowout as described below.

2.2.2.1. Marine and Migratory Birds

Many migratory birds use offshore platforms or rigs as rest sites during migration (Russell, 2005). In addition, seabirds are attracted to offshore platforms and rigs (Tasker et al., 1986; Weise et al., 2001). The numbers of birds present at a platform or rig are greater when platforms or rigs are closer to shore during drilling operations (Baird, 1990). Birds resting on the drilling rig or platform during a catastrophic blowout are likely to be killed by an explosion. While it is assumed that most birds in trans-Gulf migration would likely avoid the fire and smoke plume during the day, it is conceivable that the light from the fire could interfere with nocturnal migration, especially during poor visibility conditions. It has been documented that seabirds are attracted to natural gas flares at rigs and platforms (Russell, 2005; Wiese et al., 2001); therefore, additional bird fatalities could result from the fire following the blowout. Though different species migrate throughout the year, the largest number of species migrates from March through November. A blowout during this time would cause a greater number of bird fatalities. While the number and species of birds killed depends on the blowout location and time of year, these initial fatalities would likely not result in population-level impacts for species present at the time of the blowout and resulting fire (Russell, 2005, Table 6.12).

2.2.2.2. Fish, Fisheries, and Essential Fish Habitat

Depending on the type of blowout and the proximity of marine life to it (Table 1), an eruption of gases and fluids may generate not only a toxic effect but also pressure waves and noise significant enough to injure or kill local biota. Within a few thousand meters of the blowout, resuspended sediments may clog fish gills and interfere with respiration. Settlement of resuspended sediments may, in turn, smother invertebrates or interfere with their respiration. Offshore benthic habitats that support fisheries could also be impacted, as discussed below.

2.2.2.3. Marine Mammals

Depending on the type of blowout, the pressure waves and noise generated by the eruption of gases and fluids would likely be significant enough to harass, injure, or kill marine mammals, depending on the proximity of the animal to the blowout. A high concentration of response vessels could result in harassment or displacement of individuals and could place marine mammals at a greater risk of vessel collisions, which would likely cause fatal injuries.

2.2.2.4. Sea Turtles

Five species of sea turtles are found in the waters of the Gulf of Mexico: green, leatherback, hawksbill, Kemp's ridley, and loggerhead. All species are protected under the Endangered Species Act (ESA), and all are listed as endangered except the loggerhead turtle, which is listed as threatened. Depending on the type of blowout (Table 1), an eruption of gases and fluids may generate significant pressure waves and noise that may harass, injure, or kill sea turtles, depending on their proximity to the accident. A high concentration of response vessels could place sea turtles at a greater risk of fatal injuries from vessel collisions.

Further, mitigation by burning puts turtles at risk because they tend to be gathered up in the corralling process necessary to concentrate the oil in preparation for the burning. Trained observers should be required during any mitigation efforts that include burning.

2.2.2.5. Offshore Benthic Habitats

Gulf of Mexico benthic resources are divided into shelf habitats and deepwater habitats. Shelf habitats of the Gulf of Mexico include soft-bottom habitats (sandy and muddy substrate) and hard-bottom habitats (rock or salt outcroppings that provide habitat for encrusting organisms). Deepwater benthic communities of the Gulf of Mexico include soft-bottom, coral, and chemosynthetic habitats. The impacts to these benthic communities depend on the location and the type of catastrophic blowout that occurs.

Introduction

Sediment disturbance as a result of the blowout above the seafloor would not occur. A catastrophic blowout that occurs above the seabed (at the rig, along the riser between the seafloor and sea surface, or through leak paths on the BOP/wellhead) would result in released oil rising to the sea surface. However, if the leak is deep in the water column and the oil is ejected under pressure, oil droplets may become entrained deep in the water column. The upward movement of the oil may be reduced if methane in the oil is dissolved at the high underwater pressures, reducing the oil's buoyancy (Adcroft et al., 2010). The large oil droplets will rise to the sea surface, but the smaller droplets, formed by vigorous turbulence in the plume or the injection of dispersants, may remain neutrally buoyant in the water column, creating a subsurface plume (Adcroft et al., 2010). Oil droplets less than 100 micrometers in diameter may remain in the water column for several months (Joint Analysis Group, 2010), where they will not be in contact with benthic habitats; similarly, large oil drops on the sea surface will not be in contact with benthos. However, oil in the water column or at the sea surface may sometimes sink, contact benthos, and have impacts, as discussed below.

As discussed below, a catastrophic blowout outside the well casing and below the seafloor or at the seafloor water interface could resuspend large quantities of bottom sediments and create a large crater, destroying many organisms within a few hundred meters of the wellhead. Some of the sediment could travel up to a few thousand meters before redeposition, negatively impacting a localized area of benthic communities.

The use of subsea dispersants would increase the exposure of offshore benthic habitats to dispersed oil droplets in the water column, as well as the chemicals used in the dispersants. The use of subsea dispersants is not likely to occur for seafloor blowouts outside the well casing.

Soft-Bottom Shelf Habitats

The vast majority of the Gulf of Mexico seabed is comprised of soft sediments. Microbes to metazoans (e.g., polychaete worms and crabs) inhabit the soft-bottom benthos, many forming the base of the food chain for several species. When soft-bottom infaunal communities are physically impacted by a blowout (either lost to the crater formation or smothered by sediment), recolonization by populations from neighboring soft-bottom substrate is expected within a relatively short period of time. Many of the organisms on soft bottoms live within the sediment and have the ability to migrate upward in response to burial by sedimentation. A blowout that occurs outside the well casing can rapidly deposit 30 cm (12 in) or more of sediment within a few hundred meters and may smother much of the soft-bottom community in a localized area. In situations where soft-bottom infaunal communities are negatively impacted, recolonization by populations from neighboring soft-bottom substrate would be expected over a relatively short period of time for all size ranges of organisms, in a matter of days for bacteria, and probably less than 1 year for most macrofauna and megafauna species. Recolonization could take longer for areas affected by direct contact of concentrated oil. Initial repopulation from nearby stocks of pioneering species, such as tube-dwelling polychaetes or oligochaetes, may begin with the next recruitment event (Rhodes and Germano, 1982). Full recovery would follow as later stages of successional communities overtake the pioneering species (Rhodes and Germano, 1982). The time it takes to reach a climax community may vary depending on the species and degree of impact. Full benthic community recovery may take years to decades if the benthic habitat is heavily oiled (Gesteira and Dauvin, 2000; Sanders et al., 1980; Conan, 1982). A slow recovery rate will result in a community with reduced biological diversity and possibly a lesser food value for predatory species.

Hard-Bottom Shelf Habitats

The Gulf of Mexico shelf has several hard-bottom features upon which encrusting and epibenthic organisms attach. Though there are varying degrees of relief on the hard bottom, the impacts from a catastrophic blowout are similar for the banks of varying relief because similar organisms occur on these features. Thus, they are discussed as a single grouping under "hard-bottom communities," with references to specific communities where impacts may differ.

Topographic features are isolated areas of moderate to high relief that provide habitat for hard-bottom communities of high biomass and moderate diversity. These features provide shelter and food for large numbers of commercially and recreationally important fish. There are 37 named topographic features in the Gulf of Mexico with specific BOEMRE protections, including the Flower Garden Banks National Marine Sanctuary. The BOEMRE has created "No Activity Zones" around topographic features in order to protect these habitats from disruption due to oil and gas activities. A "No Activity Zone" is a protective perimeter drawn around each feature that is associated with a specific isobath (depth contour) surrounding the feature in which structures, drilling rigs, pipelines, and anchoring are not allowed. These "No Activity Zones" are areas where activity is prohibited based on BOEMRE policy. Notice to Lessees and Operators (NTL) 2009-G39 recommends that drilling should not occur within 152 m (500 ft) of a "No Activity Zone" of a topographic feature.

The northeastern portion of the central Gulf of Mexico is a region of low to moderate relief known as the "Pinnacle Trend" at the outer edge of the Mississippi-Alabama shelf between the Mississippi River and De Soto Canyon. These outcrops provide hard substrate for sessile invertebrate attachment that attracts fish. The NTL 2009-G39 recommends that no bottom-disturbing activities occur within 30 m (100 ft) of any hard bottoms/pinnacles with a relief of 8 ft (2 m) or greater.

Potentially sensitive biological features are features that have moderate to high relief (8 ft [2 m] or higher), provide hard surface for sessile invertebrates, attract fish, but are not located within Pinnacle-designated blocks or the "No Activity Zone" of topographic features. No bottom-disturbing activities that may cause impact to these features are permitted.

Impacts that occur to hard-bottom shelf habitats as a result of a blowout would depend on the type of blowout, distance from the blowout, relief of the biological feature, and surrounding physical characteristics of the environment (e.g., turbidity). The NTL 2009-G39 recommends the use of buffers to prevent blowouts in the immediate vicinity of a hard-bottom habitat or its associated biota. Much of the oil released from a blowout would rise to the sea surface, therefore minimizing the impact to benthic communities by direct oil exposure. However, small droplets of oil that are entrained in the water column for extended periods of time may migrate into "No Activity Zones." Although these small oil droplets will not sink themselves, they may attach to suspended particles in the water column and then be deposited on the seafloor (McAuliffe et al., 1975). These long-term impacts, such as reduced recruitment success, reduced growth, and reduced coral cover, as a result of impaired recruitment, are discussed in Section 3.2.2.6. Also, if the blowout were to occur beneath the seabed, suspension and subsequent deposition of disturbed sediment may smother localized areas of benthic communities, possibly including organisms within No Activity Zones or other hard-bottom substrate.

Benthic communities on a hard-bottom feature exposed to large amounts of resuspended and deposited sediments following a catastrophic, subsurface blowout could be subject to sediment suffocation, exposure to resuspended toxic contaminants, and reduced light availability. Impacts to corals as a result of sedimentation would vary based on coral species, the height to which the coral grows, degree of sedimentation, length of exposure, burial depth, and the coral's ability to clear the sediment. Impacts may range from sublethal effects such as reduced growth, alteration in form, and reduced recruitment and productivity to slower growth to death (Rogers, 1990).

The initial blowout impact would be greatest to communities located in clear waters that experience heavy sedimentation. Reef-building corals are sensitive to turbidity and may be killed by heavy sedimentation (Rogers, 1990; Rice and Hunter, 1992). However, it is unlikely that reef-building corals would experience heavy sedimentation as a result of a blowout because drilling activity would not be allowed near sensitive organisms in the "No Activity Zones," based on the lease stipulations as described in NTL 2009-G39. The most sensitive organisms are also typically elevated above soft sediments, making them less likely to be buried. It is possible, however, for potentially sensitive biological features outside of "No Activity Zones" or Pinnacle-designated blocks to experience some turbidity or sedimentation impacts. Corals may also experience discoloration or bleaching as a result of sediment exposure, although recovery from such exposure may occur within 1 month (Wesseling et al., 1999).

Initial impacts would be much less extreme in a turbid environment (Rogers, 1990). For example, the Pinnacle Trend community exists in a relatively turbid environment, starting just 65 km (40 mi) east of the mouth of the Mississippi River and trending to the northeast. Sediment from a blowout, if it occurred nearby, may have a reduced impact on these communities compared with an open-water reef community, as these organisms are more tolerant of suspended sediment (Gittings et al., 1992). Many of the organisms that predominate in this community also grow tall enough to withstand the sedimentation that results from their turbid environment or they have flexible structures that enable the passive removal of sediments (Gittings et al., 1992).

A portion or the entire rig may sink to the seafloor as a result of a blowout. The benthic communities (hard- or soft-bottom communities) on the seafloor upon which the rig settles would be destroyed or smothered. A settling rig may suspend sediments, which may smother nearby benthic communities as the sediment is redeposited on the seafloor. The habitats beneath the rig may be permanently lost; however, the rig itself may become an artificial reef upon which epibenthic organisms may settle. The surrounding benthic communities that were smothered by sediment would repopulate from nearby stocks through spawning recruitment and immigration.

Deepwater Habitats

The effects of a catastrophic blowout event on Gulf of Mexico benthic resources in deep water (>1,000 ft; 300 m) are similar to those on the shelf communities. The main factors are the type of blowout and the proximity to the habitat. Known deepwater communities include soft bottoms and two types of hard-bottom communities: chemosynthetic communities and deep coral communities. Many of the organisms on soft bottoms live within the sediment and have the ability to migrate upward in response to burial by sedimentation. A blowout that occurs outside the well casing can rapidly deposit 30 cm (12 in) or more of sediment within a few hundred meters and may smother much of the soft-bottom community in a localized area. In situations where soft-bottom infaunal communities are negatively impacted, recolonization by populations from neighboring soft-bottom substrate would be expected over a relatively short period of time for all size ranges of organisms, in a matter of days for bacteria, and probably less than 1 year for most macrofauna and megafauna species. Recolonization could take longer for areas affected by direct contact of concentrated oil.

The BOEMRE's restrictions applicable to work near deepwater hard-bottom areas (as described in NTL 2009-G40) would prevent direct negative effects from a seafloor blowout. The established policy prohibits location of wells within 2,000 ft (610 m) of a suspected hard-bottom habitat. Geophysical analyses have achieved a high degree of reliability in detecting the potential presence of hard-bottom communities in the Gulf of Mexico. In rare instances, the subtle geophysical signatures of hydrocarbon seepage, conducive to the development of a chemosynthetic deepwater community development at the seabed that are a probable indicator of a community are not discovered during routine environmental analysis. Therefore, it is possible that a well could be drilled close enough for a hard-bottom community to be damaged in the event of a catastrophic blowout.

Blowouts at points above the seafloor (in the riser or on the drill platform) would have little immediate effect on deepwater seafloor communities unless the structure sinks and physically impacts the seafloor. If a structure sank directly on a hard-bottom community, at least 2,000 ft (610 m) from the well, organisms could be crushed and smothered.

2.2.3. Socioeconomic Resources

2.2.3.1. Offshore Archaeological Resources

The BOEMRE protects all known, discovered, and potentially historic and prehistoric archaeological resources on the OCS by requiring appropriate avoidance criteria as well as directives to investigate these resources.

Onshore archaeological resources, prehistoric and historic sites, would not be immediately impacted during the initial phase of a catastrophic blowout because the distance of a blowout site from shore is at least 3 nautical miles. However, offshore catastrophic blowouts, when compared with spills of lesser magnitude, may initially impact multiple archaeological resources. Resources adjacent to a catastrophic blowout could be damaged by the high volume of escaping gas, buried by large amounts of dispersed sediments, crushed by the sinking of the rig or platform, destroyed during emergency relief well drilling, or contaminated by the hydrocarbons.

Based on historical information, over 2,100 potential shipwreck locations have been identified in the Gulf of Mexico OCS (USDOI, MMS, 2007). This number is a conservative estimate and is heavily weighted toward post-19th century, nearshore shipwrecks, where historic records documenting the loss of the vessels were generated more consistently. Of the 2,100 recorded wrecks, only 233 records were determined to have associated spatial data possessing sufficient accuracy for BOEMRE's needs.

The inadequacy of data related to these historic ship losses creates uncertainty in determining how many shipwrecks might be located near existing or planned oil and gas wells. If undiscovered shipwrecks are adjacent to a catastrophic blowout, the potential for impacting these nonrenewable resources is high. However, the potential of a well being drilled close enough to damage or bury a known prehistoric or historic resource, such as a shipwreck, is low when archaeological surveys are required prior to any exploration or development activities.

2.2.3.2. Commercial Fishing

The initial explosion and fire could endanger commercial fishermen in the immediate vicinity of the blowout. Although commercial fishing vessels in the area would likely aid in initial search-and-rescue operations, the subsequent fire could burn for over a month, during which time commercial vessels would be expected to avoid the area so as to not interfere with response activities. This could impact the livelihood and income of these commercial fishermen.

2.2.3.3. Recreational Resources and Fishing

A substantial amount of recreational activity is associated in the immediate area around shallow water oil and gas structures because these structures function as artificial reefs, promote coral growth, and attract fish. About 20 percent of the recreational fishing activity and 90 percent of the recreational diving activity in the Gulf of Mexico occurs within 300 ft (91 m) of oil and gas structures (Hiett and Milon, 2002). Therefore, an explosion and fire within 100 mi (161 km) of shore could endanger recreational fishermen and divers in the immediate vicinity of the blowout, especially if the blowout is located between water depths of 100 and 200 ft (30 and 61 m). Recreational vessels in the area would likely aid in initial search-and-rescue operations but would also be in danger during the explosion and subsequent fire. The subsequent fire could burn for more than a month, during which recreational vessels would be expected to avoid the area and not interfere with response activities. This will impact the income of recreational fishing and diving businesses. Also, if the fire and smoke is visible from recreational beaches, their recreational use may be impacted.

2.2.3.4. Human Resources, Land Use, and Environmental Justice

Fatalities and serious injuries would likely occur during the initial explosion and/or fire. Due to the large number of people (>100) working on a deepwater drilling rig or platform, dozens of fatalities and serious injuries could occur.

With the explosion >3 nautical miles from the shore and the likelihood that the resulting fire will burn for a short duration, the initial fire and/or explosion is not expected to impact land use, demographics, or economics, although some recreational beach use may be impacted (Section 2.2.2.3). Thus, the initial fire and explosion should not disproportionately affect low-income persons or minorities, and therefore, will not raise environmental justice concerns.

3. OFFSHORE SPILL (PHASE 2)

3.1. IMPACT-PRODUCING FACTORS AND SCENARIO

Phase 2 of the analysis focuses on the spill and response in Federal and State offshore waters.

3.1.1. Duration of Spill

The duration of the offshore spill from a blowout depends on the time needed for intervention and the time the remaining oil persists offshore. If a blowout occurs and the damaged surface facilities preclude well reentry operations, a relief well may be needed to regain control. The time required to drill the relief well depends on the complexity of the intervention, the location of a suitable rig, the type of operation that must be terminated to release the rig (e.g., casing may need to be run before releasing the rig), and problems mobilizing personnel and equipment to the location. A blown-out well may also be successfully capped prior to completion of relief wells, as occurred in the *Deepwater Horizon* event. Assuming the duration of previous spills including the *Deepwater Horizon* and the type of oil and water temperatures found in the Gulf of Mexico, the majority of visibly spilled oil on the surface of the water would not persist more than 30 days after the oil flow stopped (Inter-agency, 2010a).

3.1.1.1. Shallow Water

If a blowout occurs in shallow water, the entire intervention effort including drilling relief wells could take 1-3 months. This includes 1-3 weeks to transport the drilling rig to the well site. Spilled surface oil is not expected to persist more than 1 month after the flow is stopped. Therefore, the estimated spill duration resulting from a shallow water blowout is 2-4 months.

3.1.1.2. Deep Water

If a blowout occurs in deep water, the entire intervention effort including drilling relief wells could take 3-4 months (USDOI, MMS, 2000; Regg, 2000). This includes 2-4 weeks to transport the drilling rig to the well site. Spilled surface oil is not expected to persist more than 1 month after the flow is stopped. Therefore, the estimated spill duration from a deep water blowout is 4-5 months.

3.1.2. Area of Spill

When oil reaches the sea surface, it spreads. The speed and extent of spreading depends on the type and volume that is spilled. However, a catastrophic spill would likely spread hundreds of square miles. Also, the oil slick may break into several smaller slicks, depending on local wind patterns that drive the surface currents in the spill area.

3.1.3. Volume of Spill

For this analysis, a higher flow rate is assumed for a blowout in deep water for the following reasons. After 50 years of Gulf of Mexico development, most, if not all, of the largest shallow-water prospects have been developed. As a result, reservoir pressures in shallow water are generally reduced. Although under certain conditions oil may be present with the natural gas, deeper shelf wells target natural gas. Also, because deepwater development is costly, only larger prospects with higher flow rates are currently targeted for exploration.

3.1.3.1. Shallow Water

For this analysis, an uncontrolled flow rate of 30,000 barrels per day is assumed for a catastrophic blowout in shallow water. This assumption is based upon the results of well tests in shallow water (see Section 3.1.3 above) and the maximum flow rate from the 1979 *Ixtoc* blowout, which occurred in shallow water. Using this flow rate, the total volume of oil spilled from a catastrophic blowout in shallow water is estimated at 900,000 to 3 million barrels for a spill lasting 1-3 months. In addition to the flow rate, it is assumed that any remaining diesel fuel from a sunken drilling rig would also leak.

3.1.3.2. Deep Water

For the purposes of this analysis, an uncontrolled flow rate of 30,000-60,000 barrels per day is assumed for a catastrophic blowout in deep water. This flow rate is based on the assumption in Section 3.1.3 above, well test results, and the maximum expected flow rate of the 2010 *Deepwater Horizon* event, which occurred in deep water. Therefore, total volume of oil spilled is estimated to be 2.7-7.2 million barrels over 3-4 months. In addition, deepwater drilling rigs hold a large amount of diesel fuel (10,000-20,000 barrels). Therefore, it is assumed that any remaining diesel fuel from a sunken drilling rig would also leak and add to the spill.

3.1.4. Oil in the Environment: Properties and Persistence

The fate of oil in the environment depends on many factors, such as the source and composition of the oil, as well as its persistence (NRC, 2003). Persistence can be defined and measured in different ways (Davis et al., 2004), but the National Research Council (NRC) generally defines persistence as how long oil remains in the environment (NRC, 2003; p. 89). Once oil enters the environment, it begins to change through physical, chemical, and biological weathering processes (NRC, 2003). These processes may interact and affect the properties and persistence of the oil through

- evaporation (volatilization),
- emulsification (the formation of a mousse),
- dissolution,
- oxidation, and
- transport processes (NRC, 2003; Scholz et al., 1999).

Horizontal transport takes place via spreading, advection, dispersion, and entrainment while vertical transport takes place via dispersion, entrainment, Langmuir circulation, sinking, overwashing, partitioning, and sedimentation (NRC, 2003). The persistence of an oil slick is influenced by the effectiveness of oil-spill response efforts and affects the resources needed for oil recovery (Davis et al., 2004). The persistence of an oil slick may also affect the severity of environmental impacts as a result of the spilled oil.

Crude oils are not a single chemical, but instead are complex mixtures with varied compositions. Thus, the behavior of the oil and the risk the oil poses to natural resources depends on the composition of the specific oil encountered (Michel, 1992). Generally, oils can be divided into three groups of compounds: (1) light-weight; (2) medium-weight; and (3) heavy-weight components. On average, these groups are characterized as outlined below in Table 2.

Table 2

Properties and Persistence by Oil Component Group

Properties and Persistence	Light-Weight	Medium-Weight	Heavy-Weight
Hydrocarbon compounds	Up to 10 carbon atoms	10-22 carbon atoms	>20 carbon atoms
API º	>31.1 º	31.1º-22.3 º	<22.3 º
Evaporation rate	Rapid (within 1 day) and complete	Up to several days; not complete at ambient temperatures	Negligible
Solubility in water	High	Low (at most a few mg/L)	Negligible
Acute toxicity	High due to monoaromatic hydrocarbons (BTEX)	Moderate due to diaromatic hydrocarbons (naphthalenes – 2 ring PAH's)	Low except due to smothering (i.e., heavier oils may sink)
Chronic toxicity	None, does not persist due to evaporation	PAH components (e.g., naphthalenes – 2 ring PAH's)	PAH components (e.g., phenanthrene, anthracene – 3 ring PAH's)
Bioaccumulation potential	None, does not persist due to evaporation	Moderate	Low, may bioaccumulate through sediment sorption
Compositional majority	Alkanes and cycloalkanes	Alkanes that are readily degraded (specify, as done for others)	Waxes, asphaltenes, and polar compounds (not significantly bioavailable or toxic)
Persistence	Low due to evaporation	Alkanes readily degrade, but the diaromatic hydrocarbons are more persistent	High; very low degradation rates and can persist in sediments as tarballs or asphalt pavements

Sources: Michel, 1992; Canadian Center for Energy Information, 2010.

Of the oil reservoirs sampled in the Gulf of Mexico OCS, the majority fall within the light-weight category, while less than one quarter are considered medium-weight and a small portion are considered heavy-weight. Oil with an API gravity of 10.0 or less would sink and has not been encountered in the Gulf of Mexico OCS and, therefore, it is not analyzed in this paper (USDOI, BOEMRE, 2010c).

Heavy-weight oil may persist in the environment longer than the other two types of oil, but the medium-weight components within oil present the greatest risks to organisms because, with the exception of the alkanes, these medium-weight components are persistent, bioavailable, and toxic (Michel, 1992).

Previous studies (e.g., Johansen et al., 2001) supported the theory that most, if not all, released oil would reach the surface of the water column. However, data and observations from the *Deepwater Horizon* event challenge that theory. While analyses are in their preliminary stages, it appears that measurable amounts of hydrocarbons (dispersed or otherwise) are being detected in the water column as subsurface "plumes" and on the seafloor in the vicinity of the release. While not all of these hydrocarbons have been definitively traced back to releases from the Macondo well (*Deepwater Horizon* event), these early measurements and results warrant a reassessment of previous theories of the ultimate fate of hydrocarbons from unintended subsurface releases. It is important to note that the North Sea experiment (Johansen et al., 2001) did not include the use of dispersants at or near the source of the subsea oil discharge.

3.1.5. Release of Natural Gas

The quality and quantity of components in natural gas vary widely by the field, reservoir, or location from which the natural gas is produced. Although there is not a "typical" makeup of natural gas, it is primarily composed of methane (NaturalGas.org, 2010).

3.1.6. Offshore Cleanup Activities

As demonstrated by the *Ixtoc* and *Deepwater Horizon* spill responses, a large-scale response effort is certain to follow a catastrophic blowout. The number of vessels and responders would increase exponentially as the spill continued.

3.1.6.1. Shallow Water

Within the first week of an oil spill originating in shallow water, 25 vessels are estimated to respond, which would steadily increase to over 3,000 by the end of the spill. This includes about 25 skimmers in the vicinity of the well at a time. In addition, recovered oil may be barged to shore from recovery vessels.

Within the first week, over 500 responders are estimated to be deployed to a spill originating in shallow water, which would steadily increase up to 25,000 before the well is capped or killed within 2-4 months.

Response to an oil spill in shallow water is expected to involve over 10,000 ft (3,048 m) of boom within the first week and would steadily increase up to 5 million feet (950 mi; 1,520 km) for use offshore and nearshore, the amount dependent upon the location of the potentially impacted shoreline, environmental considerations, and agreed upon protection strategies involving the local potentially impacted communities.

Up to 25 planes and 50 helicopters are estimated to respond per day by the end of a shallow-water spill.

Along the Gulf Coast, dispersants are preapproved for use greater than 3 nautical miles from shore and in water depths greater than 33 ft (10 m), with the exception of Florida where the water depth must be 65 ft (20 m) (USDOT, CG, 2010). However, the U.S. Environmental Protection Agency (USEPA) is presently examining these preapprovals, and restrictions are anticipated regarding the future use of dispersants for ongoing spills as a result. Changes to the dispersant use preapprovals would be expected to limit this use in the future. Under the preapprovals, it is estimated that up to a total of 35,000 barrels of dispersant would be used.[1] Aerial dispersants would likely be applied from airplanes as a mist, which settles on the oil on the water's surface. In addition to dispersants, controlled burns may also occur.

3.1.6.2. Deep Water

Within the first week of oil spill originating in deep water, 50 vessels are estimated to respond, which would steadily increase to over 7,000 by the end of the spill. This includes about 25 skimmers in the vicinity of the well at a time. In addition, recovered oil may be shuttle tankered to shore from recovery vessels.

For an oil spill in deep water, over 1,000 responders are estimated to be deployed within the first week, which would steadily increase up to 50,000 before capping or killing the well within 4-5 months.

Over 20,000 ft (6,096 m) of boom is estimated to be deployed within the first week of a deepwater spill, which would steadily increase up to 11 million feet (2,100 mi; 3,350 km) offshore and nearshore, the amount dependent upon the location of the potentially impacted shoreline, environmental considerations, and agreed upon protection strategies involving the local potentially impacted communities.

Up to 50 planes and 100 helicopters are estimated to respond per day by the end of a deepwater spill.

With the exception of special Federal management areas or designated exclusion areas, dispersants have been preapproved in the vicinity of a deepwater blowout (USDOT, CG, 2010).). However, USEPA is presently examining these preapprovals, and restrictions are anticipated regarding the future use of dispersants as a result. Under preexisting preapprovals, it is estimated that up to 50,000 barrels of dispersant could be applied (2/3 on the water surface and 1/3 subsurface, if possible). Changes to the dispersant use preapprovals would be expected to limit this use. No preapproval presently exists for the use of subsea dispersants, and approval must be obtained before each use of this technology. The use of subsea dispersants depends on the location of the blowout, as discussed in Table 1. Aerial dispersants are

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1 At the *Ixtoc-I* well blowout in 1979, between 1 million and 2.5 million gallons of mostly Corexit dispersant products were applied over a 5-month period on the oil discharge. However, this scenario assumes a spill from a blowout in shallow water would last up to 3 months.

applied from airplanes as a mist, which settles on the oil on the water's surface. In addition to dispersants, it is estimated that 5-10 controlled burns would be conducted per day in suitable weather. About 500 burns in all would remove 5-10 percent of the oil.

3.1.6.3. Vessel Decontamination Stations

To avoid contaminating inland waterways, multiple vessel decontamination stations may be established offshore in Federal and State waters. Vessels responding to the spill and commercial and recreational vessels passing through the spill would anchor, awaiting inspection. If decontamination is required, work boats would use fire hoses to clean oil from the sides of the vessels. This could result in some oiling of otherwise uncontaminated waters. While these anchorage areas would be surveyed for buried pipelines that could be ruptured by ship anchors, they may not be surveyed adequately for benthic communities or archaeological sites. Therefore, some damage to benthic communities or archaeological sites may occur due to vessel decontamination activities associated with an oil spill in deep water (Alabama State Port Authority, 2010; State of Florida, Office of the Governor, 2010; Nodar, 2010; Unified Incident Command, 2010a-c; USDOC, NOAA, 2010a; USEPA, 2010a).

3.1.7. Severe Weather

A hurricane could accelerate biodegradation, increase the area affected by the spill, and/or slow the response effort. The Atlantic hurricane season runs from June 1st through November 30th, peaking in September. In an average Atlantic season, there are 11 named storms, 6 hurricanes, and 2 Category 3 or higher storms (USDOC, NOAA, National Weather Service, 2010a). As a result of a hurricane, high winds and seas would mix and "weather" the oil from an oil spill. This can help accelerate the biodegradation process (USDOC, NOAA, National Weather Service, 2010b). The high winds may distribute oil over a wider area (USDOC, NOAA, National Weather Center, 2010b). In the event of a hurricane, vessels would evacuate the area, delaying response efforts, including the drilling of relief wells and any well capping or collection efforts.

3.2. MOST LIKELY AND MOST SIGNIFICANT IMPACTS

The most recent EIS's prepared by this Agency for oil and gas lease sales in the Gulf of Mexico identify in detail the potential impacts from reasonably foreseeable oil spills (USDOI, MMS, 2007 and 2008). In addition to the impacts described in those documents, the most likely and most significant impacts due to the magnitude of shoreline oil as a result of a catastrophic spill are described below.

3.2.1. Physical Resources

3.2.1.1. Air Quality

In the Gulf of Mexico, evaporation from the oil spill would result in concentrations of VOC's in the atmosphere, including chemicals that are classified as being hazardous. The VOC concentrations would occur anywhere where there is an oil slick, but they would be highest at the source of the spill because the rate of evaporation depends on the volume of oil present at the surface. The VOC concentrations would decrease with distance as the layer of oil gets thinner. The lighter fractions of VOC's would be most abundant in the immediate vicinity of the spill site. The heavier compounds would be emitted over a longer period of time and over a larger area. Some of the compounds emitted could be hazardous to workers in close vicinity of the spill site. The hazard to workers can be reduced by monitoring and using protective gear, including respirators, as well as limiting exposure through limited work shifts, rotating workers out of high exposure areas, and pointing vessels into the wind. During the *Deepwater Horizon* event, air samples collected by individual offshore workers of British Petroleum (BP), the Occupational Safety and Health Administration (OSHA), and U.S. Coast Guard showed levels of benzene, toluene, ethylbenzene, and xylene that were mostly under detection levels. All samples had concentrations below the OSHA Occupational permissible exposure limits and the more stringent ACGIH (American Conference of Governmental Industrial Hygienists) threshold limit values (U.S. Dept. of Labor, OSHA, 2010a).

The VOC emissions that result from the evaporation of oil contribute to the formation of particulate matter ($PM_{2.5}$) in the atmosphere. In addition, VOC's could cause an increase in ozone levels, especially if the release were to occur on a hot, sunny day with sufficient concentrations of NO_x present in the lower atmosphere. However, due to the distance from shore, the oil slick would not normally have any effects on onshore ozone concentrations.

It is assumed that response efforts would include hundreds of in-situ or controlled burns, which would remove an estimated 5-10 percent of the volume of oil spilled. This could be as much as 720,000 barrels of oil for a spill of 60,000 barrels per day for 120 days. In-situ burning would result in ambient concentrations of CO, NO_x, SO_2, PM_{10}, and $PM_{2.5}$ very near the site of the burn and would generate a plume of black smoke. The levels of $PM_{2.5}$ could be a hazard to personnel working in the area, but this could be effectively mitigated through monitoring and relocating vessels to avoid areas of highest concentrations. In an experiment of an in-situ burn off Newfoundland, it was found that CO, SO_2, and NO_2 were measured only at background levels and were frequently below detection levels (Fingas et al., 1995). Limited amounts of formaldehyde and acetaldehyde were measured, but concentrations were close to background levels. Measured values of dioxins and dibenzofurans were at background levels. Measurements of PAH in the crude oil, the residues, and the air indicated that the PAH in the crude oil are largely destroyed during combustion (Fingas et al., 1995).

While containment operations may be successful in capturing some of the escaping oil and gas, recovery vessels may not be capable of storing the crude oil or may not have sufficient storage capacity. In this case, excess oil would be burned; captured gas cannot be stored or piped to shore so it would be flared. For example, in the *Deepwater Horizon* event, gas was flared at the rate of 100-200 million cubic feet per day and oil burned at the rate of 10,000-15,000 barrels per day. The estimated NO_x emissions are about 13 tons per day. The SO_2 emissions would be dependent on the sulfur content of the crude oil. For crude oil with a sulfur content of 0.5 percent, the estimated SO_2 emissions are about 16 tons per day. Particulate matter in the plume would also affect visibility. Flaring or burning activities upwind of a PSD Class I area, e.g., the Breton National Wilderness Area, could be adversely affected due to SO_2 concentrations and reduced visibility.

3.2.1.2. Offshore Water Quality

The water offshore of the Gulf's coasts can be divided into two regions: the continental shelf and slope (<1,000 ft; 305 m) and deep water (>1,000 ft; 305 m). Waters on the continental shelf and slope are heavily influenced by the Mississippi and Atchafalaya Rivers, the primary sources of freshwater, sediment, nutrients, 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. The presence or extent of a nepheloid layer, a body of suspended sediment at the sea bottom (Kennett, 1982; p. 524), affects water quality on the shelf and slope. Deep waters east of the Mississippi River are affected by the Loop Current and associated warm-core (anti-cyclonic) eddies, which flush the area with clear, low-nutrient water (Muller-Karger et al., 2001). However, cold-core cyclonic eddies (counter-clockwise rotating) also form at the edge of the Loop Current and are associated with upwelling and nutrient-rich, high-productivity waters, although the extent of this flushing can vary seasonally.

While response efforts would decrease the fraction of oil remaining in Gulf waters, significant amounts of oil would remain (Inter-agency, 2010c). Natural processes will physically, chemically, and biologically aid the degradation of oil (NRC, 2003). The physical processes involved include evaporation, emulsification, and dissolution, while the primary chemical and biological degradation processes include photooxidation and biodegradation (i.e., microbial oxidation). Water quality would not only be impacted by the oil, gas, and their respective components but also to some degree from cleanup and mitigation efforts, such as from increased vessel traffic and the addition of dispersants and methanol to the marine environment.

In the case of a catastrophic subsea blowout in deep water, it is assumed that large quantities of subsea dispersants would be used. As a result, clouds or plumes of dispersed oil may occur near the blowout site. Reports thus far from the *Deepwater Horizon* event have found such plumes and have shown that the concentrations of these clouds decrease to undetectable levels within a few miles of the source (USDOC, NOAA, 2010b). Additional reporting in the coming months will enhance the understanding of the effects of subsurface plumes. Dissolved oxygen levels are a concern with any release of a carbon source, and these levels became a particular concern during the *Deepwater Horizon* event, since dispersants were used in deep waters for the first time. Thus, USEPA required monitoring protocols in order to use subsea dispersants (USDOC, NOAA, 2010c). In areas where plumes of dispersed oil were previously found, dissolved oxygen levels decreased by about 20 percent from long-term average values in the Gulf of Mexico; however, scientists reported that these levels have stabilized and are not low enough to be considered hypoxic (USDOC, NOAA, 2010d). The temporary decrease in oxygen content has been attributed to microbial degradation of the oil. Over time, as the oil continues to be degraded and diffuses, hypoxia becomes less of a concern. As reported for the *Deepwater Horizon* event, dissolved oxygen levels would likely remain above levels of immediate concern, but there would still be a need to monitor dissolved oxygen levels over time.

Toxicity of dispersed oil in the environment would depend on many factors, including the effectiveness of the dispersion, temperature, salinity, degree of weathering, type of dispersant, and degree of light penetration in the water column (NRC, 2005). The toxicity of dispersed oil is primarily due to the toxic components of the oil itself (Australian Maritime Safety Authority, 2010).

3.2.2. Biological Resources

The most recent EIS prepared by this Agency for oil and gas lease sales in the Gulf of Mexico detail potential localized impacts to specific species from reasonably foreseeable oil spills. However, a catastrophic event, such as a high-volume, extended-duration spill resulting from a blowout, has the potential to cause population-level impacts. Multiple Federal and State-listed, threatened and endangered species could be impacted from an extended offshore spill (USDOI, FWS, 2010a and 2010b).

3.2.2.1. Marine and Migratory Birds

During Phase 2 of a catastrophic spill, the primary concern for marine and migratory birds would be their vulnerability to oiling or ingesting oil, which is related to their behavior. Wading birds (e.g., herons, egrets, etc.) and species that feed by plunge-diving into the water to catch small fish (e.g., pelicans, gannets, terns, gulls, and pelagic birds) and those that use water as a primary means of locomotion, foraging, or resting and preening (e.g., diving ducks, cormorants, pelicans, etc.) are highly vulnerable to becoming oiled and also to ingesting oil, as are black skimmers. These birds tend to feed and concentrate in convergence zones, places in the ocean where strong opposing currents meet. In addition to concentrating prey, these zones also aggregate oil (Unified Incident Command, 2010d). Oiling interferes with the birds' ability to fly (thus to obtain food) and compromises the insulative characteristics of down and contour feathers making it difficult to maintain body heat. Attempts by the birds to remove the oil by preening causes oiled birds to ingest oil and may result in mortality.

3.2.2.2. Fish, Fisheries, and Essential Fish Habitat

Early life stages of animals are usually more sensitive to oil than adults (Boesch and Rabalais, 1987; NRC, 2005). Weathered crude oil has been shown in laboratory experiments to cause malformation, genetic damage, and even mortality at low levels in fish embryos of Pacific herring (Carls et al., 1999). There is a high probability of mortality for the eggs and larvae of Gulf fishes that come in contact with spilled oil.

Adult fish may be less at risk than earlier life stages in part because they are less likely to concentrate at the surface and may avoid contact with floating oil. There were, however, sightings of whale sharks (which are defined as "threatened" by the International Union for Conservation of Nature) swimming among slicks from the *Deepwater Horizon* spill. They were not visibly oiled, but there was concern that they could be affected because they are surface feeders (Howell, 2010). Effects of oil on organisms can include direct lethal toxicity, sublethal disruption of physiological processes (internal lesions), effects of direct coating by oil (suffocation by coating gills), incorporation of hydrocarbons in organisms causing tainting or accumulation in the food chain, and changes in biological habitat (decreased dissolved oxygen) (Moore and Dwyer, 1974).

Because natural crude oil found in the Gulf of Mexico would generally float on the surface, fish species whose eggs and larvae are found at or near the water surface are most at risk from an offshore spill. Species whose spawning periods coincide with the timing of the highest oil concentrations would be at greatest risk. If there is a subsea catastrophic blowout, it is assumed dispersants would be used. Then there could be effects on multiple life history stages and trophic levels. There is limited knowledge of the toxicity of dispersants mixed with oil to specific species or life stages of ichthyoplankton, and the likely extent of mortality due to the combination of factors is difficult to determine. The combined toxic effects of the oil and any dispersants that may be used may not be apparent unless a significant portion of a year-class is absent from next year's fishery (e.g., shrimps, crabs, snapper, and tuna).

Recent studies by USEPA using representative species provide some indication of the relative toxicity of Louisiana sweet crude oil, dispersants, and oil/dispersant mixes. Bioassays were conducted using two Gulf species—a mysid shrimp (*Amercamysis bahia*) and a small estuarine fish, the inland silverside (*Menidia beryllinina*)—to evaluate the acute toxic effects of oil, eight dispersants, and oil/dispersant mixtures. In addition, USEPA used standard *in vitro* techniques using the same dispersants to (1) evaluate acute toxicity on three cell lines over a range of concentrations and (2) evaluate effects of these dispersants on androgen and estrogen function using human cell lines (to see if they are likely to disrupt hormonal systems). All dispersants showed cytotoxicity in at least one cell type at concentrations between 10 and 110 parts per million (ppm). Results of the *in vitro* toxicity tests were similar to the whole animal tests, showing generally low dispersant toxicity. Lethal concentration (LC50) values (the concentration at which half of the test subjects die) were lower than the cell-based assays. For all eight dispersants, for both species, the dispersants alone were less toxic than the dispersant/oil mixture. Louisiana sweet crude oil alone was determined to be more toxic to both the silverside fish and the mysid shrimp than the dispersants alone. The results of the testing for disruption of androgen and estrogen function indicate that the dispersants do not show biologically significant endocrine activity via androgen or estrogen pathways (USEPA, Office of Research and Development, 2010a and 2010b).

The North Atlantic bluefin tuna is an example of a fish/fishery in the Gulf of Mexico that could be at risk to lose a year-class. It has a relatively narrow peak spawning period in April and May and floating eggs. A catastrophic blowout during the spring season could cause a negative effect to this population. The Gulf of Mexico is one of only two documented spawning grounds for the Atlantic bluefin tuna; the other is in the Mediterranean Sea. Spawning is clustered in a specific type of habitat along the continental slope. Bluefin tuna are among the most valuable fish in global markets. The International Commission for the Conservation of Atlantic Tunas (ScienceDaily, 2010) currently manages the Atlantic bluefin tuna as two distinct populations, with western Atlantic spawners of the Gulf of Mexico forming a population genetically distinct from the eastern spawners of the Mediterranean Sea. The western Atlantic stock has suffered, and a significant and a long-term rebuilding plan has failed to revive the population or the fishery. The failure of the Gulf of Mexico spawning population to rebuild and the scope of illegal and under-reported catches are of such concern that the species was considered for Appendix 1 listing (most endangered status) by the Convention of International Trade in Endangered Species (CITES) in March 2010. However, NOAA recently (May 27, 2011) declared that Atlantic bluefin tuna do not warrant species protection under the ESA.

A catastrophic deepwater spill could release natural gases with methane as the primary component (NaturalGas.org, 2010) into the water column, but little is known about the effects of elevated methane levels on fish. Patin (1999) studied the elevated concentrations of methane resulting from a gas blowout from drilling platforms in the Sea of Asov on fish. The pathological changes reported were species specific and included damages to cell membranes, organs, and tissues; modifications of protein synthesis; and other anomalies typical for acute poisoning of fish. These impacts, however, were observed at levels of 4-6 milligrams/liter of methane near the accident well. The full effect of elevated methane levels on Gulf of Mexico fishes is currently unknown.

3.2.2.3. Marine Mammals

An oil spill and related spill-response activities can impact marine mammals that come into contact with oil and remediation efforts. The marine mammals' exposure to hydrocarbons persisting in the sea may result in sublethal impacts (e.g., decreased health, reproductive fitness, longevity, and increased vulnerability to disease), some soft tissue irritation, 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. More detail on the potential range of effects to marine mammals from contact with spilled oil can be found in Geraci and St. Aubin (1990). The best available information does not provide a complete understanding of the effects of the spilled oil and active response/cleanup activities on marine mammals. For example, it is expected that the large amount of chemical dispersants being used on the oil may act as an irritant on the marine mammals' tissues and sensitive membranes.

The increased human presence after an oil spill (e.g., vessels) would likely add to changes in behavior and/or distribution, thereby potentially stressing marine mammals further and perhaps making them more vulnerable to various physiologic and toxic effects. In addition, the large number of response vessels could place marine mammals at a greater risk of vessel collisions, which could cause fatal injuries.

The potential biological removal (PBR) level is defined by the Marine Mammal Protection Act (MMPA) as the maximum number of animals, not including natural mortalities that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. However, in the Gulf of Mexico, many marine mammal species have either entirely unknown PBR's or population size estimates that are more than 8 years old and therefore considered unknown. The biological significance of any injury or mortality would depend, in part, on the size and reproductive rates of the affected stocks, as well as the number, age, and size of the marine mammals affected.

According to the Consolidated Fish and Wildlife Collection Reports from the *Deepwater Horizon* event, 170 marine mammals have been collected (13 alive, 157 deceased as of April 20, 2011). Due to known low detection rates of carcasses, it is possible that the number of deaths of marine mammals is underestimated (Williams et al., 2011). The mortality estimates from the *Deepwater Horizon* event are just an example of the potential losses due to a high-volume oil spill. It is also important to note that evaluations have not yet confirmed the cause of death, and it is possible that not all carcasses were related to the *Deepwater Horizon* event. Thus, a high-volume oil spill lasting 120 days could directly impact as many individuals or more. The majority would likely be coastal or estuarine bottlenose dolphins, as was the case with the *Deepwater Horizon* event. This number represents only those marine mammals collected (either dead or alive) and does not address all potential impacts to the population. Based on these data, it is reasonable to assume that a catastrophic oil spill lasting up to 120 days could have population-level effects on many species of marine mammals (e.g., sperm whales, Bryde's whales, etc.).

3.2.2.4. Sea Turtles

Sea turtles are more likely to be affected by a catastrophic spill in shallow water than in deep water because not all sea turtles occupy a deepwater habitat. For example, Kemp's ridley sea turtles are unlikely to be in water depths of 160 ft (49 m) or greater. Hawksbill sea turtles are commonly associated with coral reefs, ledges, caves, rocky outcrops, and high energy shoals. Green sea turtles are commonly found in coastal benthic feeding grounds, although they may also be found in the convergence zones of the open ocean. Convergence zones are areas that also may collect oil. Leatherback sea turtles are commonly pelagic and are the sea turtle species most likely to be affected by a deepwater oil spill. As the spilled oil moves toward land, additional species of sea turtles are more likely to be affected.

Based on the Consolidated Fish and Wildlife Collection Reports from the *Deepwater Horizon* event, a few to over two dozen sea turtles could be impacted daily through oiling and/or collection. According to the Consolidated Fish and Wildlife Collection Report, after the *Deepwater Horizon* event, 1,149 sea turtles have been collected (536 alive, 613 deceased as of April 20, 2011). These mortality estimates from the *Deepwater Horizon* event are just an example of the potential losses due to a high-volume oil spill. It is also important to note that evaluations have not yet confirmed the cause of death, and it is possible that not all carcasses were related to the *Deepwater Horizon* event. A high-volume oil spill lasting 120 days could impact greater than 1,000 sea turtles, and the majority could be Kemp's ridley turtles, which are listed as endangered under the ESA (USDOC, NOAA, NMFS, 2010a; Unified Incident Command, 2010e). In addition, the large number of response vessels could place sea turtles at a greater risk of vessel collisions, which could cause fatal injuries.

3.2.2.5. Offshore Habitats

Sargassum mats, which are mats made from a free-floating seaweed, provide habitat for juvenile sea turtles and developing invertebrates, spawning sites for hundreds of fish species, and feeding sources for manatees. "In offshore waters, both free-floating patches of *Sargassum* seaweed and spilled oil tend to accumulate in convergence zones, places in the ocean where strong opposing currents meet. Sea turtles, especially juveniles, use these areas for food and cover. Burn operations sometime occur there because of the aggregated oil" (Unified Incident Command, 2010d). Benthic resources are discussed below.

Open-water organisms, such as phytoplankton and zooplankton, are essential to the marine food web. They play an important role in regulating climate, contribute to marine snow, and are an important source of nutrients for mesopelagic and benthic habitats. An offshore oil spill would not only have an impact on these populations but also on the species that depend on them. The microbial community can also be affected by an offshore oil spill. The microbial loop is an essential part of the marine ecosystem. Changes in the microbial community due to an oil spill could have significant impacts on the rest of the marine ecosystem.

However, several laboratory and field experiments and observations have shown that impacts to planktonic and marine microbial populations are generally short lived and do not affect all groups evenly, and in some cases stimulate growth of important species (Gonzalez et al., 2009; Graham et al., 2010; Hing et al., 2011). A study by Widger et al. (2011) does not support an argument of lasting effects due to the *Deepwater Horizon* spill on coastal microbial communities and pathogens. The study had only one pre-spill and one during-spill-time point each, with no post-spill component to monitor trends. Further, the pathogens noted are commonly found in coastal waters after significant rain events and occur as a result of untreated freshwater reaching the coast (Stumpf et al., 2010; Wetz et al., 2008; Hsieh et al., 2007). The study does not address the potential that the increase in microbial pathogens are a result of storm-water runoff, and it does not address if there was a significant rain event upstream, which could have carried these terrestrial derived pathogens to the coastal zone.

3.2.2.6. Continental Shelf Benthic Resources

A spill from a shallow-water blowout could impact benthic communities on the continental shelf due to the blowout's proximity to these habitats. A spill from a deepwater blowout could also impact shelf communities if oil that was chemically dispersed at the seafloor is transported to these areas.

Soft-Bottom Benthic Communities

Soft-bottom infaunal communities that come into direct contact with oil or dispersed oil may experience sublethal and/or lethal effects. Localized areas of lethal effects would be recolonized by populations from neighboring soft-bottom substrate once the oil in the sediment has been sufficiently reduced to a level able to support marine life (Sanders et al., 1980). This initial recolonization process may be fairly rapid, but full recovery may take up to 10 years depending on the species present, substrate in the area, toxicity of oil spilled, concentration and dispersion of oil spilled, and other localized environmental factors that may affect recruitment (Kingston et al., 1995; Gesteira and Dauvin, 2000; Sanders et al., 1980; Conan, 1982). Opportunistic species would take advantage of the barren sediment, repopulating impacted areas first. These species may occur within the first recruitment cycle of the surrounding populations or from species immigration from surrounding stocks and may maintain a stronghold in the area until community succession begins (Rhodes and Germano, 1982; Sanders et al., 1980).

Long-term or low-level exposure may occur to benthic infauna as a result of oil adhering to sediment. Mesocosm experiments using long-term, low-level concentrations of No. 2 fuel oil indicate acute toxicity to meiofauna due to direct oil contact and sublethal effects from sedimented oil and byproducts of the decomposition of the sedimented oil (Frithsen et al., 1985). Long-term exposure to low levels of fuel oil was shown to affect recruitment success; meiofaunal population recovery took between 2 and 7 months (Frithsen et al., 1985). Oil entrained within sediments at the seafloor could create a layer toxic to infaunal species. This layer will persist through burial unless it is sufficiently degraded over time. Continued deposition of pelagic material could bury the layer, but it will remain intact over some timeframe as a potentially toxic or lethal horizon.

Continued localized disturbance of soft-bottom communities may occur during oil-spill response efforts. Anchors used to set booms to contain oil or vessel anchors in decontamination zones may affect infaunal communities in the response activity zone. Infaunal communities may be altered in the anchor scar, and deposition of suspended sediment may result from the setting and resetting of anchors. The disturbed benthic community should begin to repopulate from the surrounding communities during their next recruitment event and through immigration of organisms from surrounding stocks. Any decontamination activities, such as cleaning vessel hulls of oil, may also contaminate the sediments of the decontamination zone, as some oil may settle to the seabed, impacting the underlying benthic community.

If a blowout occurs at the seafloor, drilling muds (primarily barite) may be pumped into a well in order to "kill" it. If a kill is not successful, the mud (possibly tens of thousands of barrels) may be forced out of the well and deposited on the seafloor near the well site. Any organisms beneath heavy layers of the extruded drilling mud would be buried. Base fluids of drilling muds are designed to be low in toxicity and biodegradable in offshore marine sediments (Neff et al., 2000). However, as bacteria and fungi break down the drilling fluids, the sediments may be come anoxic (Neff et al., 2000). Benthic macrofaunal recovery would occur when drilling mud concentrations are reduced to levels that enable the sediment to become re-oxygenated (Neff et al., 2000). Complete community recovery from drilling mud exposure may take 3-5 years, although microbial degradation of drilling fluids, followed by an influx of tolerant opportunistic species, is anticipated to begin almost immediately (Neff et al., 2000). In addition, the extruded mud may bury hydrocarbons from the well, making them a hazard to the infaunal species and difficult to remove.

Hard-Bottom Benthic Communities

Sensitive reef communities flourish wherever hard bottoms occur in the Gulf of Mexico. Several categories of hard bottom communities are protected by BOEMRE. The eastern Gulf of Mexico contains scattered, low-relief live bottoms including areas of flat limestone shelf rock. Potentially sensitive biological features are 8 ft (2 m) or more above the seafloor. The Pinnacle Trend area includes low- and high-relief features and is 60-120 m (200-400 ft) below the sea surface, and topographic features are high relief and generally 15 m (49 ft) or more below the sea surface. Their depth below the sea surface protects all of these habitats from a surface oil spill.

Although hard-bottom benthic communities are initially buffered from surface oil slicks by their depth below the sea surface, surface oil may be brought to depth through physical processes. Rough seas may mix the oil into subsurface water layers, where it may impact sessile biota. The total time during which seas are rough would help affect the amount of oil from a surface slick that would be mixed into the water column. Measurable amounts of oil have been documented down to a 10-m (33-ft) depth, although modeling exercises have indicated such oil may reach a depth of 20 m (66 ft). At this depth, however, the oil is found at concentrations several orders of magnitude lower than the amount shown to have an effect on corals (Lange, 1985; McAuliffe et al., 1975 and 1981; Knap et al., 1985).

The presence of a subsurface oil plume may affect hard-bottom communities. A majority of the oil released is expected to rise rapidly to the sea surface. However, upward movement of the oil may be reduced if methane in the oil is dissolved under high pressures, and oil droplets may become entrained deep in the water column (Adcroft et al., 2010). Subsurface plumes generated by high-pressure dissolution of oil may come in contact with hard-bottom features. A sustained spill would continuously create surface slicks and possibly subsurface spill plumes. Some of the oil in the water column will become diluted or evaporated over time, reducing any localized transport to the seafloor (Vandermeulen, 1982). In addition, microbial degradation of the oil occurs in the water column so that the oil would be less toxic when it contacts the seafloor (Hazen et al., 2010). However, a sustained spill may result in elevated exposure concentrations to hard-bottom features if the plume reaches them. The longer the spill takes to stop, the longer the exposure time and concentration may be.

Low-level exposures of corals to oil from a subsea plume may result in chronic or temporary impacts. For example, feeding activity or reproductive ability may be reduced when coral is exposed to low levels of oil; however, impacts may be temporary or unable to be measured over time. Experiments indicated that normal feeding activity of *Porites porites* and *Madracis asperula* were reduced when exposed to 50 ppm oil (Lewis, 1971). Reefs of *Siderastrea sidereal* that were oiled in a spill produced smaller gonads than unoiled reefs, resulting in reproductive stress (Guzmán and Holst, 1993).

Elevated concentrations of oil may be necessary to measure reduced photosynthesis or growth in corals. Photosynthesis of the zooxanthellae in *Diplora strigosa* exposed to approximately 18-20 ppm crude oil for 8 hours was not measurably affected, although other experiments indicate that photosynthesis may be impaired at higher concentrations (Cook and Knap, 1983). Measurable growth of *Diploria strigosa* exposed to oil concentrations up to 50 ppm for 6-24 hours did not show any reduced growth after 1 year (Dodge et al., 1984).

Corals exposed to subsea oil plumes may incorporate petroleum hydrocarbons into their tissue. Records indicate that *Siderastrea siderea*, *Diploria strigosa*, and *Montastrea annularis* accumulate oil from the water column and incorporate petroleum hydrocarbons into their tissues (Burns and Knap, 1989; Knap et al., 1982; Kennedy et al., 1992). Most of the petroleum hydrocarbons are incorporated into the coral tissues, not their mucus (Knap et al., 1982). However, hydrocarbon uptake may also modify lipid ratios of coral (Burns and Knap, 1989). If lipid ratios are modified, mucus synthesis may be impacted, adversely affecting the coral's ability to protect itself from oil through mucus production (Burns and Knap, 1989).

If dispersants are used on the seafloor or at the surface, oil may mix into the water column, and if they are applied subsea, they, can travel with currents through the water, and may contact settle on hard bottoms. If near the source, the dispersed oil could be concentrated enough to harm the community. If the oil remains suspended for a longer period of time, it would be more dispersed and present at lower concentrations. Reports on dispersant usage on surface plumes indicate that a majority of the dispersed oil remains in the top 10 m (33 ft) of the water column, with 60 percent of the oil in the top 2 m (6 ft) (McAuliffe et al., 1981). Dispersant usage also reduces the oil's ability to stick to particles in the water column, minimizing sedimented oil traveling to the seafloor (McAuliffe et al., 1981). There is very little information on the behavior of subsea dispersants.

Dispersed oil reaching the benthic hard-bottom communities in the Gulf of Mexico would be expected to be at very low concentrations (less than 1 ppm) (McAuliffe et al., 1981). Such concentrations would not be life threatening to larval or adult stages at depth based on experiments conducted with coral. Any dispersed oil in the water column that comes in contact with corals may evoke short-term negative responses by the organisms (Wyers et al., 1986; Cook and Knap, 1983; Dodge et al., 1984).

Reductions in feeding and photosynthesis are some impacts that may occur to coral exposed to dispersed oil. Short-term, sublethal responses of *Diploria strigosa* were reported after exposure to dispersed oil at a concentration of 20 ppm for 24 hours. Although concentrations in this experiment were higher than what is anticipated for dispersed oil at depth, effects exhibited included mesenterial filament extrusion, extreme tissue contraction, tentacle retraction, and localized tissue rupture (Wyers et al., 1986). Normal behavior resumed within 2 hours to 4 days after exposure (Wyers et al., 1986). *Diploria strigosa* exposed to dispersed oil (20:1, oil:dispersant) showed an 85 percent reduction in zooxanthellae photosynthesis after 8 hours of exposure to the mixture (Cook and Knap, 1983). However, the response was short term, as recovery occurred between 5 and 24 hours after exposure and return to clean seawater. Investigations 1 year after *Diploria strigosa* was exposed to concentrations of dispersed oil between 1 and 50 ppm for periods between 6 and 24 hours did not reveal any impacts to growth (Dodge et al., 1984).

Historical studies indicate dispersed oil to be more toxic to coral species than oil or dispersant alone. The greater toxicity may be a result of an increased number of oil droplets caused by the use of dispersant, resulting in greater contact area between oil, dispersant, and water (Elgershuizen and Kruijf, 1976). The dispersant causes a higher water-soluble amount of oil to contact the cell membranes of the coral (Elgershuizen and Kruijf, 1976). The mucus produced by coral, however, can protect the organism from oil. Both hard and soft corals have the ability to produce mucus, and mucus production has been shown to increase when corals are exposed to crude oil (Mitchell and Chet, 1975; Ducklow and Mitchell, 1979). Dispersed oil, however, which has very small oil droplets, does not appear to adhere to coral mucus, and larger untreated oil droplets may become trapped by the mucus barrier (Knap, 1987; Wyers et al., 1986). However, entrapment of the larger oil droplets may increase the coral's long-term exposure to oil if the mucus is not shed in a timely manner (Knap, 1987; Bak and Elgershuizen, 1976). Additionally, more recent field studies, using more realistic concentrations of dispersants did not result in the toxicity historically reported.

Although historical studies indicated dispersed oil may be more toxic than untreated oil to corals during exposure experiments, untreated oil may remain in the ecosystem for long periods of time, while dispersed oil does not (Baca et al., 2005; Ward et al., 2003). Twenty years after an experimental oil spill in Panama, oil and impacts from untreated oil were still observed at oil treatment sites, but no oil or impacts were observed at dispersed oil or reference sites (Baca et al., 2005). Long-term recovery of the coral at the dispersed oil site had already occurred as reported in a 10-year monitoring update, and the site was not significantly different from the reference site (Ward et al., 2003).

The BOEMRE's policy prevents wells from being placed immediately adjacent to sensitive communities. In the event of a seafloor blowout, however, some oil could be carried to hard bottoms as a result of oil droplets, sedimenting to suspended particles in the water column. Oiled sediment that settles to the seafloor may affect organisms attached to hard-bottom substrates. Impacts may include reduced recruitment success, reduced growth, and reduced coral cover as a result of impaired recruitment. Experiments have shown that the presence of oil on available substrate for larval coral settlement has inhibited larval metamorphosis and larval settlement in the area. There was also an increased number of deformed polyps after metamorphosis due to oil exposure (Kushmaro et al., 1997).

The majority of organisms exposed to sedimented oil, however, are anticipated to experience low-level concentrations because as the oiled sediments settle to the seafloor they are widely dispersed. Coral may also be able to protect itself from low concentrations of sedimented oil that settles from the water column. Coral mucus may not only act as a barrier to protect coral from the oil in the water column but it has also been shown to aid in the removal of oiled sediment on coral surfaces (Bak and Elgershuizen, 1976). Coral may use a combination of increased mucus production and ciliary action to rid themselves of oiled sediment (Bak and Elgershuizen, 1976).

Oil-spill response activity may also impact sessile benthic features. Booms anchored to the seafloor are sometimes used to control the movement of oil at the water surface. Boom anchors can physically impact corals and other sessile benthic organisms, especially when booms are moved around by waves (Tokotch, 2010). Vessel anchorage and decontamination stations set up during response efforts may also break or kill hard-bottom features as a result of setting anchors. Injury to coral reefs as a result of anchor impact may result in long-lasting damage or failed recovery (Rogers and Garrison, 2001). Effort should be made to keep vessel anchorage areas as far from sensitive benthic features as possible to minimize impact.

Drilling muds comprised primarily of barite may be pumped into a well to stop a blowout. If a “kill” is not successful, the mud (possibly tens of thousands of barrels) may be forced out of the well and deposited on the seafloor near the well site. Any organisms beneath the extruded drilling mud would be buried. Based on stipulations as described in NTL 2009-G39, a well should be far enough away from a hard-bottom community to prevent extruded drilling muds from smothering benthic communities. However, if drilling muds were to travel far enough or high enough in the water column to contact a hard-bottom community, the fluid would smother the existing community. Experiments indicate that corals perish faster when buried beneath drilling mud than when buried beneath carbonate sediments (Thompson, 1980). As discussed earlier, as the drilling fluids biodegrade, an anoxic zone surrounding the activity may occur. Recolonization would occur from the surrounding community once the area has enough oxygen to support new growth, which may take 3-5 years (Neff et al., 2000).

3.2.2.7. Deepwater Benthic Communities

It is not likely that deepwater benthic communities would be impacted by a spill from a shallow-water blowout. However, a spill resulting from a catastrophic blowout in deep water has the potential to impact offshore benthic communities due to the blowout’s proximity to these habitats and the use of subsea dispersants.

Much of the oil is expected to be treated with dispersants at the sea surface and possibly subsea at the source in the event of a deepwater blowout. The dispersed oil is mixed with the water, and its movement is then dictated by local currents and the physical, chemical, and biological degradation pathways. The oil would become more dispersed, less concentrated, and more biodegraded the longer it remains suspended in the water column. Depending on how long it remained suspended in the water column, it may be thoroughly degraded by biological action before contact with the seafloor and its sensitive resources occurs (Hazen et al., 2010; Valentine et al., 2010). Biodegradation rates in colder, deepwater environments are not well understood at this time. Oil may reach the seafloor in the following ways: as microbes begin to consume the oil particles; when the dispersed oil particles may flocculate (flocculation is suspended particles collecting into larger suspended flakes), thus increasing the density of the particles such that they are no longer in isostatic balance with the surrounding water and, thus, sink to the seafloor; when larger plankton consume the bacteria-rich oil particles and their fecal pellets are excreted and distributed over the seafloor; when water currents carry a plume to contact the seafloor directly; or most likely, where the dispersed oil to adhere to other particles and sink to the seafloor. This last scenario would result in a wide distribution of small amounts of oil. This oil could be in the process of biodegradation from bacterial action that would continue on the seafloor, resulting in scattered microhabitats with an enriched carbon environment. Biodegradation processes, both on the bottom and in the water column, would be expected to cause at least some reduction of normal ambient dissolved oxygen levels; however, this has yet to be observed at a level that would be detrimental to animal respiration (Hazen et al., 2010).

Deepwater Soft-Bottom Benthic Communities

Soft bottoms are the overwhelming majority of the deep-sea environment. Large amounts of oil would only affect these deep environments if dispersants are used. As described above, the toxic effects of dispersed oil would continue to decrease as the concentration of oil is reduced via dispersion, localized mixing, and biodegradation. As with shelf habitats, the only soft bottom that is expected to suffer significant effects would be soft bottoms in the immediate vicinity of a seafloor blowout in which some oil is mixed into the sediment. In situations where soft-bottom infaunal communities are negatively impacted, recolonization by populations from neighboring soft-bottom substrate would be expected over a relatively short period of time for all size ranges of organisms—a matter of days for bacteria and probably less than 1 year for most macrofauna and megafauna species. This could take longer for areas affected by direct oil contact in higher concentrations.

Deepwater Coral Benthic Communities

There have been no experiments showing the response of deepwater corals to oil exposure. Experiments with shallow tropical corals indicate that corals have a high tolerance to oil exposure. The mucus layers on coral resist penetration of oil and slough off the contaminant. Longer exposure times and areas of tissue where oil adheres to the coral are more likely to result in tissue damage and death of polyps. Corals with branching growth forms appear to be more susceptible to damage from oil exposure (Shigenaka, 2001). The most common deepwater coral, *Lophelia pertusa*, is a branching species. Tests with shallow tropical gorgonians indicate relatively low toxic effects to the coral (Cohen et al., 1977), suggesting deepwater gorgonians may have a similar response. Response of deepwater coral to oil exposure from a catastrophic spill would vary, depending on the level of exposure. Exposure to widely dispersed oil adhering to organic detritus and partially degraded by bacteria may be expected to result in little effect. Direct contact with plumes of relatively fresh dispersed oil droplets in the vicinity of the incident could cause death of affected coral polyps through exposure and potential feeding on oil droplets by polyps. Median levels of exposure to dispersed oil in a partly degraded condition may result in effects similar to those of shallow tropical corals, with often no discernable effects other than temporary contraction and some sloughing. The health of corals may be degraded by the necessary expenditure of energy as the corals respond to oiling (Shigenaka, 2001). Communities exposed to more concentrated oil may experience detrimental effects, including death of affected organisms, tissue damage, lack of growth, interruption of reproductive cycles, and loss of gametes. Many invertebrates associated with deepwater coral communities, particularly the crustaceans, would likely be more susceptible to damage from oil exposure. The recolonization of severely damaged or destroyed communities could take years or decades. However, because of the scarcity of deepwater hard bottoms and the comparatively low surface area, it is unlikely that a sensitive habitat would be located near a seafloor blowout, or if near, that concentrated oil would contact the site.

Deepwater Chemosynthetic Benthic Communities

Chemosynthetic communities are adapted to gas seeps that sometimes release oil also. These communities may be exposed to low quantities of well-dispersed oil undergoing biodegradation. Exposure may be similar to normal conditions for these communities and may be within the normal variation of habitat conditions. However, oil contact could cause some fluctuation in organism health, resulting in slower growth or delayed spawning. Since these organisms grow slowly, sublethal effects could eliminate a year or more of normal growth. Communities exposed to more concentrated oil may experience detrimental effects, including death of affected organisms, tissue damage, lack of growth, interruption of reproductive cycles, and loss of gametes. Other invertebrates associated with chemosynthetic communities, particularly the crustaceans, would likely be more susceptible to damage from oil exposure. Recolonization of severely damaged or destroyed communities could take years or decades.

3.2.3. Socioeconomic Resources

3.2.3.1. Offshore Archaeological Resources

Due the response methods (i.e., subsea dispersants) and magnitude of the response (i.e., thousands of vessels), a catastrophic blowout and spill have a greater potential to impact offshore archaeological resources than other accidental events.

Deep Water

In contrast to smaller spills or spills in shallow water, the use of large quantities of subsea dispersants could be used for a catastrophic subsea blowout in deep water. This could result in currently unknown effects from dispersed oil droplets settling to the seafloor. Though information on the actual impacts to submerged cultural resources is inconclusive at this time, oil settling to the seafloor could come in contact with archaeological resources. At present, there is no evidence of this having occurred. A recent experimental study has suggested that, while the degradation of wood in terrestrial environments is initially retarded by contamination with crude oil, at later stages, the biodeterioration of wood was accelerated (Ejechi, 2003). While there are different environmental constraints that affect the degradation of wood in terrestrial and waterlogged environments, soft-rot fungal activity, one of the primary wood degrading organisms in submerged environments, was shown to be increased in the presence of crude oil. There is a possibility that oil from a catastrophic blowout could come in contact with wooden shipwrecks and artifacts on the seafloor and accelerate their deterioration.

Ancillary damages from vessels associated with oil-spill response activities (e.g., anchoring) in deep water are unlikely due to the use of dynamically positioned vessels responding to a deepwater blowout. If response and support vessels were to anchor near a deepwater blowout site, the potential to damage undiscovered vessels in the area would be high due to the required number and the size of anchors and the length of mooring chains needed to safely secure vessels. Additionally, multiple offshore vessel decontamination stations would likely be established in shallow water outside of ports or entrances to inland waterways, as seen for the *Deepwater Horizon* event. The anchoring of vessels could result in damage to both known and undiscovered archaeological sites; the potential to impact archaeological resources increases as the density of anchoring activities in these areas increases.

Shallow Water

The potential for damaging archaeological resources increases as the oil spill and related response activities progress landward. In shallower waters, most of the damage would be associated with oil cleanup and response activities. Thousands of vessels would respond to a shallow-water blowout and would likely anchor, potentially damaging both known and undiscovered archaeological sites. Additional anchoring would be associated with offshore vessel decontamination stations, as described above. As the spill moves into the intertidal zone, the chance of direct contact between the oil and archaeological resources increases. As discussed above, this could result in increased degradation of wooden shipwrecks and artifacts.

Additionally, in shallower waters, shipwrecks often act as a substrate to corals and other organisms, becoming an essential component of the marine ecosystem. These organisms often form a protective layer over the shipwreck, virtually encasing the artifacts and hull remains. If these fragile ecosystems were destroyed as a result of the oil spill and the protective layer removed, the shipwreck would then be exposed to increased degradation until it reaches a new level of stasis with its surroundings.

Regardless of water depth, because oil is a hydrocarbon, heavy oiling could contaminate organic materials associated with archaeological sites, resulting in erroneous dates from standard radiometric dating techniques (e.g., ^{14}C-dating). Interference with the accuracy of ^{14}C-dating would result in the loss of valuable data necessary to understand and interpret the sites.

3.2.3.2. Commercial Fishing

In 2008, the Gulf of Mexico provided over 33 percent of the commercial fishery landings in the continental U.S. (excluding Alaska), with nearly 1.3 billion pounds valued at nearly $660 million (USDOC, NMFS, 2010).

Even though sensory and chemical testing may show no detectable oil or dispersant odors or flavors and the results could be well below the levels of concern, NOAA Fisheries would be expected to close large portions of the Gulf of Mexico during a high-volume spill as a precautionary measure to ensure public safety and to assure consumer confidence in Gulf seafood (USDOC, NOAA, NOAA Fisheries Service, 2010a). Up to 30-40 percent of the Gulf of Mexico Exclusive Economic Zone (EEZ) could be closed to commercial fishing as the spill continues and expands (USDOC, NOAA, NOAA Fisheries Service, 2010b). This area could represent 50-75 percent of the Gulf seafood production (Flynn, 2010). The size of the closure area may peak about 50 days into the spill and persist another 2-3 months until the well is killed or capped and the remaining oil is recovered or dissipates. During this period, portions or all of individual State waters would also be closed to commercial fishing.

The economic impacts of closures on commercial fishing are difficult to predict because they are dependent on the season and would vary by fishery. If fishers cannot make up losses throughout the remainder of the season, a substantial part of their annual income would be lost. In some cases, commercial fishers will move to areas still open to fishing, but at a greater cost due to longer transit times. Marketing issues are also possible; even if the catch is uncontaminated, the public may lack confidence in the product.

3.2.3.3. Recreational Fishing

Up to 30-40 percent of the Gulf of Mexico EEZ could be closed to recreational fishing as the spill continues and expands (USDOC, NOAA, NOAA Fisheries, 2010b). The size of the closure area could peak about 50 days into the spill and continue for another 2-3 months until the well is killed or capped and the remaining oil is recovered or dissipates. During this period, portions or all of individual State waters would also be closed to recreational fishing.

In 2008, over 24 million recreational fishing trips were taken; these trips generated about $12 billion in sales, over $6 billion in value-added impacts, and over 100,000 jobs (USDOC, NOAA, NMFS, 2010b). About 33 percent of the total Gulf catch came on trips that fished primarily in Federal and State waters (Pritchard, 2009). Recreational fishing is focused in the summer months. During this time, scheduled tournaments would be hard to reschedule. If the spill affected that time of year, normal direct income and indirect income to the communities that host these tournaments would be lost for that year. If a catastrophic spill occurs in the summer, a substantial number of recreational fishing trips would not occur and the economic benefits they generate would be lost for that year.

3.2.3.4. Tourism and Recreational Resources

While the spill is still offshore, there could be some ocean-dependent recreation that is affected (e.g., fishing, diving), as discussed above. In addition, there may be some effects due either to perceived damage to onshore recreational resources that has not yet materialized or to general hesitation on the part of travelers to visit the overall region due to the spill. For example, studies during the *Deepwater Horizon* oil spill show that perceptions can influence recreational activity, even if an oil spill has not yet damaged physical resources in an area (The Knowland Group, 2010; Market Dynamics Research Group, 2010). However, the majority of the impacts of a catastrophic spill would occur once the spill has contacted shore, as discussed in Section 4.2.3.4.

3.2.3.5. Employment and Demographics

In contrast to a less severe accidental event, suspension of some oil and gas activities would be likely following a catastrophic event. Depending on the duration and magnitude, this could impact hundreds of oil-service companies that supply the steel tubing, engineering services, drilling crews, and marine supply boats critical to offshore exploration. An interagency economic report estimated that the 6-month suspension, as a result of the *Deepwater Horizon* event, may have directly and indirectly resulted in up to

8,000-12,000 fewer jobs along the Gulf Coast (Inter-agency, 2010b). Most of these jobs were not permanently lost as a result of the suspension and returned following the resumption of deepwater drilling in the Gulf of Mexico. These estimates are lower than earlier estimates of 15,000-60,000 rig and associated service jobs being at risk (Hargreaves, 2010; Louisiana Mid-Continent Oil and Gas Association, 2010; Zeller, 2010; Jindal, 2010).

Whatever the number, much of the employment loss would be concentrated in coastal oil-service parishes in Louisiana (St. Mary, Terrebonne, Lafourche, Iberia, and Plaquemines) and counties/parishes where drilling-related employment is most concentrated (Harris County, Texas, in which Houston is located, and Lafayette Parish, Louisiana) (Nolan and Good, 2010; U.S. Dept. of Labor, BLS, 2010). There would be additional economic impacts to commercial and recreational fishing, as discussed in Sections 3.2.3.2 and 3.2.3.3. This impact is also expected to be more heavily concentrated in smaller businesses than in the larger companies (Inter-agency, 2010b).

Demographic impacts are unlikely from temporary job losses.

3.2.3.6. Land Use and Coastal Infrastructure

Impacts to tourism and recreational resources are addressed in Section 3.2.3.4. Possible fisheries closures are addressed in Sections 3.2.3.2 and 3.2.3.3. While still offshore, a catastrophic oil spill would not impact other land use or coastal infrastructure.

3.2.3.7. Environmental Justice

The environmental justice policy, based on Executive Order 12898 of February 11, 1994, directs agencies to incorporate into NEPA documents an analysis of potentially disproportionate and detrimental environmental and health effects of their proposed actions on minorities and low-income populations and communities. While the spill is still offshore, the primary environmental justice concern would be large commercial fishing closures disproportionately impacting minority fishers. In the event of a catastrophic spill, Federal and State agencies would be expected to close substantial portions of the Gulf to commercial and recreational fishing (USDOC, NOAA, 2010g). While oystering occurs “onshore,” oyster beds are also likely to be closed to harvests during Phase 2 of a catastrophic spill due to concerns about oil contamination and increased freshwater diversions to mitigate oil intrusion into the marshes (see Sections 3.2.3.2 and 3.2.3.3). These closures would directly impact commercial fishermen and oystermen, and indirectly impact such downstream activities as shrimp processing facilities and oyster shucking houses. The mostly African-American communities of Phoenix, Davant, and Point a la Hache in Plaquemines Parish are home to families with some of the few black-owned oyster leases, which because of freshwater diversion projects for coastal restoration have already been threatened (Mock, 2010).

The Gulf Coast hosts multiple minority and low-income groups whose use of natural resources of the offshore and coastal environments make them vulnerable to fishing closures. While not intended as an inventory of the area’s diversity, we have identified several Gulf Coast populations of particular concern. An estimated 20,000 Vietnamese fishermen and shrimpers live along the Gulf Coast; by 1990, over 1 in 20 Louisiana fishers and shrimpers had roots in Southeast Asia even though they comprised less than half a percent of the State’s workforce (Bankston and Zhou, 1996). Vietnamese account for about one-third of all the fishermen in the central Gulf of Mexico (Ravitz, 2010). Islaños, African Americans, and Native American groups are also engaged in commercial fishing and oystering. Historically, Vietnamese and African Americans have worked in the fish processing and oyster shucking industries. Shucking houses particularly, have provided an avenue into the mainstream economy for minority groups.

Therefore, fishing closures during Phase 2 of a catastrophic spill impacting the central Gulf of Mexico would disproportionately affect such minority groups as the Vietnamese, Native Americans, African Americans, and Islaños (Hemmerling and Colten, 2003).

4. ONSHORE CONTACT (PHASE 3)

4.1. IMPACT-PRODUCING FACTORS AND SCENARIO

4.1.1. Duration

The duration of the shoreline oiling is measured from initial shoreline contact until the well is capped or killed and the remaining oil dissipates offshore. The time needed to cap or kill a well may vary, depending on the well's water depth. Depending on the spill's location in relation to winds and currents and the well's distance to shore, oil could reach the coast within 1 week to 1 month, based on evidence from previous spills in the Gulf of Mexico OCS. While it is assumed that the majority of spilled oil would dissipate offshore within 30 days of stopping the flow, some oil may remain in coastal areas until cleaned, as seen in Louisiana following the *Deepwater Horizon* event (The State of Louisiana, 2010b-d).

4.1.1.1. Shallow Water

Due to the distance from shore, oil spilled as a result of a blowout in shallow water could reach shore within 1-3 weeks and could continue until the well is killed or capped (1-3 months) and the oil dissipates offshore (1 month). Therefore, it is estimated that shoreline oiling would likely occur for 1-4 months following a catastrophic blowout.

4.1.1.2. Deep Water

As discussed in Section 3.1.1, intervention is more difficult and would take longer in deeper water. In general, most of the deep water in the Gulf of Mexico is located far from shore and, therefore, it is assumed that oil would reach shore within 2-4 weeks. While most deep water is located far from shore, some areas of deep water are located relatively nearshore so that oil could reach shore earlier.

The length of shoreline oiled would continue to increase until the well is killed or capped (3-4 months) and the oil dissipates offshore (1 month). Therefore, shoreline oiling could occur for 3 to more than 4 months following a catastrophic blowout.

4.1.2. Volume of Oil

In the event of a catastrophic spill, not all of the oil spilled would contact shore. The amount of oil recovered and chemically or naturally dispersed would vary. For example, the following are recovery and cleanup rates from previous high-volume, extended spills:

- 10-40 percent of oil recovered or cleaned up (including burned, chemically dispersed, and skimmed);
- 25-40 percent of oil naturally dispersed, evaporated, or dissolved; and
- 20-65 percent of the oil remains available for biodegradation offshore or inshore contact.

In the case of the *Deepwater Horizon* event, the "Expected" scenario, developed by the Oil Budget Calculator Science and Engineering Team of the Federal Interagency Solutions Group, suggests that more than one quarter (29%) was naturally or chemically dispersed into Gulf waters, while burning, skimming, and direct recovery from the wellhead removed one quarter (25%) of the oil released. Less than one quarter (23%) of the total oil naturally evaporated or dissolved. The residual amount, just under one quarter (23%), remained in the Gulf of Mexico as a light sheen, as tarballs that have washed ashore or are buried in sand and other sediments (Inter-agency, 2010c).

For planning purposes, USCG estimates that 5-30 percent of oil will reach shore in the event of an offshore spill (33 CFR 154, Appendix C, Table 2). Using the USCG assumptions, a catastrophic spill could still result in a large amount of oil reaching shore.

4.1.3. Length of Shoreline Contacted

While larger spill volumes increase the chance of oil reaching the coast, other factors that influence the length and location of shoreline contacted include the duration of the spill and the well's location in relation to winds, currents, and the shoreline. As seen with the *Deepwater Horizon* spill, as the spill continued, the length of oiled shoreline at any one time increased exponentially as follows:

Duration of Spill	Length of Shoreline Oiled[1]
30 days	0-50 miles
60 days	50-100 miles
90 days	100-1,000 miles
120 days	>1,000 miles[2]

[1] Not cumulative.
[2] Length was extrapolated.
Source: Operational Science Advisory Team, 2011.

Dependent upon winds and currents throughout the spill event, already impacted areas could be re-oiled.

4.1.3.1. Shallow Water

While a catastrophic spill from a shallow-water blowout is expected to be lower in volume than a deepwater blowout, as explained in Section 3.1, the site would be closer to shore, allowing less time for oil to be weathered, dispersed, and recovered. This could result in a more concentrated and toxic oiling of the shoreline.

4.1.3.2. Deep Water

While a catastrophic spill from a deepwater blowout is expected to have a much greater volume than a shallow-water blowout (see Section 3.1), the site would be farther from shore, allowing more time for oil to be weathered, dispersed, and recovered. This could result in a broader, patchier oiling of the shoreline.

Translocation of the spilled oil via winds and currents is also a factor in the length of shoreline contacted. For example, oil could enter the Loop Current and then the Gulf Stream. However, the longer it takes oil to travel, the more it would degrade, disperse, lose toxicity, and break into streamers and tarballs (USDOC, NOAA, Office of Response and Restoration, 2010d).

4.1.4. Severe Weather

The Atlantic hurricane season runs from June 1st through November 30th, peaking in September. In an average Atlantic season, there are 11 named storms, 6 hurricanes, and 2 Category 3 or higher storms (USDOC, NOAA, National Weather Service, 2010a). In the event of a hurricane, vessels would evacuate the area, delaying response efforts, including the drilling of relief wells. The storm surge may push oil to the coastline and inland as far as the surge reaches, or the storm surge may remove the majority of oil from shore, as seen in some of the previous spills reviewed.

Movement of oil during a hurricane would depend greatly on the track of the hurricane in relation to the slick. A hurricane's winds rotate counter-clockwise. In general, a hurricane passing to the west of the slick could drive oil to the coast, while a hurricane passing to the east of the slick could drive the oil away from the coast.

4.1.5. Onshore Cleanup Activities

As described in Section 3.1, a large-scale response effort would be expected for a catastrophic blowout. The number of vessels and responders would increase exponentially as the spill continued. In addition to the response described in Section 3.1.6, the following response is also estimated to occur once the spill contacts the shore.

An exponential increase in the length of shoreline impacted would likely overwhelm response efforts.

4.1.5.1. Shallow Water

- There would be 5-10 staging areas established.
- Weathering permitting, about 200-300 skimmers could be deployed near shore to protect coastlines.

4.1.5.2. Deep Water

- There would be 10-20 staging areas established.
- Weather permitting, about 500-600 skimmers could be deployed near shore to protect coastlines. As seen in Louisiana following the *Deepwater Horizon* event, a few hundred coastal skimmers could still be in operation a few months after the well is capped or killed (The State of Louisiana, 2010e).

4.2. MOST LIKELY AND MOST SIGNIFICANT IMPACTS

The most recent EIS's prepared by this Agency for oil and gas lease sales in the Gulf of Mexico identify in detail the potential impacts from reasonably foreseeable oil spills (USDOI MMS, 2007 and 2008). The most likely and significant onshore impacts caused by a catastrophic spill are described below.

4.2.1. Physical Resources

4.2.1.1. Air Quality

As the spill nears shore, there would be low-level concentrations of odor-causing pollutants associated with evaporative emissions from the oil spill. These may cause temporary eye, nose, or throat irritation, nausea, or headaches, but the doses are not thought to be high enough to cause long-term harm (USEPA, 2010b). However, responders could be exposed to levels higher than OSHA permissible exposure levels (U.S. Department of Labor, OSHA, 2010b). During the *Deepwater Horizon* oil spill, USEPA took air samples at various onshore locations along the length of the Gulf coastline. All except three measurements of benzene were below 3 parts per billion (ppb). The highest level was 91 ppb. During the *Deepwater Horizon* event, air samples collected by BP, OSHA, and USCG near shore showed levels of benzene, toluene, ethylbenzene, and xylene that were mostly under detection levels. Among the 15,000 samples taken by BP, there was only one sample where benzene exceeded the OSHA Occupational permissible exposure limits. All other sample concentrations were below the more stringent ACGIH threshold limit values (U.S. Department of Labor, OSHA, 2010a). All measured concentrations of toluene, ethylbenzene, and xylene were well within the OSHA permissible exposure levels and ACGIH threshold limit values.

4.2.1.2. Coastal Water Quality

Water quality governs the suitability of waters for plant, animal, and human use. Water quality is important in the bays, estuaries, and nearshore coastal waters of the Gulf because these waters provide feeding, breeding, and/or nursery habitat for many commercially significant invertebrates and fishes, as well as sea turtles, birds, and marine mammals. A catastrophic spill would significantly impact coastal water quality in the Gulf of Mexico. In the Gulf of Mexico, water quality prior to the *Deepwater Horizon* event was rated as fair while sediment quality was rated as poor (USEPA, 2008). In addition, the coastal habit index, a rating of wetlands habitat loss, was also rated as poor. Both the sediment quality and the coastal habitat index affect water quality.

Though response efforts would decrease the amount of oil remaining in Gulf waters and reduce the amount of oil contacting the coastline, significant amounts of oil would remain. Coastal water quality would be impacted not only by the oil, gas, and their respective components but also to some degree from cleanup and mitigation efforts. Increased vessel traffic, hydromodification, and the addition of dispersants and methanol in an effort to contain, mitigate, or clean up the oil may also tax the environment.

The use of dispersants as a response tool involves a tradeoff. The purpose of chemical dispersants is to facilitate the movement of oil into the water column in order to encourage weathering and biological breakdown of the oil (i.e., biodegradation) (NRC, 2005; Australian Maritime Safety Authority, 2010). Thus, the tradeoff is generally considered to be between the shoreline and surface of the water versus the water column and benthic resources (NRC, 2005). If the oil moves into the water column and is not on the surface of the water, it is less likely to reach sensitive shore areas (USEPA, 2010c). Since sea birds are often on the surface of the water or in shore areas, dispersants are also considered to be very effective in reducing the exposure of sea birds to oil (Australian Maritime Safety Authority, 2010). In addition to dispersion being enhanced by artificial processes, oil may also be dispersed from natural processes. For instance, microbial metabolism of crude oil results in the dispersion of oil (Bartha and Atlas, 1983). Dispersion has both positive and negative effects. The positive effect is that the oil, once dispersed, is more available to be degraded. The negative effect is that the oil, once dispersed, is more available to microorganisms, which temporarily increases the toxicity (Bartha and Atlas, 1983). Toxicity of dispersed oil in the environment will depend on many factors, including the effectiveness of the dispersion, temperature, salinity, the degree of weathering, type of dispersant, and degree of light penetration in the water column (NRC, 2005). The toxicity of dispersed oil is primarily due to the toxic components of the oil itself (Australian Maritime Safety Authority, 2010).

Oxygen and nutrient concentrations in coastal waters vary seasonally. The zone of hypoxia (depleted oxygen) on the Louisiana-Texas shelf occurs seasonally and is affected by the timing of freshwater discharges from the Mississippi and Atchafalaya Rivers, which carry nutrients to the surface waters. The hypoxic conditions continue until local wind-driven circulation mixes the water again. The 2010 hypoxic zone could not be linked to the *Deepwater Horizon* event in either a positive or a negative manner (LUMCON, 2010). Nutrients from the Mississippi River fueled enhanced phytoplankton and attributed to the formation of the hypoxic zone.

4.2.2. Biological Resources

Recent EIS's prepared by this Agency for oil and gas lease sales in the Gulf of Mexico detail the potential localized impacts to individuals from reasonably foreseeable oil spills. However, a catastrophic event, such as a high-volume, extended-duration spill resulting from a blowout, has the potential to cause population level impacts, as described below.

Dozens of Federal and State-listed threatened and endangered species, including marine mammals, sea turtles, fish, and birds, could continue to be impacted during Phase 3 of a catastrophic oil spill as oil and response activities persist. Additional species could be impacted in extreme conditions (i.e., oil is pushed onto beaches or into rivers or marshes due to a hurricane) (USDOI, FWS, 2010a and 2010b).

4.2.2.1. Coastal and Marine Birds

Gulf coastal habitats are essential to the annual cycles of many species of breeding, wintering, and migrating waterfowl, wading birds, shorebirds, and songbirds. For example, the northern Gulf Coast supports a disproportionately high number of beach-nesting bird species (USDOI, FWS, 2010c). Once oil contacts shore, a few dozen to over a hundred birds could be impacted daily by oiling and/or collection. By extrapolating the number of birds impacted as a result of the *Deepwater Horizon* event, a spill lasting 120 days could result in direct mortality of over 7,000 birds (USDOI, FWS, 2010d). This number does not reflect total realized mortality but rather only the actual number of birds recovered as of October 2010. This number represents a small fraction of total bird mortality due to carcasses sinking, being scavenged, drifting outside the search zone, or simply going undetected due to wind, current, weather, and habitat factors (Ford et al., 1987; Piatt et al., 1990; Fowler and Flint, 1997; Flint et al., 1999; Wiese and Robertson, 2004; Byrd et al., 2009). In an early review of oil-related mortality for seabirds, Dunnett et al. (1982) provided an estimate of 10 percent, and 60 percent of the dead birds may be recovered under typical field conditions. Piatt and Ford (1996,Table 1) summarized recovery rates from 17 carcass-drift experiments, indicating a range of 0-59 percent of carcasses being recovered. Using data from the *Exxon Valdez* oil spill, Piatt and Ford (1996) estimated recovery rates from joint probability and Monte Carlos simulations of only 8.0 percent and 6.9 percent, respectively.

The timing and location of the spill are the two primary factors for determining the severity of impacts on birds. The worst impacts to oiled birds or to those birds that have ingested oil with their prey would be if the oil spill occurs during the nesting season. An oil spill during nesting season could result in the loss of entire colonies of breeding birds on barrier islands surrounded by oil, along with the potential loss of all eggs and nestlings. Losses of shorebirds could occur through direct oiling of beaches on which nests are located, by oil covering the feeding sites near the nesting locations, or by the deaths of oiled parents, leaving eggs or hatchlings unprotected and unfed.

Endangered and Threatened Birds

Two species listed as endangered or threatened by the U.S. Fish and Wildlife Service that could be impacted by a catastrophic oil spill are the whooping crane (*Grus americana)* and the endangered wood stork (*Mycteria americana)*. Both are wading birds; the whooping crane is found in Texas, Louisiana, and Florida, and the wood stork is found in Alabama, Florida, Georgia, and South Carolina. Both species use marsh habitats and eat small fish, frogs, mollusks, snails, insects, crustaceans, and aquatic invertebrates. Thus, they could both become oiled directly if oil reaches the marshes. They could also ingest oil along with their primary prey items, and their prey could be substantially reduced due to oil, resulting in a decline in health and reproduction in both species of wading birds.

4.2.2.2. Fish, Fisheries, and Essential Fish Habitat

The life history of estuarine–dependent species involves spawning on the continental shelf, transportation of eggs, larvae or juveniles back to the estuary nursery grounds and migration of the adults back to the sea for spawning (Deegan, 1989; Beck et al., 2001). Estuaries in the Gulf of Mexico are extremely important nursery areas and are considered essential fish habitat for fish and aquatic life (Beck et al., 2001). Oiling of these areas, depending on the severity, can destroy nutrient-rich marshes and erode coastlines that have been significantly damaged by recent hurricanes.

The Gulf of Mexico supports a wide variety of finfish, and most of the commercial finfish resources are linked either directly or indirectly to the estuaries that ring the Gulf of Mexico. Darnell et al. (1983) observed that the density distribution of fish resources in the Gulf was highest nearshore off of the central Gulf Coast. For all seasons, the greatest abundance occurred between Galveston Bay and the mouth of the Mississippi River. Monthly ichthyoplankton collections over the years 2004-2006 offshore of Alabama have confirmed that peak seasons for ichthyoplankton concentrations on the shelf are spring and summer (Hernandez et al., 2010). Therefore, if a catastrophic blowout occurs in the spring and summer seasons, it could cause greater harm to fish populations, not just individual fish.

Oyster beds could be damaged by freshwater diversions that release tens of thousands of cubic feet of freshwater per second for months in an effort to keep oil out of the marshes. Adult oysters survive well physiologically in salinities from those of estuarine waters (about 7.5 parts per thousand sustained) to full strength seawater (Davis, 1958). While oysters may tolerate small changes in salinity for a few weeks, a rapid decrease in salinity over months would kill oysters. In the event of a catastrophic oil spill, the year's oyster production would be lost because of exposure to freshwater and/or oil. Depending on the severity, oyster beds could take 2-5 years to recover (Burdeau, 2010).

4.2.2.3. Marine Mammals

Section 3.2.2 discusses the most likely and most significant impacts to the offshore marine mammal community. A high-volume oil spill lasting 120 days could directly impact over 20 species of marine mammals. As the spill enters coastal waters, manatees and coastal and estuarine dolphins would be the most likely to be impacted.

Manatees primarily inhabit open coastal (shallow nearshore) areas and estuaries, and they are also found far up in freshwater tributaries. During warmer months, manatees are common along the Gulf Coast of Florida from the Everglades National Park northward to the Suwannee River in northwestern

Florida, and they are less common farther westward. In winter, the Gulf of Mexico subpopulations move southward to warmer waters. The winter range is restricted to waters at the southern tip of Florida and to waters near localized warm-water sources, such as power plant outfalls and natural springs in west-central Florida. Manatees are infrequently found as far west as Texas (Powell and Rathbun, 1984; Rathbun et al., 1990; Schiro et al., 1998). If a catastrophic oil spill reached the Florida coast when manatees were in or near coastal waters, the spill could have population-level effects.

It is possible that manatees could occur in coastal areas where vessels traveling to and from the spill site could affect them. A manatee present where there is vessel traffic could be injured or killed by a vessel strike (Wright et al., 1995). Due to the large number of vessels responding to a catastrophic spill both in coastal waters and traveling through coastal waters to the offshore site, manatees would have an increased risk of collisions with boats. Vessel strikes are the primary cause of death of manatees.

There have been no experimental studies and only a few observations suggesting that oil impacts have harmed any manatees (St. Aubin and Lounsbury, 1990). Types of impacts to manatees and dugongs from contact with oil include (1) asphyxiation due to inhalation of hydrocarbons, (2) acute poisoning due to contact with fresh oil, (3) lowering of tolerance to other stress due to the incorporation of sublethal amounts of petroleum components into body tissues, (4) nutritional stress through damage to food sources, and (5) inflammation or infection and difficulty eating due to oil sticking to the sensory hairs around their mouths (Preen, 1989, in Sadiq and McCain, 1993; Australian Maritime Safety Authority, 2003). For a population whose environment is already under great pressure, even a localized incident could be significant (St. Aubin and Lounsbury, 1990). Spilled oil might affect the quality or availability of aquatic vegetation, including seagrasses, upon which manatees feed. The 2009 Stock Assessment Report (USDOI, FWS, 2009) for the Florida stock of West Indian manatees estimates that there is a minimum population estimate of 3,802 individuals based on a single synoptic survey of warm-water refuges in January 2009. The manatee's potential biological removal is the maximum number of animals, not including natural mortalities, that may be removed from the population or stock while allowing that stock to reach or maintain its optimum sustainable population and is approximately 12 individuals. Therefore, if a catastrophic spill and response vessel traffic occurred near manatee habitats in the eastern Gulf of Mexico, population level impacts could occur because the possibility exists for the number of mortalities to exceed the potential biological removal.

Bottlenose dolphins were the most affected species of marine mammals from the *Deepwater Horizon* event. There were 171 marine mammals collected as of April 20, 2010 (the majority of which were deceased). This includes 155 bottlenose dolphins, 2 *Kogia* spp., 2 melon-headed whales, 6 spinner dolphins, 2 sperm whales, and 4 unknown species (USDOC, NOAA, NOAA Fisheries, 2011). It is also important to note that evaluations have not yet confirmed the cause of death, and it is possible that not all carcasses were related to the *Deepwater Horizon* event. Bottlenose dolphins can be found throughout coastal waters in the Gulf of Mexico. Like manatees, dolphins could be affected, possibly to population level, by a catastrophic oil spill if it reaches the coast (as well as affecting them in the open ocean), through direct contact, inhalation, ingestion, and stress, as well as through collisions with cleanup vessels.

4.2.2.4. Sea Turtles

Out of the five species of sea turtle that occur in the Gulf of Mexico, only three nest in this area. The largest nesting location for the Kemp's ridley sea turtle is in Rancho Nuevo, Mexico, but they also nest in Texas. Loggerhead sea turtles nest in all states around the Gulf of Mexico. There are also records of nesting colonies of hawksbill sea turtles in the Yucatan Peninsula of Mexico (Plotkin et al., 1995; OBIS-SEAMAP, 2009). Kemp's ridley, loggerhead, and hawksbill sea turtles are therefore most likely to be affected by a catastrophic oil spill when there is onshore contact.

Female sea turtles seasonally emerge during the warmer summer months to nest on beaches. Thousands of sea turtles nest along the Gulf Coast, and turtles could build nests on oiled beaches. Nests could also be disturbed or destroyed by cleanup efforts. Untended booms could wash ashore and become a barrier to sea turtle adults and hatchlings (USDOC, NOAA, 2010e). Hatchlings, with a naturally high mortality rate, could traverse the beach through oiled sand and swim through oiled water to reach preferred habitats of *Sargassum* floats. Response efforts could include mass movement of eggs from hundreds of nests or thousands of hatchlings from Gulf Coast beaches to the east coast of Florida or to the open ocean to prevent hatchlings entering oiled waters (Jernelöv and Lindén, 1981; USDOI, FWS, 2010e). Due to poorly understood mechanisms that guide female sea turtles back to the beaches where they hatched, it is uncertain if relocated hatchlings would eventually return to the Gulf Coast to nest (Florida Fish and Wildlife Conservation Commission, 2010). Therefore, shoreline oiling and response efforts may affect future population levels and reproduction (USDOI, NPS, 2010). Sea turtle hatchling exposure to, fouling by, or consumption of tarballs persisting in the sea following the dispersal of an oil slick would likely be fatal.

4.2.2.5. Terrestrial Mammals and Reptiles

Beach Mice

Seven subspecies of the field mouse, collectively known as beach mice, live along the Gulf Coast. Five subspecies of beach mice (Alabama, Perdido Key, Choctawhatchee, St. Andrew, and Anastasia Island) are listed as State and federally endangered; the southeastern beach mouse is listed as federally threatened; and the Santa Rosa beach mouse is a Federal species of concern. Beach mice are restricted to the coastal barrier sand dunes along the Gulf Coast of Alabama and Florida. Erosion caused by the loss of vegetation due to oiling would likely cause more damage than the direct oiling of beach mice, due to degradation or loss of habitat. In addition, vehicular traffic and activity associated with cleanup can trample or bury beach mice nests and burrows or cause displacement from preferred habitat. Improperly trained personnel and vehicle and foot traffic during shoreline cleanup of a catastrophic spill would disturb beach mouse populations and would degrade or destroy habitat.

The Alabama, Choctawhatchee, St. Andrew, and Perdido Key beach mice are already designated as protected species under the Endangered Species Act because of the loss of coastal habitat (USDOI, MMS, 2007). The species' coastal habitat is designated as their critical habitat. For example, the endangered Alabama beach mouse's (*Peromyscus polionotus ammobates*) habitat is 1,211 acres (490 hectares) of frontal dunes covering just 10 mi (16 km) of shoreline designated as critical habitat (USDOI, FWS, 2007). Critical habitat is the specific geographic areas that are essential for the conservation of a threatened or endangered species. With the potential oiling of over 1,000 mi (1,609 km) of shoreline, the entire critical habitat for a subspecies of beach mice could be completely oiled. Thus, destruction of the remaining habitat due to a catastrophic spill and cleanup activities would increase the threat of extinction of several subspecies of beach mice.

Diamondback Terrapin

The Texas diamondback terrapin (*Malaclemys terrapin littoralis*) and the Mississippi diamondback terrapin (*Malaclemys terrapin pileata*) are two subspecies of terrapin that occur in the Gulf of Mexico, and they are Federal species of concern. The former's range runs from Louisiana through Texas, while the latter's includes Louisiana, Mississippi, Alabama, and Florida (USDOI, FWS, 2010f). Terrapins inhabit brackish waters including coastal marshes, tidal flats, creeks, and lagoons behind barrier beaches (Hogan, 2003). Their diet consists of fish, snails, worms, clams, crabs, and marsh plants (Cagle, 1952). Spending most of their lives at the aquatic-terrestrial boundary in estuaries, terrapins are susceptible to habitat destruction from oil-spill cleanup efforts as well as direct contact with oil. However, most impacts cannot be quantified at this time. Even after the oil is no longer visible, terrapins may still be exposed while they forage in the salt marshes lining the edges of estuaries, where oil may have accumulated under the sediments and within the food chain. Terrapin nests can also be disturbed or destroyed by cleanup efforts. The range of the possible chronic effects from oil and dispersants contact including lethal or sublethal oil-related injuries may include skin irritation from the oil or dispersants, respiratory problems from the inhalation of volatile petroleum compounds or dispersants, gastrointestinal problems caused by the ingestion of oil or dispersants, and damage to other organs due to the ingestion or inhalation of these chemicals.

4.2.2.6. Coastal Habitats

A spill from a catastrophic blowout lasting up to 120 days could impact over 1,000 mi (1,609 km) of shoreline. Shoreline oiling would vary between heavy, moderate, light, and occasional tarballs. Due to the length of shoreline that could potentially be oiled and the sensitivity of the Gulf Coast, a high-volume, extended-duration spill could cause extensive habitat degradation. Loss of vegetation could lead to erosion and permanent landloss.

In some previous spills reviewed, a strong storm removed the majority of oil from shore. However, storm surges may carry oil into the coastline and inland as far as the surge reaches. In addition, four significant hurricanes (Katrina, Rita, Gustav, and Ike) have made landfall along the Texas/Louisiana coast in the last 6 years, greatly degrading the coastal beaches, marshes, and barrier islands, making them more susceptible to a catastrophic spill.

Coastal Barrier Beaches and Associated Dunes

Barrier islands make up more than two-thirds of the northern Gulf of Mexico shore. Each of the barrier islands is either high profile or low profile, depending on the elevations and morphology of the island (Morton et al., 2004). The distinguishing characteristics of the high- and low-profile barriers relate to the width of the islands along with the continuity of the frontal dunes. Low-profile barriers are narrow with discontinuous frontal dunes easily overtopped by storm surge, which makes the island susceptible to over wash and secondarily to erosion. This over wash can create channels to bring sand onto the island or into lagoons formed on these islands. High-profile barrier islands are generally wider than the low-profile islands and have continuous, vegetated, frontal dunes with elevations high enough to prevent over wash from major storm surge and, therefore, are less susceptible to erosion. The sand stored in these high-profile dunes allows the island to withstand prolonged erosion and therefore prevents breaching, which could result in damaging the island core.

As a result of a catastrophic spill, many of the barrier islands and beaches would receive varying degrees of oiling. Oil disposal on sand and vegetated sand dunes would have little deleterious effects on the existing vegetation or on the recolonization of the oiled sands by plants (Webb, 1988). The depth of oiling would be variable, based on the wave environment and sediment source at a particular beach head. Layering of oil and sand could occur if it was not cleaned before another tidal cycle. However, most areas of oiling are expected to be light, and sand removal during cleanup activities should be minimized. In areas designated as natural wilderness areas (e.g., Breton National Wildlife National Refuge and Gulf Islands National Seashore), land managers may require little to no disruption of the natural system. In these environments it is preferred to let the oil degrade naturally without aggressive and intrusive cleanup procedures. Manual rather than mechanized removal techniques will be used in these areas and only if heavy oiling has occurred. Thus, these areas may not be treated as thoroughly as other shorelines.

Once oil has reached the beaches and barrier islands and becomes buried or sequestered, it becomes difficult to treat. During wave events when the islands and beaches erode, the oil can become remobilized and transported. Thus, the fate of oil is not as simple as either reaching land, becoming sequestered, or being treated; but must be considered in terms of a continuing process of sequestration, remobilization, and transport.

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, however, would reduce the impact severity at a landfall site because they would accelerate the processes of oil-slick dispersal, spill spreading, and oil weathering.

Due to the distance of beaches from deepwater blowout and the combination of weathering and dispersant treatment of the oil offshore, the toxicity of the oil reaching shore should be greatly reduced, thereby minimizing the chances of irreversible damage to the impacted areas. A blowout in shallower waters near shore may have equal or greater impacts due to a shorter period of weathering and dispersion prior to shoreline contact, even though a smaller volume of spilled oil is expected.

Vessel traffic in close proximity to barrier islands has been shown to move considerably more bottom sediment than tidal currents, thus increasing coastal and barrier island erosion rates. If staging areas are in close proximity to these islands, recovery time of the barrier islands could be greatly extended due to the magnitude of vessels responding to a catastrophic spill.

Wetlands

Coastal wetland habitats in the Gulf of Mexico occur as bands around waterways; broad expanses of saline, brackish, and freshwater marshes; mud and sand flats; and forested wetlands of cypress-tupelo swamps and bottomland hardwoods. A spill from a catastrophic blowout could oil a few to several hundreds of acres of wetlands depending on the depth of inland penetration (Burdeau and Collins, 2010). This would vary from moderate to heavy oiling.

The NOAA Environmental Sensitivity Index (ESI) ranks shorelines according to their sensitivity to oil, the natural persistence of oil, and the expected ease of cleanup after an oil spill. These factors cause oil to persist in coastal and estuarine areas (USDOI, MMS, 2010). According to the ESI, the most sensitive shoreline types (i.e., sheltered tidal flats, vegetated low banks, salt/brackish-water marshes, freshwater marshes/swamps, and scrub-shrub wetlands) tend to accumulate oil and are difficult to clean, thus causing oil to persist in these coastal and estuarine areas (USDOI, MMS, 2010).

Precautions such as oil booms, skimmer ships, and barge barriers would be deployed to protect the beaches and the wetlands behind them or on the beach fringe from oil. However, if not maintained, these booms can cause significant harm to fragile wetlands. In most cases, the beach face would take the most oil; however, in areas where the marsh is immediately adjacent to the beach face or embayments, or in the case of small to severe storms, marshes would be oiled. For example, in Alabama, Mississippi, and Florida, severe weather could push oil into the tidal pools and back beach areas that support tidal marsh vegetation.

Previous studies of other large spills have shown that, when oil has a short residence time in the marsh and it is not incorporated into the sediments, the marsh vegetation has a good chance of survival, even though aboveground die-off of marsh vegetation may occur (Mendelssohn et al., 2002). However, if reoiling occurs after the new shoots from an initial oiling are produced, such that the new shoots are killed, then the marsh plants may not have enough stored energy to produce a second round of new shoots. Longer term damage may result from continued reoiling than from a temporally continuous oiling (Lin et al, 2002; Lin and Mendelssohn, 2009). Other studies noted the utilization of dispersants in the proper dosages results in a reduction in marsh damage from oiling (Lin and Mendelssohn, 2009). The works of several investigators (Webb et al., 1981 and 1985; Alexander and Webb, 1983 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 0.025 gallons per ft^2 (1.0 liter per m^2) of marsh. Concentrations less than this may cause diebacks for one growing season or less, depending upon the concentration and the season during which contact occurs. The duration and magnitude of a spill resulting from a catastrophic blowout could result in concentrations above this critical level and would result in longer term effects to wetland vegetation, including some plant mortality and loss of land.

Due to the distance of deep water from shore, the possibility of a spill from a deepwater blowout reaching coastal wetlands with the toxicity to significantly impact the coastal wetlands is low due to the response procedures implemented during a catastrophic spill. The utilization of nearshore booming protection for beaches and wetlands, in combination with offshore skimming, burning, and dispersal treatments for the oil near the spill site, would result in capture and detoxification of the majority of oil reaching shore. Therefore, a spill from a shallow-water blowout is more likely to contribute to wetland damage.

The impact of oil cleanup can result in additional impacts to wetlands, if not done properly. Aggressive onshore and marsh cleanup methods have not yet been utilized and probably would not be initiated until the oil spill has been stopped. Depending on the marsh remediation methods used, further impacts to the wetlands may occur from cleanup activities.

Submerged Vegetation

Approximately 500,000 hectares (1.25 million acres) of submerged seagrass beds are estimated to exist in exposed, shallow coastal waters and embayments of the northern Gulf of Mexico, and over 80 percent of this area is in Florida Bay and Florida coastal waters (Beck et al., 2006; Carlson and Madley, 2006). Submerged vegetation distribution depends on an interrelationship between a number of environmental factors that include temperature, water depth, turbidity, salinity, turbulence, and substrate suitability (Sheridan and Minello, 2003). Marine seagrass beds generally occur in shallow, relatively clear, protected waters with predominantly sand bottoms (Short et al., 2001). Freshwater submerged aquatic vegetation (SAV) species occur in the low-salinity waters of coastal estuaries (Castellanos and Rozas, 2001). Seagrasses and freshwater SAV's provide important habitat for immature shrimp, black drum, spotted sea trout, juvenile southern flounder, and several other fish species and provide a food source for species of wintering waterfowl (Castellanos and Rozas, 2001; Short et al., 2001; Caldwell, 2003). These areas would have considerable impact from various cleanup efforts, such as increased vessel traffic. Although many of the beds are protected by extensive barrier islands, severe storms can cause inundation and overwashing of these islands, resulting in oiling of the seagrass beds if the storm occurred during an oil spill. In addition, boom anchors could damage seagrass beds (USDOC, NOAA, 2010e). It is assumed that there would be a decrease in submerged vegetation and a negative impact on the bed communities in a highly affected area. If bays and estuaries accrue oil, there is an assumption that there would be a decrease in seagrass cover and negative community impacts. Depending on the species and environmental factors, seagrasses may exhibit minimal impacts from a spill; however, communities within the beds could accrue greater negative outcomes (Jackson et al., 1989; Taylor et al., 2006). Community effects could range from direct mortality due to smothering or indirect mortality from loss of food sources and loss of habitat due to a decrease in ecological performance of the entire system (Zieman et al., 1984).

4.2.3. Socioeconomic Resources

4.2.3.1. Onshore Archaeological Resources

Regardless of the water depth in which the catastrophic blowout occurs, it is assumed that more than 1,000 mi (1,609 km) of shoreline could be oiled to some degree. Onshore prehistoric and historic sites would be impacted to some extent by a high-volume spill from a catastrophic blowout that reaches shore. Sites on barrier islands could suffer the heaviest impact (McGimsey, personal communication, 2010). A few prehistoric sites in Louisiana, located inland from the coastline in the marsh and along bayous, could experience some light oiling. As discussed above, impacts would include the loss of ability to accurately date organic material from archaeological sites due to contamination. Efforts to prevent coastal cultural resources from becoming contaminated by oil would likely be overwhelmed in the event of a hurricane and by the magnitude of shoreline impacted. The most significant damage to archaeological sites could be related to cleanup and response efforts. Fortunately, important lessons were learned from the *Exxon Valdez* spill in Alaska in 1989, in which the greatest damage to archaeological sites was related to cleanup activities and looting by cleanup crews rather than from the oil itself (Bittner, 1996). As a result, cultural resources were recognized as significant early in the response, and archaeologists are, at present, embedded in Shoreline Cleanup Assessment Teams (SCAT) and are consulting with cleanup crews. Historic preservation representatives are present at both the Joint Incident Command as well as each Area Command under the general oversight of the National Park Service to coordinate response efforts (Odess, personal communication, 2010). Despite these efforts, some archaeological sites suffered damage from looting or from spill cleanup activities (most notably the parade ground at Fort Morgan, Alabama) (Odess, personal communication, 2011).

4.2.3.2. Commercial Fishing

In addition to closures in Federal waters, portions of individual State waters would also be closed to commercial fishing. The economic impacts of closures on commercial fishing are complicated to predict because it is dependent on season and would vary by fishery. If fishers cannot make up losses in the remainder of the season, a substantial part of their annual income will be lost. In some cases, commercial fishers may move to areas still open to fishing, but at a greater cost due to longer transits.

4.2.3.3. Recreational Fishing

In addition to closures in Federal waters, portions to of individual State waters would also be closed to recreational fishing. More than 67 percent of the total Gulf catch came on trips that fished primarily in inland waters (Pritchard, 2009). In 2008, over 24 million recreational fishing trips were taken, which generated about $12 billion in sales, over $6 billion in value added impacts, and over 100,000 jobs (USDOC, NOAA, NMFS, 2010b). The majority of recreational fishing occurs in the summer months. During this time, scheduled fishing tournaments are held and would be hard to reschedule. If the spill affected the summer months, normal direct income and indirect income to the communities that host these tournaments would be lost for that year. If a catastrophic spill occurs in the summer, the majority of recreational fishing trips would not occur and economic benefits they generate would be lost for that year.

4.2.3.4. Tourism and Recreational Resources

Tourism and recreation are integral components of the economy of the Gulf of Mexico. Visitors to Texas, Louisiana, Mississippi, Alabama, and Florida spent approximately $145 billion in 2008 (U.S. Travel Association (2008). This spending helped to support approximately 2.4 million jobs in recreation-based industries statewide (U.S. Dept. of Labor, 2010a). Roughly 600,000 of these jobs are in counties and parishes that are directly along the coast, making them particularly vulnerable to a catastrophic event and the likely associated decrease in tourism. Recreation jobs account for 14.8 percent of Gulf Coast employment, greater than the national average of 12.4 percent (QCEW Fact Sheet). The coastal counties and parishes that have the highest concentration of recreation workers (over 10,000 workers) in each state are as follows: Cameron, Nueces, and Galveston Counties (Texas); Jefferson and Orleans Parishes (Louisiana); Harrison County (Mississippi); Mobile and Baldwin Counties (Alabama); and Escambia, Okaloosa, Bay, Pasco, Pinellas, Hillsborough, Manatee, Sarasota, Lee, Collier, Broward, and Miami-Dade Counties (Florida). Gulf Coast recreational employment is reasonably cyclical, with the peak months during the past few years occurring between March and June (U.S. Dept. of Labor, 2010b).

A catastrophic spill has the potential to significantly impact the Gulf Coast recreation and tourism industries. The water-dependent and beach-dependent components of these industries would be particularly vulnerable. This is particularly true for some of the nature parks and island resources directly along the coast, such as Padre Island National Seashore (Texas), Dauphin Island (Alabama), and the Gulf Islands National Seashore (Mississippi/Florida). Kaplan and Whitman (unpublished) attempt to isolate the economic significance of the recreational resources in the Gulf of Mexico that are particularly relevant to OCS oil and gas activities. They found roughly 60,000 jobs that were dependent on these activities in 2005, although there is uncertainty with this estimate, due to measurement issues and due to events that have occurred since their data collection period (most notably Hurricane Katrina).

In analyzing the potential impacts of a catastrophic spill, one must also consider the range of activities that depend on the base resources that may be affected. For example, the restaurant and lodging industries are particularly important to the Gulf economy. They are also sensitive to general tourism trends in any particular area. However, the economic impacts on these sectors from a spill may be partially offset due to an influx of cleanup and relief workers. Finally, one should consider the economic context in which a catastrophic event occurs. The *Deepwater Horizon* event occurred in the context of an economy that was only beginning to recover from a very deep recession. In difficult economic times, recreation workers may be more prone to being laid off in response to a catastrophic event. Workers may also find it more difficult to transition between jobs, which can increase the severity of the economic effects. In a recession, tourism also may be more sensitive both to actual damage and to perceptions of economic problems within a region.

4.2.3.5. Employment and Demographics

By the end of a catastrophic spill, up to 50,000 personnel would be expected to have responded to protect the shoreline and wildlife and to cleanup vital coastlines. The degree to which new cleanup jobs offset job losses would vary greatly from county to county (or parish to parish). However, these new jobs would not make up for lost jobs, in terms of dollar revenue. In most cases, cleanup personnel are paid less (e.g., $15-$18 per hour compared with roughly $45 per hour on a drilling rig), resulting in consumers in the region having reduced incomes overall and thus, investing less money in the economy (Aversa, 2010). Permanent demographic impacts are unlikely from these temporary jobs.

There would be additional economic impacts to tourism and both recreational and commercial fishing, as discussed in Sections 4.2.3.2 through 4.2.3.4 above.

4.2.3.6. Land Use and Coastal Infrastructure

In the event of a catastrophic spill, impacts on land use and infrastructure would be temporary and variable in nature. These impacts include land use in staging areas, waste disposal locations and capacities, and potential delays due to vessel decontamination stations near ports, as described below.

Up to 20 staging areas and as many as 50,000 responders would likely result in increased traffic congestion and some possible competing land-use issues near the staging areas, depending on the real estate market at the time of the event. Some infrastructure categories, such as vessels, ports, docks and wharves, would likely become very engaged in response activities and this could result in a shortage of space and functionality at infrastructure facilities if ongoing drilling activities were simultaneously occurring. However, if a drilling suspension was enacted, like the one related to the *Deepwater Horizon* event, conflicting demands on infrastructure facilities would likely fail to materialize (Dismukes, personal communication, 2010a).

In the category of waste disposal, the impacts would be more visible as thousands of tons of oily liquid and solid wastes from the oil-spill cleanup are disposed of in onshore landfills. The USEPA, in consultation with the U.S. Coast Guard, would likely issue solid-waste management directives to address the issue of contaminated materials and solid or liquid wastes that are recovered as a result of cleanup operations (USEPA, 2010d and 2010e).

For navigation and port use, there is also the potential for delays in cargo handling and slow vessel traffic due to decontamination operations at various sites along the marine transportation system (USDOT, 2010). However, most cleanup activities would be complete within a year of the event, so impacts would be expected to be limited in duration (Dismukes, personal communication, 2010b).

4.2.3.7. Environmental Justice

While most coastal populations along the Gulf of Mexico coast are not generally minority or low income, several communities on the coasts of St. Mary, Lafourche, Terrebonne, St. Bernard, and Plaquemines Parishes have minority or low-income population percentages that are higher than their state average. These minorities populations are predominately Native American, Islaños, or African American. For example, a few counties or parishes along the Gulf Coast have more than a 2-percent Native American population (USDOI, MMS, 2007); about 2,250 Houma Indians (a State of Louisiana recognized tribe) are concentrated in Lafourche Parish, Louisiana, comprising 2.4 percent of the parish's population, and about 800 Chitimacha (a federally recognized tribe) make up 1.6 percent of St. Mary Parish's population. While these are not significant numbers on their own, viewed in the context of Louisiana's overall 0.6 percent Native American average, these communities take on greater environmental justice importance.

Gulf Coast minority and low-income groups are particularly vulnerable to the coastal impacts of a catastrophic oil spill due to their greater than average dependence on the natural resources in the offshore and coastal environments. Besides their economic reliance on commercial fishing and oystering, coastal low-income and minority groups rely heavily on these fisheries and other traditional subsistence fishing, hunting, trapping, and gathering activities to augment their diets and household incomes (see Hemmerling and Colton, 2003, for an evaluation of environmental justice considerations for south Lafourche Parish). Regular commuting has continued this reliance on the natural resources of the coastal environments even when populations have been forced to relocate because of landloss and the destruction from recent hurricane events.

State fishery closures due to a catastrophic oil spill would disproportionately affect minority and low-income groups. Shoreline impacts would generate additional subsistence-related effects. Therefore, these minority groups would be disproportionately affected if these coastal areas were impacted by a catastrophic spill and the resulting response.

5. POST-SPILL, LONG-TERM RECOVERY (PHASE 4)

5.1. IMPACT-PRODUCING FACTORS AND SCENARIO

During the final phase a catastrophic blowout and spill, it is presumed that the well has been capped or killed and cleanup activities are concluding. While it is assumed that the majority of spilled oil would be dissipated within 30 days of stopping the flow (Inter-agency, 2010a), oil has the potential to persist in the environment long after a spill event and has been detected in sediment 30 years after a spill (USDOI, FWS, 2004). On sandy beaches, oil can sink deep into the sediments. In tidal flats and salt marshes, oil may seep into the muddy bottoms (USDOI, FWS, 2010g).

5.2. MOST LIKELY AND MOST SIGNIFICANT IMPACTS

At this point in the scenario, the spill has been stopped and long-term recovery begins. There is a great deal of uncertainty regarding the long-term impacts of a catastrophic spill in the Gulf of Mexico. The most likely and most significant impacts, as described below, will likely relate to the continued exposure of organisms to the spilled oil, oil components, and dispersants remaining in the air, water, and sediments, as well as the effects of continued cleanup efforts.

A catastrophic spill can have long-term impacts on Gulf of Mexico ecosystems. An ecosystem is a geographically specified system of organisms, including humans, their environment, and the processes that control their dynamics. Ecosystems involve complex connections between organisms, their environment, and the processes that drive the system (USDOC, NOAA, 2010f). In some cases, marine ecosystems may take decades to fully recover or may recover to alternative states (Ragen, 2010).

5.2.1. Physical Resources

5.2.1.1. Air Quality

There would be some residual air quality impacts after the well is capped or "killed." As most of the oil would have been burned, evaporated, or weathered over time, air quality would return to pre-oil spill conditions. While impacts to air quality are expected to be localized and temporary, as discussed in Sections 2.2.1.1, 3.2.1.1, and 4.2.1.1, adverse effects that may occur from the exposure of humans and wildlife to air pollutants could have long-term consequences.

5.2.1.2. Coastal and Offshore Water Quality

The leading source of contaminants that impairs coastal water quality in the Gulf of Mexico is urban runoff. Urban runoff can include suspended solids, heavy metals, pesticides, oil, grease, and nutrients (such as from lawn fertilizer). Urban runoff increases with population growth, and the Gulf Coast region has experienced a 103 percent population growth since 1970 (USDOC, NOAA, NOS, 2008). Other pollutant source categories include (1) agricultural runoff, (2) municipal point sources, (3) industrial sources, (4) hydromodification (e.g., dredging), and (5) vessel sources (e.g., shipping, fishing, and recreational boating). The NRC (2003, Table I-4, p. 237) estimated that, on average, approximately 26,324 barrels of oil per year entered Gulf waters from petrochemical and oil refinery industries in Louisiana and Texas. The Mississippi River introduced approximately 3,680,938 barrels/year (NRC, 2003, Table I-9, p. 242) into the waters of the Gulf. Hydrocarbons also enter the Gulf of Mexico through the result of natural seeps in the Gulf of Mexico at a rate of approximately 980,392 barrels per year (a range of approximately 560,224-1,400,560 barrels/year) (NRC, 2003, p. 191). Produced water (formation water) is, by volume, the largest waste stream from the oil and gas industry that enters Gulf waters. The NRC has estimated the quantity of oil in produced water entering the Gulf per year to be 473,000 bbl (NRC, 2003, p. 200, Table D-8).[2] These sources total about 5.5 million barrels of oil per year that routinely enters Gulf of Mexico waters. In comparison, a catastrophic spill of 30,000-60,000 barrels per day for 90-120 days would spill a total of 2.7-7.2 million barrels of oil. When added to the other sources of oil listed above, this would result in a 48- to 129-percent increase in the volume of oil entering the water during the year of the spill. In addition, the oil from a spill will be much more concentrated in some locations than the large number of other activities that release oil into the Gulf of Mexico. Section 3.1.4 discusses the properties and persistence of oil in the environment.

5.2.2. Biological Resources

As described below, long-term consequences on biological resources can include impaired reproduction, which can potentially impact population levels. Oil has the potential to persist in the environment long after a spill event and has been detected in sediment 30 years after a spill (USDOI, FWS, 2004). On sandy beaches, oil can sink deep into the sediments. In tidal flats and salt marshes, oil

2 These numbers were generated from converting the units reported in the noted reference and do not imply any level of significance.

may seep into the muddy bottoms. Oil in these systems has the potential to have long-term impacts on fish and wildlife populations.

Some animals may survive initial exposure to spilled oil but may accumulate high levels of contaminants in their bodies that can be passed on to predators, in a process known as bioaccumulation (USDOI, FWS, 2010g).

5.2.2.1. Coastal and Marine Birds

There is a high probability of underestimating the impacts of oil spills on avian species potentially encountering oil, particularly seabirds. Despite being oiled, some birds are able to fly and may later be killed by the oil, far from the spill location. Often overlooked and understudied are the long-term, sublethal, chronic effects due to sublethal exposure to oil. These effects may persist for years after exposure, reducing the capacity of affected individuals within the population to recover, due to effects that may range from minor physiological disorders through damage to vital organs (i.e., liver and kidney) (Alonso-Alvarez et al., 2007). The long-term impacts of potential food stress for bird species from an altered ecosystem are unknown, but disturbances to the ecosystem can cause long-term sublethal impacts, including malnourishment and decreased reproductive success. Sublethal effects of oil could ultimately result in reductions in long-term survival or lower reproductive success for some species of birds (Fry et al., 1986; Leighton, 1993; Esler et al., 2000; Golet et al., 2003; Velando et al., 2010). In addition, even light oiling of avian eggs transferred via contact with contaminated breast feathers from an incubating female can be toxic to developing embryos (Albers, 1980; Albers and Heinz, 1983). Effects such as delayed sexual maturity of most seabird species, loss of breeding-age individuals, particularly females, may have long-term, population-level effects. Long-term, sublethal, chronic effects may exceed immediate losses due to direct mortality (i.e., oiled birds) if such residual effects influence a significant proportion of the population or disproportionately impact an important population segment (Newton, 1998; Peterson et al., 2003; Alonso-Alvarez et al., 2007). Depending on the effects, some populations could take years or decades before reaching a full recovery, and some may never recover.

5.2.2.2. Fish, Fisheries, and Essential Fish Habitat

In addition to possible small fish kills due to direct impacts (as described under Phases 2 and 3), a catastrophic spill could affect fish populations in the long term. Due to a catastrophic spill, a significant portion of a year class of fish could be absent from the following year's fishery, reducing overall population numbers. However, sublethal impacts, especially for long-lived species (e.g., snapper and grouper), could be masked by reduced fishing pressure due to closures. In addition, healthy fish resources and fishery stocks depend on ideal habitat (essential fish habitat) for spawning, breeding, feeding, and growth to maturity. Thus, a catastrophic spill that affects these areas could result in long-term impacts, including destruction to a portion of their habitats.

5.2.2.3. Marine Mammals

Even after the spill is stopped, oilings or deaths of marine mammals would still likely occur due to oil and dispersants persisting in the water, past marine mammal/oil or dispersant interactions, and ingestion of contaminated prey. The animals' exposure to hydrocarbons persisting in the sea may result in sublethal impacts (e.g., decreased health, reproductive fitness, and longevity; and increased vulnerability to disease) and some soft tissue irritation, 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. A catastrophic oil spill could lead to increased mortalities, resulting in potential population-level effects for some species/populations (USDOC, NOAA, NMFS, 2010c).

5.2.2.4. Sea Turtles

Sea turtles take many years to reach sexual maturity. Green sea turtles reach maturity between 20 and 50 years of age; loggerheads may be 35 years old before they are able to reproduce; and hawksbill sea turtles typically reach lengths of 27 inches for males and 31 inches for females before they can reproduce (USDOC, NOAA, NMFS, 2010d). Declines in the food supply for sea turtles, which include invertebrates and sponge populations, could also affect sea turtle populations. While all of the pathways that an oil spill or the use of dispersants can affect sea turtles is poorly understood, some pathways may include the following: (1) oil or dispersants on the sea turtle's skin and body can cause skin irritation, chemical burns, and infections; (2) inhalation of volatile petroleum compounds or dispersants can damage the respiratory tract and lead to diseases; (3) ingesting oil or dispersants may cause injury to the gastrointestinal tract; and (4) chemicals that are inhaled or ingested may damage internal organs. In most foreseeable cases, exposure to hydrocarbons persisting in the sea following the dispersal of an oil slick would result in sublethal impacts (e.g., decreased health, reproductive fitness, and longevity and increased vulnerability to disease) to sea turtles. Other possible internal impacts might include harm to the liver, kidney, and brain function, as well as cause anemia and immune suppression, or could lead to reproductive failure or death. As discussed in Section 4.2.2, shoreline oiling and response efforts may affect future population levels and reproduction (USDOI, NPS, 2010). The deaths of subadult and adult sea turtles may also drastically reduce the population.

5.2.2.5. Terrestrial Mammals and Reptiles

Beach Mice

Within the last 20-30 years, the combination of habitat loss due to beachfront development, isolation of remaining beach mouse habitat areas and populations, and destruction of remaining habitat by tropical storms and hurricanes has increased the threat of extinction of several subspecies of beach mice. Destruction of the remaining habitat due to a catastrophic spill and cleanup activities would increase the threat of extinction.

Diamondback Terrapin

Habitat destruction, road construction, and drowning in crab traps are the most recent threats to diamondback terrapins. Tropical storms, hurricanes, and beach erosion threaten their preferred nesting habitats. Destruction of the remaining habitat due to a catastrophic spill and response efforts could drastically affect future population levels and reproduction.

5.2.2.6. Coastal Habitats

Coastal habitats serve important ecological functions, and the loss of vegetation in coastal areas could lead to erosion and permanent landloss.

Coastal Barrier Beaches and Associated Dunes

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.

The protection once afforded to inland marshes by coastal barrier beaches has been greatly reduced due to decreased elevations and the continued effect of subsidence, sea-level rise, and saltwater intrusion. A catastrophic spill has the potential to contribute to this reduction.

The cleanup impacts of a catastrophic spill could result in short-term (up to 2 years) adjustments in beach profiles and configurations as a result of sand removal and disturbance during cleanup operations. Some oil contact to lower areas of sand dunes is expected. These contacts would not result in significant destabilization of the dunes. The long-term stressors to barrier beach communities caused by the physical effects and chemical toxicity of an oil spill may lead to decreased primary production, plant dieback, and hence further erosion.

Wetlands

Wetlands serve a number of important ecological functions. For example, Louisiana's coastal wetlands support more than two-thirds of the wintering waterfowl population of the Mississippi Flyway, including 20-25 percent of North America's puddle duck population. Therefore, loss of wetlands would also impact a significant portion of the waterfowl population.

The duration and magnitude of a spill resulting from a catastrophic blowout could result in high concentrations of oil that would result in long-term effects to wetland vegetation, including some plant mortality and loss of land. This would add to continuing impacts of other factors, such as hurricanes, subsidence, saltwater intrusion, and sea-level rise. The wetlands along the Gulf Coast have already been severely damaged by the 2005 and 2008 hurricane seasons, leaving the mainland less protected. It was estimated in 2000 that coastal Louisiana would continue to lose land at a rate of approximately 2,672 ha/yr (10 mi^2/yr) over the next 50 years. Further, it was estimated that an additional net loss of 132,794 ha (512 mi^2) may occur by 2050, which is almost 10 percent of Louisiana's remaining coastal wetlands (Barras et al., 2003). Barras (2006) indicated an additional 217 mi^2 (562 km^2) of land lost during the 2005 hurricane season. A catastrophic spill occurring nearshore would contribute further to this landloss. Following Hurricanes Katrina and Rita, another series of hurricanes (Gustav and Ike) made landfall along the Louisiana and Texas coasts in September 2008. Hurricane Gustav made landfall as a Category 2 storm near Cocodrie, Louisiana, pushing large surges of saline water into the fresh marshes and coastal swamps of Louisiana from Grand Isle westward. While Hurricane Gustav did not impact the quantity of wetlands that Hurricanes Katrina and Rita impacted, it did have a severe and continuing effect on the coastal barrier islands and the wetlands associated with backshore (back of the island) and foreshore (front of the island). While Hurricane Gustav affected the eastern portion of the Louisiana coast closer to Grand Isle and Houma, Hurricane Ike concentrated on Louisiana's western coast. The Texas coast received the brunt of Hurricane Ike where it made landfall slightly east of Galveston. The storm surge basically removed the dune systems and significantly lowered the beach elevations along the eastern portion of the Texas coast near Galveston and the Bolivar Peninsula. The erosion and wash-over associated with Hurricane Ike's tidal surge breeched beach ridges and opened the inland freshwater ponds and their associated wetlands to the sea. As a result of the four successive storms, the Louisiana and Texas coasts have lost protective elevations, barrier islands, and wetlands, and they now have the potential for transitioning to a less productive salt-marsh system in areas where fresh-marsh systems once existed.

In addition, a poorly executed oil cleanup can result in additional impacts. Aggressive onshore and marsh cleanup methods have not yet been utilized and probably would not be initiated until the oil spill has been stopped. Depending on the marsh remediation methods used, further impacts to the wetlands may occur from cleanup activities. Boat traffic in marsh areas from the thousands of response vessels associated with a catastrophic spill would produce an incremental increase in erosion rates, sediment resuspension, and turbidity (i.e., an adverse but not significant impact to coastal wetland and seagrass habitats.)

5.2.2.7. Open-Water Habitats

Submerged Vegetation

If bays and estuaries accrue oil, there is an assumption that there would be a decrease in seagrass cover and negative community impacts. Submerged vegetation serves important ecological functions. For example, seagrasses and freshwater SAV's provide important habitat for immature shrimp, black drum, spotted sea trout, juvenile southern flounder, and several other fish species, and they provide a food source for species of wintering waterfowl (Castellanos and Rozas, 2001; Short and Coles, 2001; Caldwell, 2003). Therefore, loss of submerged vegetation would impact these species.

Sargassum

Oceanographic processes that concentrate *Sargassum* into mats and rafts would also concentrate toxic substances. Therefore, it may be assumed that *Sargassum* would be found in areas where oil, dispersants, and other chemicals have accumulated following a catastrophic spill. The ultimate effects of toxins to *Sargassum* are unclear; however, it is evident that the accumulation provides a toxic environment for associated species, especially those that use the *Sargassum* as areas of refuge for larvae or other developmental stages (Unified Incident Command, 2010d). There would be noticeable effects on species that eat the plant material, such as sea turtles, and the death rate of *Sargassum* may be increased due to toxic substances, which would contribute to a major decline in its biomass. This would decrease available habitat for associated organisms and indirectly affect the survival rate and recruitment for associated fish species. The severity and duration of any toxic effects would be dependent on both the physical properties of the toxic components and their biological effects, such as how long it might take them to degrade, their solubility in water, and the degree that they accumulate in biological tissue.

5.2.2.8. Benthic Habitats

Shelf Habitats

In situations where soft-bottom infaunal communities are negatively impacted, recolonization by populations from neighboring soft-bottom substrate would be expected over a relatively short period. Recolonization would begin with recruitment and immigration of opportunistic species from surrounding stocks. More complex communities would follow with time. Repopulation could take longer for areas affected by direct oil contact in higher concentrations.

Hard-bottom communities exposed to large amounts of resuspended sediments following a catastrophic, subsurface blowout could be subject to sediment suffocation, exposure to resuspended toxic contaminants, and reduced light penetration. The greatest impacts would occur to communities that exist in clear water with very low turbidity. The consequences of a blowout along, directly on, or near one of these features could be long lasting, although the occurrence of a blowout near such sensitive communities is unlikely because of stipulations described in NTL 2009-G39 prevents drilling activity near sensitive hard-bottom habitats. Impacts would more likely be from low-level or long-term exposure. This type of exposure has the potential to greatly impact coral reef communities, resulting in impaired reef health. Impacts to a community in more turbid waters would be greatly reduced, as the species are tolerant of suspended sediments, and recovery would occur quicker.

Deepwater Soft-Bottom Benthic Communities

In situations where soft-bottom infaunal communities are negatively impacted, recolonization by populations from neighboring soft-bottom substrate would be expected over a relatively short period of time for all organisms ranging from a matter of days for bacteria and probably less than 1 year for most macrofauna and megafauna species. This could take longer for areas affected by direct oil contact in higher concentrations.

Deepwater Coral Benthic Communities

Deepwater corals are expected to be resistant to oiling, with little effect from low exposure. Many invertebrates associated with deepwater coral communities, particularly the crustaceans, would likely be more susceptible to damage from oil exposure. Recolonization of severely damaged or destroyed communities could take years to decades.

Deepwater Chemosynthetic Benthic Communities

While chemosynthetic communities that receive low quantities of well-dispersed oil undergoing biodegradation would likely experience little negative effect, recolonization of severely damaged or destroyed communities could take years to decades.

5.2.3. Socioeconomic Resources

5.2.3.1. Offshore and Onshore Archaeological Resources

While it is unlikely (Section 2.2.3.1), a known shipwreck could be impacted by the blowout itself or the subsequent oil spill; impacts (i.e., contamination) from the release of large quantities of dispersants associated with a deepwater, catastrophic blowout are possible. Because a site cannot be avoided unless its location in known, undiscovered shipwrecks are at a much higher risk as a result of a blowout. Long-term effects of oiling of prehistoric and historic archaeological resources are poorly understood; however, damage to the protective layer of corals and other organisms on shipwreck sites by oiling could alter the surrounding site dynamics and increase their degradation. In addition, onshore habitat degradation could lead to erosion, which would increase exposure to and subsidence of prehistoric and historic sites. Unlike biological resources that have the potential to recover, damage to archaeological resources from the spill or cleanup activities would be irreversible, leading to loss of important archaeological data needed for proper study and interpretation. Archaeological sites also provide recreational opportunities both offshore and onshore; therefore, the loss of a site would also have impacts on recreation.

5.2.3.2. Commercial Fishing

The Gulf is an important biologic and economic area in terms of seafood production and recreational fishing. According to NOAA, there are 3.2 million recreational fishermen in the Gulf of Mexico region who took 24 million fishing trips in 2008. Commercial fishermen in the Gulf harvested more than 1 billion pounds of finfish and shellfish in 2008 (USDOC, NOAA, 2010g). The economic impacts of closures on commercial fishing are complicated to predict because the economic effects are dependent on season and would vary by fishery. If fishers cannot make up losses in the remainder of the season, a substantial part of their annual income could be lost. While the commercial fishing industry of Texas did not sustain measurable direct or indirect economic effects following the 1979 *Ixtoc* blowout and spill (Restrepo et al., 1982), there is a documented phenomenon that, long after an incident, the perception of tainted fish and shellfish from the impacted area persists (Keithly and Diop, 2001). It is reasonable to assume that a negative perception could impact the value of commercial fish resources for several seasons.

5.2.3.3. Recreational Fishing

In 2008, over 24 million recreational fishing trips were taken in the Gulf of Mexico, which generated about $12 billion in sales, over $6 billion in value-added impacts, and over 100,000 jobs (USDOC, NOAA, NMFS, 2010b). Unlike commercial fishing, recreational fishing is concentrated during the summer months. Therefore, a catastrophic spill occurring at the beginning of the recreational fishing season and continuing through the season would result in the loss of millions of recreational fishing trips and billions in subsequent sales. For example, during the summer months, scheduled fishing tournaments are held that would be hard to reschedule. Normal direct income and indirect income to the communities that host these tournaments would be lost for that year.

5.2.3.4. Tourism and Recreational Resources

The longer-term implications of a catastrophic event on tourism would depend on the extent to which any structural/ecological damage can be repaired, as well as on the extent to which public confidence in the tourism industry can be restored. For example, a catastrophic oil spill would likely affect the fish populations in the affected waters to some extent. The most direct impact of this would be decreased recreational fishing activity in a region to the extent that the fish population has decreased. However, a region would not fully recover from the event until confidence in fishing is restored and the remaining fish population recovers. In addition, restaurants in the region would be impacted to the extent to which they are perceived to use seafood products caught or raised in contaminated waters. Similarly, although beaches can be decontaminated not long after a spill has been stopped, lingering perceptions can be expected to negatively impact tourism.

Oxford Economics (2010) conducted a study of recent catastrophic events in order to estimate the longer-term economic implications of the *Deepwater Horizon* oil spill. They estimate that the long-term economic damage from the spill could be between $7.6 and $22.7 billion. Analyzing previous oil spills and other catastrophic events, they also suggest that it could take 15-36 months for the tourism industry to recover to pre-spill levels. Given Florida’s dependence on fishing and beach activities (as well as the overall size of its economy), this study suggests that the State would bear the majority of the economic damage from the spill. This study also points out the complicated set of economic and psychological forces that ultimately determine the extent to which the tourism and recreation industries would recover from a catastrophic oil spill.

5.2.3.5. Employment and Demographics

While a catastrophic spill could immediately impact several Gulf States for several months through fishing closures, loss of tourism, and any suspension of oil and gas activities, anticipating the long-term economic and employment impacts in the Gulf of Mexico is a difficult task. Many of the potentially affected jobs, like fishing charters, are self-employed. Thus, they would not necessarily file for unemployment and will not be included in business establishment surveys used to estimate State unemployment levels. In addition, unemployment numbers in states are based on nonagricultural jobs, and the fishing industry is considered within the agriculture category. On the other side, it is also a challenge to estimate how many of these displaced workers have been hired to clean up the spill. For example, while thousands of vessels of opportunity would be active in the spill response, not all of these would be displaced commercial fishermen from the affected areas. The positive employment impacts related to response activities are likely to be shorter term than the negative impacts discussed above.

Catastrophic spills have a huge regional economic impact, as seen recently in the *Deepwater Horizon* event. It is estimated that the total economic consequences of the *Deepwater Horizon* event will lead to a net loss of just under $20 billion for the U.S. economy in 2010, which would lower U.S. economic growth in 2010 by roughly 0.1 percent and would reduce growth to a greater extent in the four states most affected.

5.2.3.6. Land Use and Coastal Infrastructure

Based on the rapid recovery of infrastructure that was heavily damaged by the catastrophic 2005 hurricane season, there are not expected to be any long-term impacts to land use and coastal infrastructure as a result of a catastrophic oil-spill event. However, BOEMRE would continue to monitor the post-spill, long-term recovery phase of the *Deepwater Horizon* event for any changes that indicate otherwise. A catastrophic spill could generate up to 60,000 tons of oil-impacted solid materials disposed in landfills along the Gulf Coast. This waste may contain debris, beach or marsh material (sand/silt/clay), vegetation, and personal protection equipment collected during cleanup activities. This would be equivalent to 2-6 years of waste produced from OCS oil and gas activities in the Gulf of Mexico (Dismukes et al., 2007). However, landfill capacity is not expected to be an issue at any phase of the oil-spill event or the long-term recovery. According to USEPA, existing landfills that are receiving oil-spill waste from the *Deepwater Horizon* event have plenty of capacity to handle the expected waste volumes. The oil-spill waste that is being disposed of in landfills represents less than 7 percent of the total daily waste normally accepted at these landfills (USEPA, 2010a).

It is not expected that any long-term, land-use impacts would arise from properties that are utilized for restoration activities and would somehow have their future economic use compromised. The rise or fall of property values would not be solely a function of some kind of economic impact from a catastrophic oil-spill event. There are many other factors that influence the value of property and its best economic use. It is not clear from past experiences whether vegetation loss or erosion created by a spill could result in changes in land use. The amount and location of erosion and vegetation loss can be influenced by the time of year the spill occurs, its location, and weather patterns, including hurricane landfalls (Dismukes, personal communication, 2010a).

5.2.3.7. Environmental Justice

After the spill is stopped, the primary environmental justice concerns relate to possible long-term health impacts to cleanup workers, a predominately minority population, and to possible disposal of oil-impacted solid waste in predominantly minority areas.

Suspension of Oil and Gas Activities

An analysis of socioeconomic characteristics shows that people of Cajun ethnicity in the Gulf States, often found to be of a comparatively low socioeconomic status and to work jobs in the textile and oil industries (Henry and Bankston, 1999). Past studies suggest that a healthy offshore petroleum industry also indirectly benefits low-income and minority populations (Tolbert, 1995). One BOEMRE study in Louisiana found income inequality decreased during the oil boom of the 1980's and increased with the decline (Tolbert, 1995). Although we know that many oil- and gas-related service industries are cutting costs and putting off maintenance to defer massive layoffs in response to the oil-spill-caused deepwater drilling suspension and the slowed schedule for shallow-water drilling permits, we do not fully understand their long-term impacts.

Onshore and Offshore Cleanup Workers

By the end of a catastrophic spill, up to 50,000 personnel would be expected to be responding to the spill. The majority of these are field responders (United Incident Command, 2010f). As seen with the *Deepwater Horizon* event, the racial composition of cleanup crews was so conspicuous that Ben Jealous, the president of the National Association for the Advancement of Colored People (NAACP), sent a public letter to BP Chief Operations Officer Tony Hayward on July 9, 2010, demanding to know why African Americans were over-represented in “the most physically difficult, lowest paying jobs, with the most significant exposure to toxins” (NAACP, 2010). While regulations require the wearing of protective gear and only a small percentage of cleanup workers suffer immediate illness and injuries (Center for Disease Control, 2010), exposure could have long-term health impacts (e.g., increased rates of some types of cancer) (Savitz and Engel, 2010; Kirkeleit et al., 2008). Of the 38 accidents involving supertankers and resulting in large oil spills throughout the world, only seven studies on the repercussions of the exposure of spilled oils on human health have been completed. Aguilera et al. (2010) compiled and reviewed these studies for patterns of health effects and found evidence of the relationship between exposure and “acute physical, psychological, genotoxic, and endocrine effects in the exposed individuals.” Acute symptoms from exposure to oil, dispersants, and degreasers include headaches, nausea, vomiting, diarrhea, sore eyes, runny nose, sore throat, cough, nose bleeds, rash, blisters, shortness of breath, and dizziness (Sathiakumar, 2010). The USEPA’s monitoring data have so far shown that the use of dispersants during the *Deepwater Horizon* event did not result in a presence of chemicals that surpassed human health benchmarks (Trapido, 2010). Longitudinal epidemiological studies of possible long-term health effects from exposure to either the *Deepwater Horizon* event oil or dispersants, such as the possible bioaccumulation of toxins in tissues and organs, are lacking and the potential for the long-term human health effects are largely unknown (although the National Institutes of Health has proposed such a study).

Prior research on post-spill cleanup efforts found that the duration of cleaning work was a risk factor for acute toxic symptoms and that seamen had the highest occurrence of toxic symptoms compared with volunteers or paid workers. Therefore, participants in the *Deepwater Horizon*’s “Vessels of Opportunity” program, which recruited local boat owners (including Cajun, Houma Indian, and Vietnamese fishermen) to assist in cleanup efforts, would likely be one of the most exposed groups. African Americans are thought to have made up a high percentage of the cleanup workforce. The OSHA released two matrices of gear requirements for onshore and offshore Gulf operations that are organized by task (OSHA). Of past oil-spill workers, uninformed and poorly informed workers were at more risk of exposure and symptoms, demonstrating the importance of education and proper training of workers (Sathiakumar, 2010). Therefore, a catastrophic spill could disproportionately affect seamen and onshore workers such as Cajuns, Vietnamese, Houma Indian, and African Americans.

During a recent National Institute of Environmental Sciences workshop regarding the health effects of the *Deepwater Horizon* oil spill, Chairperson Nancy E. Adler pointed to the uncertainty regarding health effects and these types of events, “While studies of previous oil spills provide some basis for identifying and mitigating the human health effects of these exposures, the existing data are insufficient to fully understand and predict the overall impact of hazards from the *Deepwater Horizon* oil spill on the health of individuals—including workers, volunteers, residents, visitors, and special populations” (Institute of Medicine, 2010). In order to address these data gaps, the National Institute of Environmental Sciences plans to begin a prospective study of the mental and physical health of about 50,000 workers who helped battle the spill.

Solid-Waste Disposal

Following a catastrophic spill, environmental justice concerns arise related to the disposal of cleanup-related wastes near minority and/or low-income communities (Schleifstein, 2010). It is estimated a catastrophic spill could generate up to 60,000 tons of oil-impacted solid materials that would be disposed in landfills along the Gulf Coast. While no new landfills would be built due to a catastrophic spill, the use of existing landfills might exacerbate existing environmental justice issues. For example, Mobile, Alabama, and Miami, Florida, are majority minority urban centers with a majority of minority residents living within a 1-mi (1.6-km) radius of chosen landfills or liquid processing centers. While only a small percentage of *Deepwater Horizon* waste was sent to these facilities—13 percent of the liquid waste to Liquid Environmental Solutions in Mobile and only 0.28 percent of the total liquid waste to Cliff Berry in Miami—they could potentially receive more for future spills. For example, of the nine landfills approved by USEPA for oil-impacted solid materials, more than half of the waste was disposed of in four landfills that were located in areas where minority groups comprised the majority of the population (Hernandez, 2010). Disposal procedures for the *Deepwater Horizon* event involved sorting waste materials into standard "waste stream types" at small, temporary stations, and then sending each type to existing facilities that were licensed to dispose of them. The location of temporary sorting stations was linked to the location of containment and cleanup operations. Hence, future locations of any sorting stations are not predictable since they would be determined by the needs of cleanup operations. However, waste disposal locations were determined by the specializations of existing facilities and by contractual relationships between them and the cleanup and containment firms. Louisiana received about 82 percent of the *Deepwater Horizon* liquid waste recovered; of this, 56 percent was manifested to mud facilities located in Venice, Plaquemines Parish, Louisiana, and Port Fourchon, Lafourche Parish, Louisiana, and then transferred to a processing facility in Port Arthur, Texas. The waste remaining after processing was sent to deep well injection landfills located in Fannett and Big Hill, Texas. The sites located in Venice and Port Fourchon, Louisiana, and Port Arthur, Fannett, and Big Hill, Texas, have low-minority populations but a few of these areas have substantial poverty rates relative to State and county means. Although, in the case of the *Deepwater Horizon* event, most of the cleanup occurred in the CPA and disposal occurred in both the CPA and WPA; this would likely happen should a future event occur.

6. CUMULATIVE ENVIRONMENTAL AND SOCIOECONOMIC IMPACT

Like the recent, devastating hurricane seasons of 2005 and 2008, the *Deepwater Horizon* event has changed the environmental baseline of the Gulf of Mexico. Another catastrophic oil spill would make the resources of the Gulf even more susceptible to further impacts, adding to the cumulative effects of an already sensitive ecosystem.

The Gulf Coast has survived major natural and manmade disasters (i.e., hurricanes and oil spills), through which the people and environmental resources of the Gulf of Mexico and the Gulf Coast have repeatedly demonstrated their resiliency. While environmental and socioeconomic resources may recover from a natural or manmade disaster if given enough time between disasters, disasters happening in unison or within short periods of each other would make recovery more difficult.

The magnitude of OCS and non-OCS activity in the Gulf of Mexico is so immense that routine activities associated with a single OCS oil and gas activity (e.g., single lease sale, single well) have a minor to no incremental contribution to the impacts of cumulative activities. However, a catastrophic blowout and spill would have a major contribution to cumulative impacts.

7. SUMMARY OF IMPACTS

7.1. SUMMARY OF IMPACTS FROM PHASE 1 (INITIAL EVENT)

The initial phase of the catastrophic event analyzed in the Gulf of Mexico is a blowout causing an explosion and fire, possibly resulting in the sinking of the drilling rig or platform. Impacts during Phase 1 would be limited to workers on the platform and environmental resources offshore in the immediate vicinity of the blowout. Air quality impacts include the emission of pollutants from the oil and the fire that are hazardous to human health and that can possibly be fatal. Water quality impacts include localized water quality effects, which could include the release of a large amount of methane gas and the disturbance of a large amount of sediments over an extended area, if the blowout occurs outside the wellbore, below the seafloor.

An explosion would kill any birds resting on the platform, including birds protected under the Migratory Bird Treaty Act. Eruption of gases and fluids may generate significant pressure waves and noise to injure or kill individual animals in the vicinity, including federally listed threatened and endangered species under the ESA or MMPA. A shock wave underwater may also impact commercial and recreational fisheries in the area. Benthic communities beyond avoidance zones could be smothered. In addition to a large number of fatalities and injuries of people on the drilling rig or platform itself, commercial and recreational fishers and divers near the blowout could be injured or killed. The blowout could also damage any unidentified archaeological sites nearby.

7.2. Summary of Impacts from Phase 2 (Offshore Spill)

The second phase of the catastrophic event analyzed is an extended, offshore spill estimated to last 1-4 months for a blowout in shallow water and 3-5 months for a blowout in deep water, due to more difficult intervention. A large-scale response effort would be expected for a catastrophic spill, including tens of thousands of responders, several thousand vessels, and the release of a large amount of dispersants.

A catastrophic spill has the potential to cause population level impacts to offshore biological resources. Multiple Federal and State-listed, threatened and endangered species could be impacted in the water column or at the sea surface. In addition, natural processes (e.g., flocculation) and human intervention (i.e., subsea dispersants) could expose benthic communities and archaeological sites to oil. Additionally, known and previously undiscovered archaeological sites and benthic habitats could be damaged by bottom-disturbing activities associated with the response effort, including the anchoring of vessels. Pollutants in the spilled oil that are hazardous to response workers without protective equipment would be emitted into the air through evaporation and through in-situ or controlled burns of oil slicks.

Socioeconomic impacts would begin while the spill is still offshore. A large portion of the Gulf of Mexico EEZ and most of State waters could be closed to commercial and recreational fishing for several months, possibly causing the loss of revenue for an entire season or year. These closures may predominately affect minority or ethnic groups. Tourism may also be impacted due to either perceived damage to recreational resources that has not yet materialized or to general hesitation on the part of travelers to visit the overall region due to the spill. Suspension of some oil and gas activities would possibly follow a catastrophic event, temporarily affecting jobs in the oil and gas industry.

7.3. Summary of Impacts from Phase 3 (Onshore Contact)

The third phase of the catastrophic event analyzed is oiling of the shoreline. Exponential increase of the length of impacted shoreline is expected as the spill would continue over several months, which would likely overwhelm response efforts. Due to longer intervention times, a deepwater blowout and spill could impact over 1,000 mi (1,609 km) of shoreline. While a catastrophic spill from a shallow-water blowout is expected to be a lower volume than a deepwater blowout, the site would generally be located closer to shore, allowing less time for oil to be weathered, dispersed, and recovered. This could result in more concentrated and toxic oiling of several hundred miles of shoreline for more than 2 months.

The severity of oiling would vary between heavy, moderate, light, and occasional tarballs. However, due to the length of shoreline that could be potentially oiled and the sensitivity of the Gulf Coast, a catastrophic spill could cause extensive habitat degradation. Loss of vegetation could lead to erosion and permanent landloss. Though response efforts (including the use of skimmers and booms) would decrease the amount of oil contacting the coastline, significant amounts of oil would remain to impact coastal water quality. Gulf of Mexico water quality is already rated as fair to poor, according to USEPA. Depending on timing and location, a catastrophic spill has the potential to cause population-level impacts on biological resources. Dozens of Federal and State-listed, threatened and endangered species could be impacted. Impacts on air quality may have adverse effects on oil-spill responders.

While cultural resources were recognized as significant early in the response and archaeologists are at present embedded in SCAT teams and consulting with cleanup crews, efforts to prevent coastal cultural resources from becoming contaminated by oil would likely be overwhelmed by the magnitude of shoreline impacted and/or in the event of a hurricane during the spill cleanup efforts. In addition to closures in Federal waters, portions to all of individual State waters would also be closed to commercial and recreational fishing. The economic impact of these closures would have a disproportional effect on minority and low-income groups, and shoreline impacts would generate additional subsistence-related effects. A catastrophic spill also has the potential to significantly impact the Gulf Coast recreation and tourism industries, particularly water-dependent and beach-dependent components of these industries. An influx of cleanup and relief workers would not fully offset economic impacts. The influx a large number of responders and the creation of staging areas due to a catastrophic spill would have temporary impacts (e.g., increased traffic congestion and some possible competing land-use issues) on land use and infrastructure. In addition, there is a potential for delays in cargo handling and slow vessel traffic due to decontamination operations at various sites along the marine transportation system.

7.4. Summary of Impacts from Phase 4 (Long-Term Impacts)

Phase 4 focuses on the long-term impacts of a catastrophic oil spill. While impacts to air and water quality may be shorter term, a catastrophic spill can have impacts on Gulf of Mexico ecosystems long after the well is capped or killed and cleanup activities have concluded. In some cases, marine ecosystems may take decades to fully recover or may recover to alternative states.

Coastal and offshore habitats serve important ecological functions. Onshore, the loss of vegetation could lead to erosion and permanent landloss. Offshore, repopulation of benthic communities could take longer for areas affected by direct oil contact in higher concentrations. For birds, fish, marine mammals and sea turtles, damage of habitats, loss of reproductively capable adults as well as juveniles, and sublethal impacts from oil exposure can lead to impaired reproduction. This can potentially reduce population levels. For example, a catastrophic spill could decrease available habitat for associated organisms and indirectly affect the survival rate and recruitment for associated fish species. In the case of birds, long-term, sublethal, chronic effects may exceed immediate losses due to direct mortality (i.e., oiled birds) if such residual effects influence a significant proportion of the population or disproportionately impact an important population segment. A catastrophic spill could cause the destruction of the remaining habitat of certain onshore species, such as the diamondback terrapin or beach mice.

A catastrophic spill can also have long-term impacts on socioeconomic resources. Positive employment impacts related to response activities are likely to be shorter term than the negative impacts. Catastrophic spills have a huge regional economic impact (billions of dollars), as recently seen with the *Deepwater Horizon* event. The longer-term implications for commercial and recreational fishing and tourism depend on the extent and perception of environmental damage. After the spill is stopped, the primary environmental justice concerns would be long-term health impacts of predominately minority workers and the disposal of oil-impacted solid waste in predominantly minority areas. Long-term impacts to land use and coastal infrastructure are not expected. Unlike biological or other socioeconomic resources that have the potential to recover, damage to archaeological resources from the spill or cleanup activities would be irreversible, leading to the loss of important archaeological data needed for proper study and interpretation.

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9. REFERENCES

Adcroft, A., R. Hallberg, J.P. Dunne, B.L. Samuels, J.A. Galt, C.H. Barker, and B. Payton. 2010. Simulations of underwater plumes of dissolved oil in the Gulf of Mexico. Geophysical Research Letters. Vol. 37. 5 pp.

Aguilera, F., J. Méndez, E. Pásaro, and B. Laffon. 2010. Review on the effects of exposure to spilled oils on human health. Journal of Applied Toxicology 30:291–301. doi:10.1002/jat.1521.

Alabama State Port Authority. 2010. Spill continues to impact Gulf Coastal States, Port of Mobile will remain open. Media Update, July 2, 2010. Internet website: http://www.asdd.com/pdf/ASPA_PortofMobile_OilSpillUpdate_07022010.pdf.

Albers, P.H. 1980. Transfer of crude oil from contaminated water to bird eggs. Environmental Research 22:307-314.

Albers, P.H. and G.H. Heinz. 1983. FLIT-MLO and No. 2 fuel oil: Effects of aerosol applications to mallard eggs on hatchability and behavior of ducklings. Environmental Research 30:381-388.

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

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

Alonso-Alvarez, C., I. Munilla, M. López-Alonso, and A. Veland. 2007. Sublethal toxicity of the *Prestige* oil spill on yellow-legged gulls. Environ. Int. 54:773-781.

Australian Maritime Safety Authority. 2010. Oil spill dispersants: Top 20 frequently asked questions (FAQs). Internet website: http://www.amsa.gov.au/Marine_Environment_Protection/National_plan/General_Information/Dispersants_Information/FAQ_Oil_Spills_Dispersants.asp. Accessed June 29, 2010.

Aversa, J. 2010. Oil spill's economic damage may not go beyond Gulf. Internet website: http://www.washingtonpost.com/wp-dyn/content/article/2010/06/28/AR2010062800624.html. Accessed June 30, 2010.

Baca, B., G.A. Ward, C.H. Lane, and P.A. Schuler. 2005. Net environmental benefit analysis (NEBA) of dispersed oil on nearshore tropical ecosystems derived from the 20 year "TROPICS" field study. In: Proceedings 2005 International Oil Spill Conference. May 15-19, 2005, Miami Beach, FL. Washington, DC: American Petroleum Institute.

Baird, P.H. 1990. Concentrations of seabirds at oil-drilling rigs. Condor 92:768-771.

Bak, R.P.M. and J.H.B.W. Elgershuizen. 1976. Patterns of oil-sediment rejection in corals. Marine Biology 37:105-113.

Bankston, C.L. and M. Zhou. 1996. Go fish: The Louisiana Vietnamese and ethnic entrepreneurship in an extractive industry. National Journal of Sociology 10(1): 37-55.

Barras, J.A. 2006. Land area change in coastal Louisiana after the 2005 hurricanes: A series of three maps. U.S. Dept. of the Interior, Geological Survey. Open File Report 06-1274.

Barras, J.A., S. Beville, D. Britsch, S. Hartley, S. Hawes, J. Johnston, P. Kemp, Q. Kinler, A. Martucci, J. Porthouse, D. Reed, K. Roy, S. Sapkota, and J. Suhayda. 2003. Historical and projected coastal Louisiana land changes: 1978-2050. U.S. Dept. of the Interior, Geological Survey. Open File Report 03-334.

Bartha, R. and R.M. Atlas. 1983. Transport and transformations of petroleum: Biological processes. In: Boesch, D.F. and N.N. Rabalais, eds). Long-term environmental effects of offshore oil and gas development. Taylor and Francis, Abingdon.

Beck, M.W., K.L. Heck, Jr., K.W. Able, D.L. Childers, D.B. Eggleston, B.M. Gillanders, B. Halpern, C.G. Hays, K. Hoshino, T.J. Minello, R.J. Orth, P.F. Sheridan, and M.P. Weinstein. 2001. The identification, conservation, and management of estuarine and marine nurseries for fish and invertebrates. BioScience 51(8):633-641.

Beck, W.W., W.L. Kruczynski, and P.F. Sheridan. 2006. Conclusion. In: Handley, D.A, D. Altsman, and R. DeMay, eds. 2006. Seagrass status and trends in the northern Gulf of Mexico: 1940-2002. Scientific Investigations Report 2006-5287. U.S. Environmental Protection Agency 855-R-04-003. Internet website: http://pubs.usgs.gov/sir/2006/5287/. Accessed October 28, 2010.

Bittner, J.E. 1996. Cultural resources and the *Exxon-Valdez* oil spill: An overview. Proceedings of the *Exxon-Valdez* Oil Spill Symposium. American Fisheries Society Symposium 18:814-818.

Boesch, D.F. and N.N. Rabalais, eds. 1987. Long-term environmental effects of offshore oil and gas development. London: Elsevier Applied Science Publishers. 696 pp.

Burdeau, C. 2010. Widespread oyster deaths found on Louisiana reefs. The Associated Press. July 17, 2010. Internet website: http://www.nola.com/news/gulf-oil-spill/index.ssf/2010/07/widespread_oyster_deaths_found.html.

Burdeau C. and J. Collins. 2010. Marshes fouled by Gulf of Mexico oil spill show signs of regrowth. The Associated Press. August 12, 2010. Internet website: http://www.nola.com/news/gulf-oil-spill/index.ssf/2010/08/marshes_fouled_by_gulf_of_mexi.html.

Burns, K.A. and A.H. Knap. 1989. The Bahía Las Minas oil spill: Hydrocarbon uptake by reef building corals. Marine Pollution Bulletin 20(8):391-398.

Byrd, G.V., J.H. Reynolds, and P.L. Flint. 2009. Persistence rates and detection probabilities of bird carcasses on beaches of Unalaska Island, Alaska, following the wreck of the M/V *Selendang Ayu*. Marine Ornithology 37:197-204.

Caetano, M., M.J. Madureira, and C. Vale. 2003. Metal remobilization during resuspension of anoxic contaminated sediment: Short-term laboratory study. Water, Air, and Soil Pollution 143:23-40.

Cagle, F.R. 1952. A Louisiana terrapin population (*Malaclemys*). Copeia 1952:74-76.

Caldwell, A.B. 2003. Do terraces and coconut mats affect seeds and submerges aquatic vegetation at Sabine National Wildlife Refuge? Master's thesis, Louisiana State University, Baton Rouge, LA. 41 pp. Internet website: http://etd.lsu.edu/docs/available/etd-0625103-110131/unrestricted/Caldwell_thesis.pdf.

Canadian Center for Energy Information. 2010. What are oil sands and heavy oil? Internet website: http://www.centreforenergy.com/AboutEnergy/ONG/OilsandsHeavyOil/Overview.asp?page=1. Accessed on September 27, 2010.

Carls, M.G., S.D. Rice, and J. Hose. 1999. Sensitivity of fish embryos to weathered crude oil: Part 1. Low-level exposure during incubation causes malformations, genetic damage and mortality in larval Pacific herring (*Clupea pallashi*). Environmental Toxicology and Chemistry 18(3):481-493.

Carlson, P.R., Jr. and K. Madley. 2006. Statewide summary for Florida. In: Handley, D.A, D. Altsman, and R. DeMay, eds. 2006. Seagrass status and trends in the northern Gulf of Mexico: 1940-2002. Scientific Investigations Report 2006-5287. U.S. Environmental Protection Agency 855-R-04-003. Internet website: http://pubs.usgs.gov/sir/2006/5287/.

Castellanos, D.L. and L.P. Rozas. 2001. Nekton use of submerged aquatic vegetation, marsh, and shallow unvegetated bottom in the Atchafalaya River Delta, a Louisiana tidal freshwater ecosystem. Estuaries 24(2):184-197.

Centers for Disease Control and Prevention. 2010. NIOSH report of BP illness and injury data (April 23 – June 6, 2010). Internet website: http://www.cdc.gov/niosh/topics/oilspillresponse/pdfs/NIOSHRept-BPInjuryandIllnessDataApril23-June6.pdf.

Clark Atlanta University. Environmental Justice Resource Center. 2010. BP waste oil spill waste disposal correction. Internet website: http://www.ejrc.cau.edu/GulfCorrection8-24-2010.html.

Cook, B.B. and A.H. Knap. 1983. The effects of crude oil and chemical dispersant on photosynthesis in the brain coral, *Diploria strigosa*. Marine Biology 78:21-27.

Conan, G. 1982. The long-term effects of the *Amoco Cadiz* oil spill. Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences 297(1087).

Council of Environmental Quality (CEQ). 2010. Report regarding the Minerals Management Service's National Environmental Policy Act policies, practices, and procedures as they relate to Outer Continental Shelf oil and gas exploration and development. 41 pp. Internet website: http://www.whitehouse.gov/sites/default/files/microsites/ceq/20100816-ceq-mms-ocs-nepa.pdf.

Darnell, R.M., R.E. Defenbaugh, and D. Moore. 1983. Atlas of biological resources of the continental shelf, northwestern Gulf of Mexico. U.S. Dept. of the Interior, Bureau of Land Management, New Orleans, LA. BLM Open File Report No. 82-04.

Davis, H.C. 1958. Survival and growth of clam and oyster larvae at different salinities. Biological Bulletin, Marine Biological Laboratory 114(3):296-307.

Davis, B., D.S. Etkin, M. Landry, and K. Watts. 2004. Determination of oil persistence: A historical perspective. Proc. Fifth Biennial Freshwater Spills Symposium. Internet website: http://www.environmental-research.com/erc_papers/ERC_paper_19.pdf.

Deegan, L.A. 1989. Nekton, the free-swimming consumers. In: Day, J.W. Jr., C.A.S. Hall, W.M. Kemp, and A. Yanez-Arancibia, eds. Estuarine ecology. New York, NY: Wiley and Sons, Inc. 400 pp.

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

Dismukes, D. 2010a. Personal communication. Associate Director, LSU Center for Energy Studies, Baton Rouge, LA. September 1, 2010.

Dismukes, D. 2010b. Personal communication. Associate Director, LSU Center for Energy Studies, Baton Rouge, LA. August 30, 2010.

Dismukes, D.E., M. Barnett, D. Vitrano, and K. Strellec. 2007. Gulf of Mexico OCS oil and gas scenario examination: Onshore waste disposal. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 2007-051. 5 pp. Internet website: http://www.gomr.boemre.gov/PDFs/2007/2007-051.pdf.

Dodge, R.E., S.C. Wyers, A.H. Knap, H.R. Frith, T.D. Sleeter, and S.R. Smith. 1984. The effects of oil and oil dispersants on hermatypic coral skeletal growth (extension rate). Coral Reefs 3:191-198.

Ducklow, H.W. and R. Mitchell. 1979. Composition of mucus released by coral reef Coelenterates. Limnology and Oceanography 24(4):706-714.

Dunnet, G.M.. D.J. Crisp, G. Conan, and W.R.P. Bourne. 1982. The long-term effects of oil pollution on marine populations, communities and ecosystems. Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences 297(1087):413-427. Internet website: http://www.jstor.org/stable/2396584. Accessed October 28, 2010.

Dunstan, W. M., L.P. Atkinson, J. Natoli. 1975. Stimulation and inhibition of phytoplankton growth by low molecular weight hydrocarbons. Marine Biology, 08-01.

Eccleston, C.H. 2008. NEPA and environmental planning: Tools, techniques, and approaches for practitioners. Boca Raton, FL: CRC Press. 447 pp.

Ejechi, B.O. 2003. Biodegradation of wood in crude oil-polluted soil. World Journal of Microbiology & Biotechnology 19(8):799-804. ISSN: 0959-3993.

Elgershuizen, J.H.B.W. and H.A.M. deKruijf. 1976. Toxicity of crude oils and a dispersant to the stony coral *Madracis mirabilis*. Marine Pollution Bulletin 7(2):22-25.

Energy Resources Co. Inc. (ERCO). 1982. IXTOC oil spill assessment: Executive summary. U.S. Dept. of the Interior, Bureau of Land Management, Contract No. AA851-CTO-71. Cambridge, MA. 39 pp. Internet website: http://www.gomr.mms.gov/PI/PDFImages/ESPIS/3/3977.pdf.

Esler, D., J.A. Schmutz, R.L. Jarvis, and D.M. Mulcahy. 2000. Winter survival of adult female harlequin ducks in relation to history of contamination by the *Exxon Valdez* oil spill. Journal of Wildlife Management 64:839-847.

Fanning, K., K.L. Carder, and P.R. Betzer. 1982. Sediment resuspension by coastal waters: A potential mechanism for nutrient re-cycling on the ocean's margins. Deep-Sea Research 29:953-965.

Fingas, M., F. Ackerman, P. Lambert, K. Li, Z. Wang, J. Mullin, L. Hannon, D. Wang, A. Steenkammer, R. Hiltabrand, R. Turpin, and P. Campagna. 1995. The Newfoundland offshore burn experiment: Further results of emissions measurement. In: Proceedings of the Eighteenth Arctic and Marine Oilspill Program Technical Seminar, Volume 2, June 14-16, 1995, Edmonton, Alberta, Canada. Pp. 915-995.

Fischel, M., W. Grip, and I.A. Mendelssohn. 1989. Study to determine the recovery of a Louisiana marsh from an oil spill. In: Proceedings, 1989 Oil Spill Conference, February 13-16, 1989, San Antonio, TX. Washington, DC: American Petroleum Institute. Pp. 383-387.

Flint, P.L., A.C. Fowler, and R.F. Rockwell. 1999. Modeling losses of birds associated with the oil spill from the M/V *Citrus* off St. Paul Island, Alaska. Ecological Modeling 117:261-267.

Florida Fish and Wildlife Conservation Commission. 2010. Sea turtle nests to be moved Friday. June 22, 2010. 2 pp. Internet website: http://www.myfwc.com/NEWSROOM/10/statewide/News_10_X_OilSpill34.htm. Accessed September 29, 2010.

Flynn, D. 2010. NOAA closes Gulf spill area to fishing. Food Safety News. May 3, 2010. Internet website: http://www.foodsafetynews.com/2010/05/noaa-closes-spill-area-to-fishing/.

Ford, R.G., G.W. Page, and H.R. Carter. 1987. Estimating mortality of seabirds from oil spills. In: Proceedings of the 1987 Oil Spill Conference. Washington, DC: American Petroleum Institute. Pp. 747-751.

Fowler, A.C. and P.L. Flint. 1997. Persistence rates and detection probabilities of oiled King Eider carcasses on beaches of St. Paul Island, Alaska. Marine Pollution Bulletin 34:522-526.

Frithsen, J.B., R. Elmgren, and D.T. Rudnick. 1985. Responses of benthic meiofauna to long-term, low-level additions of No. 2 fuel oil. Marine Ecology Progress Series 23:1-14.

Fry, D.M., J. Swenson, L.A. Addiego, C.R. Grau, and A. Kang. 1986. Reduced reproduction of wedge-tailed shearwaters exposed to weathered Santa Barbara crude oil. Archives of Environmental Contamination and Toxicology 15:453-463.

George-Ares, A. and J.R. Clark. 2000. Aquatic toxicology of two Corexit® registered dispersants. Chemosphere 40(8):897-906.

Geraci, J.R. and D.J. St. Aubin, eds. 1990. Sea mammals and oil: Confronting the risks. San Diego, CA: Academic Press.

Gesteria, J.L.G. and J.C. Dauvin. 2000. Amphipods are good bioindicators of the impact of oil spills on sift-bottom macrobenthic communities. Marine Pollution Bulletin 40(11):1017-1027.

Gittings, S.R., T.J. Bright, W.W. Schroeder, W.W. Sager, J.S. Laswell, and R. Rezak. 1992. Invertebrate assemblages and ecological controls on topographic features in the northeast Gulf of Mexico. Bulletin of Marine Science 50(3):435-455.

Golet, G.H., P.E. Seisner, A.D. McGuire, D.D. Roby, J.B. Fischer, K.J. Kuletz, D.B. Irons, T.A. Dean, S.C. Jewett, and S.H. Newman. 2003. Long-term direct and indirect effects of the *Exxon Valdez* oil spill on pigeon guillemots in Prince William Sound, Alaska. Marine Ecology Progress Series 241:287-304.

González, J, F.G. Figueiras, M. Aranguren-Gassis, B.G. Crespo, E. Fernández, X.A.G. Morán and M. Nieto-Cid. 2009. Effect of a simulated oil spill on natural assemblages of marine phytoplankton enclosed in microcosms. Estuarine, Coastal and Shelf Science 83(3):265-276.

Graham, W.M., R.H. Condon, R.H. Carmichael, I. D'Ambra, H.K. Patterson, L.J. Linn, and F.J. Hernandez, Jr. 2010. Oil carbon entered the coastal planktonic food web during the *Deepwater Horizon* oil spill. Environ. Res. Lett. 5 045301:1-6.

Guzmán, H.M. and I. Holst. 1993. Effects of chronic oil-sediment pollution on the reproduction of the Caribbean reef coral *Siderastrea siderea*. Marine Pollution Bulletin 26:276-282.

Guzman, H.M., J.B.C. Jackson, and E. Weil. 1991. Short-term ecological consequences of a major oil spill on Panamanian subtidal reef corals. Coral Reefs 10:1-12.

Haig, S.M., C.L. Ferland, F.J. Cuthbert, J. Dingledine, J.P. Goossen, A. Hecht, and N. McPhillips. 2005. A complete species census and evidence for regional declines in piping plovers. Journal of Wildlife Management 69:160-173.

Hamilton, P. 1990. Deep currents in the Gulf of Mexico. Journal of Physical Oceanography 20:1087-1104.

Hargreaves, S. 2010. Drilling ban: Jobs at stake. Internet website: http://money.cnn.com/2010/06/24/news/economy/drilling_jobs_at_stake/index.htm?postversion=2010062410. Accessed June 30, 2010.

Hazen, T.C., E.A. Dubinsky, T.Z. DeSantis, G.L. Andersen, Y.M. Picento, N. Singh, J.K. Jansson, A. Probst, S.E. Borglin, J.L. Fortney, W.T. Stringfellow, M. Bill, M.S. Conrad, L.M. Tom, K.L. Chavarria, T.R. Alusi, R. Lamendella, D.C. Joyner, C. Spier, J. Baelum, M. Auer, M.L. Zelma, R. Chakraborty, E.L. Sonnenthal, P. D'haeseleer, H.N. Holman, S. Osman, Z. Lu, J.D. Van Nostrand, Y. Deng, J. Zhou, and O.U. Mason. 2010. Deep-sea oil plume enriches indigenous oil-degrading bacteria. Science Express. August 24, 2010.

Hemmer, M.J., M.G. Barron, and R.M. Greene. 2010. Comparative toxicity of Louisiana sweet crude oil (LSC) and chemically dispersed LSC to two Gulf of Mexico aquatic test species. U.S. Environmental Protection Agency, Office of Research and Development. July 31, 2010.

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

Henry, J.M. and C.L. Bankston III. 1999. Louisiana Cajun ethnicity: Symbolic or structural? Sociological Spectrum: Mid-South Sociological Association, 1521-0707, 19(2):223-248.

Hernandez, D. 2010. Here's where BP is dumping its oil spill waste. ColorLines. August 4 2010. Internet website: http://colorlines.com/archives/2010/08/heres_where_bp_is_dumping_its_oil_spill_waste.html.

Hernandez, F.J., S. Powers, and W. Graham. 2010. Seasonal variability in ichthyoplankton abundance and seasonal composition in the northern Gulf of Mexico off Alabama. Fish Bull 108:193-207.

Hiett, R.L. and J.W. Milon. 2002. Economic impact of recreational fishing and diving associated with offshore oil and gas structures in the Gulf of Mexico: Final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2002-010. 98 pp.

Hing, L.S., T. Ford, P. Finch, M. Crane, and D. Morritt. 2011. Laboratory stimulation of oil-spill effects on marine phytoplankton. Aquat. Toxicol. 103(1-2):32-7.

Hogan, J.L. 2003. Occurrence of the diamondback terrapin (*Malaclemys terrapin littoralis*) at South Deer Island in Galveston Bay, Texas, April 2001–May 2002. U.S. Dept. of the Interior, Geological Survey. USGS Open File Report 03-022. 30 pp.

Howell, K. 2010. Gulf spill roundup. *Greenwire,* July 2, 2010.

Hsieh, J.L., J.S. Fries, and R.T. Noble. 2007. *Vibrio* and phytoplankton dynamics during the summer of 2004 in a eutrophying estuary. Ecological Applications 17(5):S102-S109.

Institute of Medicine. 2010. Assessing the effects of the Gulf of Mexico oil spill on human health: A summary of the June 2010 workshop. Washington, DC: The National Academies Press. Internet website: http://www.iom.edu/Reports/2010/Assessing-the-Effects-of-the-Gulf-of-Mexico-Oil-Spill-on-Human-Health.aspx.

Inter-agency. 2010a. BP *Deepwater Horizon* oil budget: What happened to the oil? 5 pp. Internet website: http://www.restorethegulf.gov/sites/default/files/imported_pdfs/posted/2931/Oil_Budget_description_8_3_FINAL.844091.pdf.

Inter-agency. 2010b. Estimating the economic effects of the deepwater drilling moratorium on the Gulf Coast economy. 25 pp. Internet website: http://www.esa.doc.gov/drilling_moratorium.pdf.

Inter-agency. 2010c. Oil budget calculator: *Deepwater Horizon*. 40 pp. Internet website: http://www.restorethegulf.gov/sites/default/files/documents/pdf/OilBudgetCalc_Full_HQ-Print_111110.pdf.

Jackson, J.B.C., J.D. Cubit, B.D. Keller, V. Batista, K. Burns, H.M. Caffey, R.L. Caldwell, S.D. Garrity, C.D. Getter, C. Gonzalez, H.M. Guzman, K.W. Kaufmann, A.H. Knap, S.C. Levings, M.J. Marshall, R. Steger, R.C. Thompson, and E. Weil. 1989. Ecological effects of a major oil spill on Panamanian coastal marine communities. Science 243:37-44.

Jernelöv, A. and O. Lindén. 1981. *Ixtoc I*: A case study of the world's largest oil. Ambio 10(6):299-306.

Jindal, Governor Bobby. 2010. Governor Jindal letter to President Obama and Secretary Salazar: Severe impacts of moratorium on deepwater drilling. Internet website: http://emergency.louisiana.gov/Releases/06032010-letter.html. Accessed June 30, 2010.

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

Joint Analysis Group. 2010. Review of R/V *Brooks McCall* data to examine subsurface oil. Internet website: http://www.noaa.gov/sciencemissions/PDFs/JAG_Report_1_BrooksMcCall_Final_June20.pdf. Accessed October 14, 2010.

Kaplan, M.F. and C. Whitman. Unpublished. Measuring the economic impact of tourism and recreation industries on Gulf Coast communities—Relationship between OCS development and coastal resources (2008). U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. Contract No. 1435-01-99-CA-30951-18261. x + 164 pp.

Kennedy, C.J., N.J. Gassman, and P.J. Walsh. 1992. The fate of benzo[a]pyrene in the Scleractinian corals *Favia fragrum* and *Montastrea annularis*. Marine Biology 113:313-318.

Keithly, W and H. Diop. 2001. The demand for eastern oysters, Crassostrea virginica, from the Gulf of Mexico in the presence of *Vibrio vulnificus*. Marine Fisheries Review 63(1):47-53.

Kingston, P.F., I.M.T. Dixon, S. Hamilton, and D.C. Moore. 1995. The impact of the *Braer* oil spill on the macrobenthic infauna of the sediments off the Shetland Islands. Marine Pollution Bulletin 30(7):445-459.

Kirkeleit J., T. Riise, M. Bråtveit and B.E. Moen. 2008. Increased risk of acute myelogenous leukemia and multiple myeloma in a historical cohort of upstream petroleum workers exposed to crude oil. Cancer Causes Control. 2008 Feb, 19(1):13-23. Epub 2007 Sep 29. Internet website: http://www.ncbi.nlm.nih.gov/pubmed/17906934.

Kirsch, E.M. and J.G. Sidle. 1999. Status of the interior population of least tern. Journal of Wildlife Management 63:470-483.

Knap, A.H. 1987. Effects of chemically dispersed oil on the brain coral, *Diploria strigosa*. Marine Pollution Bulletin 18(3):119-122.

Knap, A.H., J.E. Solbakken, R.E. Godge, T.D. Sleeter, S.C. Wyers, and K.H. Palmork. 1982. Accumulation and elimination of (9-14C) phenanthrene in the reef-building coral (*Diploria strigosa*). Bulletin of Environmental Contamination and Toxicology 28:281-284.

Knap, A.H., S.C. Wyers, R.E. Dodge, T.D. Sleeter, H.R. Frith, S.R. Smith, and C.B. Cook. 1985. The effects of chemically and physically dispersed oil on the brain coral, *Diploria strigosa* (Dana)—a summary review. In: Proceedings 1985 Oil Spill Conference, Los Angeles, CA. (USCG/API/EPA) API Publ. No. 4385:547-551.

Knowland Group, The. 2010. Survey data. Internet website: http://www.hotelnewsresource.com/article46295.html.

Kushmaro, A., G. Henning, D.K. Hofmann, and Y. Benayahu. 1997. Metamorphosis of *Heteroxenia fuscescens* Plaunlae (Cnidaria: Octocorallia) is inhibited by crude oil: A novel short term toxicity bioassay. Marine Environmental Research 43(4):295-302.

Lange, R. 1985. A 100 ton experimental oil spill at Halten Bank, off Norway. In: Proceedings, 1985 Oil Spill Conference. . .February 25-28, 1985, Los Angeles, CA. Washington, DC: American Petroleum Institute.

LeDee, O.E., F.J. Cuthbert, and P.V. Bolstad. 2008. A remote sensing analysis of coastal habitat composition for a threatened shorebird, the piping plover (*Charadrius melodus*). Journal of Coastal Research 24:719-726.

Leighton, F.A. 1993. The toxicity of petroleum oils to birds. Environ. Rev. 1:92-103.

Lewis, J.B. 1971. Effects of crude oil and oil spill dispersant on coral reefs. Marine Pollution Bulletin 2:59-62.

Lin, Q., I.A. Mendelssohn, M.T. Suidan, K. Lee, and A.D. Venosa. 2002. The dose-response relationship between No. 2 fuel oil and the growth of the salt marsh grass, *Spartina alterniflora*. Marine Pollution Bulletin 44:897-902.

Lin Q. and I. Mendlessohn. 2009. Potential of restoration and phytoremediation with *Juncus roemerianus* for diesel-contaminated coastal wetlands. Ecological Engineering 8 January 2009, pp. 85-91. Internet website: http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VFB-4V2J6J8-4&_user=10&_coverDate=01%2F08%2F2009&_rdoc=1&_fmt=high&_orig=search&_origin=search&_sort=d&_docanchor=&view=c&_searchStrId=1619317074&_rerunOrigin=scholar.google&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=e4e701499ce803ec8e0d60bf57c2d99c&searchtype=a. Accessed December 16, 2010.

Louisiana, The State of. 2010a. Report on oil sightings throughout coastal Louisiana. Press Release. September 17, 2010. Internet website: http://emergency.louisiana.gov/Releases/91710Sightings.html.

Louisiana, The State of. 2010b. Report on oil sightings throughout coastal Louisiana. Press Release. September 16, 2010. Internet website: http://emergency.louisiana.gov/Releases/091610Sightings.html.

Louisiana, The State of. 2010c. Report on oil sightings throughout coastal Louisiana. Press Release. September 14, 2010. Internet website: http://emergency.louisiana.gov/Releases/91410Sightings.html.

Louisiana, The State of. 2010d. Report on oil sightings throughout coastal Louisiana. Press Release. September 13, 2010. Internet website: http://emergency.louisiana.gov/Releases/91310Sightings.html.

Louisiana, The State of. 2010e. Report on coastal skimming activities in Louisiana. Press Release. September 17, 2010. Internet website: http://emergency.louisiana.gov/Releases/91710Skimming.html.

Louisiana Mid-Continent Oil and Gas Association. 2010. Impact of President Obama's order halting work on 33 exploratory wells in the deepwater Gulf of Mexico. Internet website: http://www.lmoga.com/Economic%20Impacts%20of%20Gulf%20Moratorium.pdf. Accessed July 7, 2010.

Louisiana Universities Marine Consortium (LUMCON). 2010. 2010 Dead zone—one of the largest ever. LUMCON News. Internet website: http://www.lumcon.edu/Information/news/default.asp?XMLFilename=201008021451.xml. Accessed August 10, 2010.

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

Market Dynamics Research Group. 2010. Importance of leisure travel attributes and perceptions of Louisiana. Internet website: http://www.louisianatravel.com/.

McAuliffe, C.D., A.E. Smalley, R.D. Groover, W.M. Welsh, W.S. Pickle, and G.E. Jones. 1975. Chevron Main Pass Block 41 oil spill: Chemical and biological investigation. In: Proceedings, 1975 Conference on Prevention and Control of Oil Pollution, March 25-27, 1975, San Francisco, CA. Washington, DC: American Petroleum Institute.

McAuliffe, C.D., B.L. Steelman, W.R. Leek, D.F. Fitzgerald, J.P. Ray, and C.D. Barker. 1981. The 1979 southern California dispersant treated research oil spills. In: Proceedings 1981 Oil Spill Conference. March 2-5, 1981, Atlanta, GA. Washington, DC: American Petroleum Institute. Pp. 269-282.

McGimsey, C. 2010. Personal communication. Discussion with the State Archaeologist, Louisiana Division of Archaeology, Department of Culture, Recreation, and Tourism with regard to effects of the oil spill on cultural resources.

Mechalas, B.J. 1974. Pathways and environmental requirements for biogenic gas production in the ocean. In: Kaplan, I.R., ed. Natural Gases in Marine Sediments. Marine Science, Volume 3. New York, NY: Plenum Press.

Michel, J. 1992. Chapter 2. Oil behavior and toxicity. In: Introduction to coastal habitats and biological resources for spill response. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Office of Response and Restoration. NOAA Report No. HMRAD 92-4. Internet website: http://response.restoration.noaa.gov/type_subtopic_entry.php?RECORD_KEY%28entry_subtopic_type%29=entry_id,subtopic_id,type_id&entry_id(entry_subtopic_type)=275&subtopic_id(entry_subtopic_type)=8&type_id(entry_subtopic_type)=2.

Mitchell, R. and I. Chet. 1975. Bacterial attack of corals in polluted seawater. Microbial Ecology 2:227-233.

Mock, B. 2010. Boats moored by the BP oil spill, a long-threatened community of black fishers fears for its future. The Lens: Investigating New Orleans and the Gulf Coast. Internet website: http://www.projectnola.com/component/content/article/86-the-lens/90049-boats-moored-by-the-bp-oil-spill-a-long-threatened-community-of-black-fishers-fears-for-its-future. Accessed May 2010.

Moore, S.F. and R.L. Dwyer. 1974. Effects of oil on marine organisms: A critical assessment of published data. Water Research 8:819-827.

Morton R.A., T.L. Miller, and L.J. Moore. 2004. Historical shoreline changes along the US Gulf of Mexico: A summary of recent shoreline. U.S. Dept. of the Interior, Geological Survey. Open File Report 2004-1089. Internet website: http://pubs.usgs.gov/of/2004/1089/references.html.

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

National Association for the Advancement of Colored People (NAACP). 2010. NAACP blasts BP for oil spill response. July 10, 2010. Internet website: http://www.naacp.org/blog/entry/naacp-blasts-bp-for-oil-spill-response/.

National Research Council (NRC). 2003. Oil in the sea III: Inputs, fates, and effects (Committee on Oil in the Sea: J.N. Coleman, J. Baker, C. Cooper, M. Fingas, G. Hunt, K. Kvenvolden, J. McDowell, J. Michel, K. Michel, J. Phinney, N. Rabalais, L. Roesner, and R.B. Spies). Washington, DC: National Academy Press. 265 pp.

National Research Council (NRC). 2005. Oil spill dispersants: Efficacy and effects. Washington, DC: National Academy Press. 377 pp.

NaturalGas.org. 2010. Background. Internet website: http://www.naturalgas.org/overview/background.asp. Accessed August 25, 2010.

Neff, J.M., S. McKelvie, and R.C. Ayers, Jr. 2000. Environmental impacts of synthetic based drilling fluids. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-064. 118 pp.

Newton, I. 1998. Population limitation in birds. San Diego, CA: Academic Press.

Nodar, J. 2010. Gulf tanker decontaminated before entering Mississippi. T he Journal of Commerce Online. May 26, 2010. Internet website: http://www.joc.com/maritime/tanker-requires-cleaning-entering-mississippi-river.

Nolan, B. and A. Good. 2010. Moratorium in wake of Gulf oil spill idles much more than rigs, workers. Internet website: http://www.nola.com/news/gulf-oil-spill/index.ssf/2010/07/moratorium_in_wake_of_gulf_oil.html. Accessed July 6, 2010.

OBIS-SEAMAP. 2 009. Sea turtle nesting sites: OBIS-SEAMAP. State of the World's Sea Turtles (SWOT). 2009. Internet website: http://seamap.env.duke.edu/swot.

Odess, D. 2010. Personal communication. Telecon regarding Section 106 in relation to response to the oil spill.

Odess, D. 2011. Personal communication. Trustees Meeting January 12, 2011, New Orleans, LA.

Office of the Governor, State of Florida. 2010. Gulf oil spill situation update. Florida Releases. July 18, 2010. Internet website: http://www.thegovmonitor.com/world_news/united_states/florida-releases-july-18-2010-gulf-oil-spill-situation-update-35721.html.

Operational Science Advisory Team. 2011. Summary report for fate and effects of remnant oil remaining in the beach environment. Annex B: Spatial oil distribution. 35 pp. Internet website: http://www.restorethegulf.gov/sites/default/files/u316/OSAT-2%20Report%20no%20ltr.pdf.

Oxford Economics. 2010. Potential impact of the Gulf oil spill on tourism. Internet website: http://www.ustravel.org/sites/default/files/page/2009/11/Gulf_Oil_Spill_Analysis_Oxford_Economics_710.pdf.

Patin, S. 1999. Gas impacts on fish and other marine organisms. In: Environmental impact of the offshore oil and gas industry. New York, NY: EcoMonitor Publishing. 425 pp.

PCCI Marine and Environmental Engineering (PCCI). 1999. Oil spill containment, remote sensing and tracking for deepwater blowouts: Status of existing and emerging technologies, final report. Prepared for U.S. Dept. of the Interior, Minerals Management Service, Alexandria, VA. Purchase Order Number 1435-01-98-PO-15135. Internet website: http://www.boemre.gov/tarprojects/311/311AA.pdf.

Peterson, C.H., S.D. Rice, J.W. Short, D. Esler, J.L. Bodkin, B.E. Ballachey, and. D.B. Irons. 2003. Long-term ecosystem response to the *Exxon Valdez* oil spill. Science 302:2082-2086.

Piatt, J.F. and R.G. Ford. 1996. How many seabirds were killed by the *Exxon Valdez* oil spill? In: Rice, S.D., R.B. Spies, D.A. Wolfe, and B.A. Wright, eds. Proceedings of the *Exxon Valdez* oil spill symposium. Am. Fisheries Soc. Symposium 18, Bethesda, MD. Pp. 712-719.

Piatt, J.F., H.R. Carter, and D.N. Nettleship. 1990. Effects of oil pollution on marine bird populations. In: White, J., ed. The effects of oil on wildlife: Research, rehabilitation and general concerns. Hanover, PA: Sheridan Press.

Plotkin, P.T., ed. 1995. National Marine Fisheries Service and U.S. Fish and Wildlife Service Status reviews for sea turtles listed under the Endangered Species Act of 1973. U.S. Dept. of Commerce, National Marine Fisheries Service, Silver Spring, MD.

Powell, J.A. and G.B. Rathbun. 1984. Distribution and abundance of manatees along the northern coast of the Gulf of Mexico. Northeast Gulf Sci. 7:1-28.

Pritchard, E.S., ed. 2009. Fisheries of the United States: 2008. U.S. Dept. of Commerce, National Marine Fisheries Service, Office of Science and Technology, Fisheries Statistics Division, Silver Spring, MD.

Ragen, T.J. 2010. Testimony of Timothy J. Ragen, Executive Director, U.S. Marine Mammal Commission, before the House Subcommittee on Insular Affairs, Oceans, and Wildlife, regarding the *Deepwater Horizon* oil spill and its effects on marine mammals. June 10, 2010. 8 pp. Internet website: http://www.mmc.gov/testimony/pdf/testimony_061010.pdf. Accessed September 29, 2010.

Rathbun, G.B., J.P. Reid, and G. Carowan. 1990. Distribution and movement patterns of manatees (*Trichechus manatus*) in northwestern peninsular Florida. FL Mar. Res. Publ. No. 48. 33 pp.

Ravitz, J. 2010. Vietnamese fishermen in Gulf fight to not get lost in translation. CNN. June 25, 2010. Internet website: http://www.flutrackers.com/forum/showthread.php?t=148708.

Regg, J. 2000. Deepwater development: A reference document for the deepwater environmental assessment, Gulf of Mexico OCS (1997 through 2000). U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Report MMS 99-0066. Internet website: http://www.gomr.boemre.gov/PDFs/2000/2000-015.pdf.

Restrepo, C.E., F.C. Lamphear, C.A. Gunn, R.B. Ditton, J.P. Nichols, and L.S. Restrepo. 1982. IXTOC I oil spill economic impact study, executive summary. Report prepared by Restrepo and Associates for the U.S. Dept. of the Interior, Bureau of Land Management, New Orleans OCS Office, New Orleans, LA.

Rhodes, D.C. and J.D. Germano. 1982. Characterization of organism-sediment relations using sediment profile imaging: An efficient method of remote ecological monitoring of the seafloor (Remots™ System). Marine Ecology Progress Series 8:115-128.

Rice, S.A. and C.L. Hunter. 1992. Effects of suspended sediment and burial on Scleractinian corals from west central Florida patch reefs. Bulletin of Marine Science 51(3):429-442.

Rogers, C.S. 1990. Responses of coral reefs and reef organisms to sedimentation. Marine Ecology Progress Series 62:185-202.

Rogers, C.S. and V.H. Garrison. 2001. Ten years after the crime: Lasting effects of damage from a cruise ship anchor on a coral reef in St. John, U.S. Virgin Islands. Bulletin of Marine Science 69(2):793-803.

Russell, R.W. 2005. Interactions between migrating birds and offshore oil and gas platforms in the northern Gulf of Mexico: Final Report. U.S. Dept. of the Interior, Minerals Management Service, U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2005-009. 348 pp.

Sanders, H.L., J.F. Grassle, G.R. Hamson, L.S. Morse, S. Garner-Price, and C.C. Jones. 1980. Anatomy of an oil spill: Long-term effects from the grounding of the barge *Florida* off West Falmouth, Massachusetts. Journal of Marine Research 38:265-380.

Savitz, D.A. and L.S. Engel. 2010. Lessons for study of the health effects of oil spills. Annals of Internal Medicine. August 23, 2010. Internet website: http://www.annals.org/content/early/2010/08/23/0003-4819-153-8-201010190-00276.full.

Sathiakumar, N. 2010. Short-term physical effects of oil spills. Presentation, School of Public Health, University of Alabama at Birmingham. Internet website: http://www.iom.edu/~/media/Files/Activity%20Files/PublicHealth/OilSpillHealth/NaliniSathiakumar-6-22-1110am.pdf.

Schenkman, L. 2010. Gulf cruise raises questions on methane, but much data still to analyze. *Science Insider*. June 23, 2010. Internet website: http://news.sciencemag.org/scienceinsider/2010/06/gulf-cruise-raises-questions-on-.html.

Schiro, A.J., D. Fertl, L.P. May, G.T. Regan, and A. Amos. 1998. West Indian manatee (*Trichechus manatus*) occurrence in U.S. waters west of Florida. Presentation, World Marine Mammal Conference, 20-24 January, Monaco.

Schleifstein, M. 2010. Environmental justice concerns arising from Gulf of Mexico oil spill aired. *The Times-Picayune*. June 15, 2010. Internet website : http://www.nola.com/news/gulf-oil-spill/index.ssf/2010/06/environmental_justice_concerns.html.

Scholz, D.K., J.H. Kucklick, R.G. Pond, A.H. Walker, A. Bostrom, and P. Fischbeck. 1999. Fate of spilled oil in marine waters: Where does it go? What does it do? How do dispersants affect it? An information booklet for decision-makers. American Petroleum Institute Publication Number 4691.

ScienceDaily. 2010. Spawning habitat of bluefin tuna in Gulf of Mexico: Critical area intersects *Deepwater Horizon* oil spill. May 31, 2010. Internet website: http://www.sciencedaily.com/releases/2010/05/100528210726.htm.

Sheridan, P. and T.J. Minello. 2003. Nekton use of different habitat types in seagrass beds of lower Laguna Madre, Texas. Bulletin of Marine Science 72(1):37-61.

Shigenaka, G. 2001. Toxicity of oil to reef-building corals: A spill response perspective. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Office of Response and Restoration, Hazardous Materials Response Division, Seattle, WA. NOAA Technical Memorandum NOS OR&R 8. 95 pp. Internet website: http://response.restoration.noaa.gov/book_shelf/1_coral_tox.pdf.

Short, F.T. and R.G. Coles, eds. 2001. Global seagrass research methods. Amsterdam, The Netherlands: Elsevier Science B.V. 473 pp.

Short, F.T., R.G. Coles, and C. Pergent-Martini. 2001. Global seagrass distribution. In: Short, F.T. and R.G. Coles, eds. Global seagrass research methods. Amsterdam, The Netherlands: Elsevier Science B.V. Pp 5-6, 20.

St. Aubin, D.J. and V. Lounsbury. 1990. Oil effects on manatees: Evaluating the risks. In: Geraci, J.R. and D.J. St. Aubin, eds. Sea mammals and oil: Confronting the risk. San Diego, CA: Academic Press. Pp. 241-251.

Stumpf, C.H., M.F. Piehler, S. Thompson, and R.T. Noble. 2010. Loading of fecal indicator bacteria in tidal creek headwaters: Hydrographic, meteorological, and terrestrial runoff relationships. Journal of Water Research 44(16):4704-15.

Szell, C.C. and M.S. Woodrey. 2003. Reproductive ecology of the least tern along the lower Mississippi River. Waterbirds 26:35-43.

Tasker, M.L., P. Hope-Jones, B.F. Blake, T.J. Dixon, and A.W. Wallis. 1986. Seabirds associated with oil production platforms in the North Sea. Ringing and Migration 7:7-14.

Taylor, H.A., M.A. Rasheed, and R. Thomas. 2006. Port Curtis post oil spill seagrass assessment, Gladstone-2006. DPI&F Information Series QI06046 (DPI&F, Cairns). 19 pp. Internet website: http://www.seagrasswatch.org/Info_centre/Publications/pdf/meg/GladstonePostOilSpillReport2006_Final.pdf.

Thompson, J.H. 1980. Effects of drilling mud on seven species of reef-building coral as measured in field and laboratory. Report to the U.S. Dept. of Interior, Geological Survey by Texas A&M University, Department of Oceanography, College Station, TX.

Tokotch, B. 2010. Oil and coral fact sheet. 3 pp. Internet website: http://sero.nmfs.noaa.gov/sf/deepwater_horizon/Oil-CoralOnePage.pdf.

Tolbert, C.M. 1995. Oil and gas development and coastal income inequality: A comparative analysis. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 94-0052. 75 pp.

Trapido, E.J., Sc.D., F.A.C.E. 2010. Health and the *Deepwater Horizon* Gulf oil spill. (October 5-6, 2010). JSOST *Deepwater Horizon* Oil Spill Principal Investigator (PI) Conference, St. Petersburg, FL.

Unified Incident Command. 2010a. Vessel decontamination stations available around Louisiana. *Deepwater Horizon* Incident Joint Information Center. June 20, 2010. Internet website: http://www.deepwaterhorizonresponse.com/go/doc/2931/679467/.

Unified Incident Command. 2010b. Ask a responder: Q & A with Coast Guard Task Force leader for commercial vessel decontamination. September 29, 2010. Internet website: http://www.deepwaterhorizonresponse.com/go/doc/2931/828195/.

Unified Incident Command. 2010c. Media availability: Media invited to observe commercial-vessel decontamination operations. June 23, 2010. Internet website: http://www.deepwaterhorizonresponse.com/go/doc/2931/687191/.

Unified Incident Command. 2010d. Fish and Wildlife report, consolidated Fish and Wildlife collection report. Internet website: http://www.deepwaterhorizonresponse.com/go/doctype/2931/55963/&offset=0. Accessed September 29, 2010.

Unified Incident Command. 2010e. Unified Area Command continues to build a sea turtle observer program for on-water oil clean-up. *Deepwater Horizon* Incident Joint Information Center. July 2, 2010. Internet website: http://www.deepwaterhorizonresponse.com/go/doc/2931/734531/.

Unified Incident Command. 2010f. Unified Area Command daily report, August 25, 2010.

U.S. Department of Labor. Occupational Safety & Health Administration. 2010. On-shore & off-shore PPE matrix for Gulf operations. Internet website: http://www.osha.gov/oilspills/gulfoperations-ppe-matrix.pdf.

U.S. Department of Labor. Occupational Safety & Health Administration. 2010. Keeping workers safe during oil spill response and cleanup operations: Gulf oil response and heat. Internet website: http://www.osha.gov/oilspills/heatstress.html.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). 2010a. NOAA assists with multi-agency effort to decontaminate ships passing through oil spill. Internet website: http://www.noaanews.noaa.gov/stories2010/20100528_ships.html. Accessed May 28, 2010.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). 2010b. Administration's Joint Analysis Group releases first scientific report on subsea monitoring data from Gulf spill. Internet website: http://www.noaanews.noaa.gov/stories2010/20100623_brooks.html. Updated June 23, 2010.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). 2010c. Second Federal analysis gives further clues about location and movement of subsurface oil. July 23, 2010. Internet website: http://www.noaanews.noaa.gov/stories2010/20100722_jag.html.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). 2010d. No dead zones observed or expected as part of BP *Deepwater Horizon* oil spill. September 7, 2010. Internet website: http://www.noaanews.noaa.gov/stories2010/20100907_jag3.html.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). 2010e. Using booms in response to oil spills. 4 pp. Internet website: http://sero.nmfs.noaa.gov/sf/deepwater_horizon/NOAA_boom_fact_sheet.pdf. Accessed September 29, 2010.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). 2010f. What is an ecosystem? Internet website: http://ecosystems.noaa.gov/what_eco.htm. Accessed October 1, 2010.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). 2010g. NOAA closes commercial and recreational fishing in oil-affected portion of Gulf of Mexico. May 2, 2010. Internet website: http://www.noaanews.noaa.gov/stories2010/20100502_fisheries.html.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). Hazardous Materials Response and Assessment Division. 1992. Oil spill case histories, 1967-1991: Summaries of significant U.S. and international spills. HMRAD 92-11 to USCG Research and Development Center, Seattle, WA.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). National Marine Fisheries Service (NMFS). 2010a. Sea turtles, dolphins, and whales and the Gulf of Mexico oil spill. Internet website: http://www.nmfs.noaa.gov/pr/health/oilspill.htm. Accessed June 10, 2011.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). National Marine Fisheries Service (NMFS). 2010b. Fisheries economics of the United States, 2008. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-F/SPO-109. 177 pp. Internet website: http://www.st.nmfs.noaa.gov/st5/publication/index.html.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). National Marine Fisheries Service (NMFS). 2010c Annual commercial landings by group. 2 pp. Internet website: http://www.st.nmfs.noaa.gov/st1/commercial/landings/gc_runc.html. Accessed July 10, 2010

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). National Marine Fisheries Service (NMFS). 2010d. Impacts of oil on marine mammals and sea turtles. 2 pp. Internet website: http://www.nmfs.noaa.gov/pr/pdfs/health/oil_impacts.pdf.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). National Ocean Service (NOS). 2008. Gulf of Mexico at a glance. Washington, DC: U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration.

U.S. Department of Commerce. National Oceanic Atmospheric Administration (NOAA). National Weather Service. 2010a. Tropical cyclone climatology. Internet website: http://www.nhc.noaa.gov/pastprofile.shtml. Updated July 14, 2010.

U.S. Department of Commerce. National Oceanic Atmospheric Administration (NOAA). National Weather Service. 2010b. NOAA's oil spill response: Hurricanes and the oil spill. Internet website: http://www.nhc.noaa.gov/pdf/hurricanes_oil_factsheet.pdf. Accessed May 27, 2010.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). NOAA Fisheries Service. 2010a. Information about the Federal fishing closure in oil-affected portions of the Gulf of Mexico. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, NOAA Fisheries Service, Southeast Regional Office, Saint Petersburg, FL. Southeast Fishery Bulletin, July 12, 2010. Internet website: http://sero.nmfs.noaa.gov/sf/deepwater_horizon/FB_Closure%20info_Eng.pdf

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). NOAA Fisheries Service. 2010b. *Deepwater Horizon*/BP oil spill: Size and percent coverage of fishing area closures due to BP oil spill. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, NOAA Fisheries Service, Southeast Regional Office, Saint Petersburg, FL. Internet website: http://sero.nmfs.noaa.gov/ClosureSizeandPercentCoverage.htm. Updated September 21, 2010.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). NOAA Fisheries Service. 2011. Dolphins and whales and the Gulf of Mexico oil spill. Internet website: http://www.nmfs.noaa.gov/pr/health/oilspill/mammals.htm. Last updated June 29, 2011. Accessed July 12, 2011.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). Office of Response and Restoration. 2010a. IXTOC I. Internet website: http://www.incidentnews.gov/incident/6250. Accessed on September 23, 2010.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). Office of Response and Restoration. 2010b. Chevron Main Pass Block 41. Internet website: http://www.incidentnews.gov/incident/6209. Accessed on September 23, 2010.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). Office of Response and Restoration. 2010c. Shell Platform 26. Internet website: http://www.incidentnews.gov/incident/6211. Accessed on September 23, 2010.

U.S. Department of Commerce. National Oceanic and Atmospheric Administration (NOAA). Office of Response and Restoration. 2010d. Shoreline threat update: Southern Florida, Florida Keys and East Coast *Deepwater Horizon*/BP oil spill, July 30, 2010. Internet website: http://response.restoration.noaa.gov/topic_subtopic_entry.php?RECORD_KEY%28entry_subtopic_topic%29=entry_id,subtopic_id,topic_id&entry_id(entry_subtopic_topic)=815&subtopic_id(entry_subtopic_topic)=2&topic_id(entry_subtopic_topic)=1#evolution.

U.S. Department of Labor. 2010a. Quarterly census of employment and wages. Internet website: http://data.bls.gov:8080/PDQ/outside.jsp?survey=en.

U.S. Department of Labor. 2010b. QCEW fact sheet. June 2010. Internet website: http://www.bls.gov/cew/gulf_coast_leisure_hospitality.htm.

U.S. Department of Labor. Bureau of Labor Statistics (BLS). 2010. Fact sheet: Employment in the oil and gas well drilling industry. Internet website: http://www.bls.gov/cew/oil_gas_drilling.htm. Accessed July 1, 2010.

U.S. Department of Labor. Occupational Safety and Health Administration (OSHA). 2010a. Internet website: http://www.osha.gov/oilspills/index_sampling.html. Accessed on September 22, 2010.

U.S. Department of Labor. Occupational Safety and Health Administration (OSHA). 2010b. Direct reading results by site. Internet website: http://www.osha.gov/oilspills/oil_directreading_bysite.html. Updated August 4, 2010.

U.S. Department of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE). 2010a. Spills ≥50 barrels (2,100 gallons)—1967. Internet website: http://www.boemre.gov/incidents/SigPoll67.htm. Updated September 17, 2010.

U.S. Department of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE). 2010b. Gulf of Mexico Region, Spills ≥ 50 barrels (2,100 gallons)—1970. Internet website: http://www.boemre.gov/incidents/SigPoll70.htm.

U.S. Department of the Interior. Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE). 2010c. Technical Information Management System (TIMS). Accessed September 13, 2010.

U.S. Department of the Interior. Fish and Wildlife Service (FWS). 2004. Effects of oil spills on wildlife and habitat. December 2004. Internet website: http://alaska.fws.gov/media/unalaska/Oil%20Spill%20Fact%20Sheet.pdf.

U.S. Department of the Interior. Fish and Wildlife Service (FWS). 2007. Alabama beach mouse—revision of critical habitat. January 2007. Daphne Ecological Services Field Office. Internet website: http://www.fws.gov/daphne/abm/pdf/ABM-FactSheet-finalCH-1-30-07.pdf.

U.S. Department of the Interior. Fish and Wildlife Service (FWS). 2009. Stock assessment report for the West Indian manatee Florida stock. U.S. Dept. of the Interior, Fish and Wildlife Service, Jacksonville, FL. December 20, 2009. Internet website: http://www.fws.gov/northflorida/Manatee/SARS/20091230_rpt_Final_Florida_Manatee_SAR.pdf.

U.S. Department of the Interior. Fish and Wildlife Service (FWS). 2010a. Wildlife threatened on the Gulf Coast. June 2010. Internet website: http://www.fws.gov/home/dhoilspill/pdfs/NewWildlifeOfGulf.pdf.

U.S. Department of the Interior. Fish and Wildlife Service (FWS). 2010b. Federally listed wildlife and plants threatened by Gulf oil spill. June 2010. Internet website: http://www.fws.gov/home/dhoilspill/pdfs/FedListedBirdsGulf.pdf.

U.S. Department of the Interior. Fish and Wildlife Service (FWS). 2010c. Beach-nesting birds of the Gulf. May 2010. Internet website: http://www.fws.gov/home/dhoilspill/pdfs/DHBirdsOfTheGulf.pdf.

U.S. Department of the Interior. Fish and Wildlife Service (FWS). 2010d. Bird impact data from DOI-ERDC database download 12 Oct. 2010. Internet website: http://www.fws.gov/home/dhoilspill/pdfs/Bird%20Data%20Species%20Spreadsheet%2010122010.pdf.

U.S. Department of the Interior. Fish and Wildlife Service (FWS). 2010e. State and Federal wildlife agencies, other partners, move to safeguard sea turtle nests; FedEx providing transportation to Florida's Space Coast. News Release, July 9, 2010. Internet website: http://www.fws.gov/southeast/news/2010/r10-048.html.

U.S. Department of the Interior. Fish and Wildlife Service (FWS). 2010f. Species report. Internet website: http://ecos.fws.gov/tess_public/SpeciesReport.do. Accessed August 30, 2010.

U.S. Department of the Interior. Fish and Wildlife Service (FWS). 2010g. Effects of oil on wildlife and habitat. Fact Sheet, June 2010. Internet website: http://www.fws.gov/home/dhoilspill/pdfs/DHJICFWSOilImpactsWildlifeFactSheet.pdf.

U.S. Department of the Interior. Minerals Management Service (MMS). 2000. Gulf of Mexico deepwater operations and activities: Environmental assessment. U.S. Dept. of the Interior, Minerals

Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2000-001. Internet website: http://www.gomr.boemre.gov/PDFs/2000/2000-001.pdf.

U.S. Department of the Interior. Minerals Management Service (MMS). 2007. Gulf of Mexico OCS oil and gas lease sales: 2007-2012; Western Planning Area Sales 204, 207, 210, 215, and 218; Central Planning Area Sales 205, 206, 208, 213, 216, and 222—final environmental impact statement. 2 vols. U.S. Dept. the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2007-018.

U.S. Department of the Interior. Minerals Management Service (MMS). 2008. Gulf of Mexico OCS oil and gas lease sales: 2009-2012; Central Planning Area Sales 208, 213, 216, and 222; Western Planning Area Sales 210, 215, and 218—final supplemental environmental impact statement. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS EIS/EA MMS 2008-041. Internet website: http://www.gomr.mms.gov/PDFs/2008/2008-041.pdf.

U.S. Department of the Interior. Minerals Management Service (MMS). 2010. Preliminary revised program Outer Continental Shelf Oil and Gas Leasing Program, 2007-2012. Internet website: http://www.boemre.gov/5-year/PDFs/PRP2007-2012.pdf.

U.S. Department of the Interior. National Park Service (NPS). 2010. Managing sea turtles during the oil spill response. 2 pp. Internet website: http://www.deepwaterhorizonresponse.com/posted/2931/Managing_Sea_Turtles_During_the_Oil_Spill_Response.786623.pdf.

U.S. Department of Transportation (USDOT). 2010. Gulf Coast ports surrounding the *Deepwater Horizon* oil spill. Fact Sheet, June 2010. U.S. Dept. of Transportation, Research and Innovative Technology Administration. Internet website: http://www.bts.gov/publications/bts_fact_sheets/2010_001/pdf/entire.pdf.

U.S. Department of Transportation. Coast Guard (USCG). 2010. Dispersants/on-water oil removal capacity (CAPS). Internet website: https://homeport.uscg.mil/mycg/portal/ep/contentView.do?contentTypeId=2&channelId=-30095&contentId=125795&programId=114824&programPage=%2Fep%2Fprogram%2Feditorial.jsp&pageTypeId=13489. Updated April 26, 2010.

U.S. Environmental Protection Agency (USEPA). 2008. Coastal condition report III. U.S. Environmental Protection Agency, Office of Research and Development/Office of Water, Washington, DC. EPA/842-R-08-002. Internet website: http://water.epa.gov/type/oceb/assessmonitor/downloads.cfm.

U.S. Environmental Protection Agency (USEPA). 2010a. Questions and answers about the BP oil spill in the Gulf Coast. Internet website: http://www.epa.gov/BPSpill/qanda.html#waste19. Accessed August 31, 2010.

U.S. Environmental Protection Agency (USEPA). 2010b. Odors from the BP oil spill. Internet website: http://www.epa.gov/BPSpill/odor.html. Accessed October 1, 2010.

U.S. Environmental Protection Agency (USEPA). 2010c. BP's analysis of subsurface dispersant use. Internet website: http://www.epa.gov/bpspill/dispersants-bp.html.

U.S. Environmental Protection Agency (USEPA). 2010d. Recovered oil, contaminated materials and liquid and solid wastes management directive, Louisiana, June 29, 2010. Internet website: http://www.epa.gov/bpspill/waste/wastemanagementdirective_la.pdf.

U.S. Environmental Protection Agency (USEPA). 2010e. Recovered oil, contaminated materials and liquid and solid wastes management directive, Mississippi, Alabama, Florida, June 29, 2010. Internet website: http://www.epa.gov/bpspill/waste/wastemanagementdirective_msalfl.pdf.

U.S. Environmental Protection Agency (USEPA). Office of Research and Development. 2010a. Comparative toxicity of Louisiana sweet crude oil (LSC) and chemically dispersed LSC to two Gulf of Mexico aquatic test species. 13 pp. Internet website: http://www.epa.gov/bpspill/reports/updated-phase2dispersant-toxtest.pdf.

U.S. Environmental Protection Agency (USEPA). Office of Research and Development. 2010b. Analysis of eight oil spill dispersants using *in vitro* tests for endocrine and other biological activity. 47 pp. Appendices 61 pp.

U.S. Travel Association. 2010. The power of travel. Internet website: http://www.poweroftravel.org/statistics.

Vandermeulen, J.H. 1982. Some conclusions regarding long-term biological effects of some major oil spills. Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences 297(1087).

Velando, A., I. Munilla, M. Lopez-Alonso, J. Freire, and C. Perez. 2010. EROD activity and stable isotopes in seabirds to disentangle marine food web contamination after the *Prestige* oil spill. Environmental Pollution 158(2010):1275-1280. Internet website: http://webs.uvigo.es/cristobal/papers/8.EROD%20activity%20and%20stable%20isotopes%20in%20seabirds%20to%20disentangle%20marine%20food%20web%20contamination%20after%20the%20Prestige%20oil%20spill.pdf. Accessed October 28, 2010.

Ward, G.A., B. Baca, W. Cyriacks, R.E. Dodge, and A. Knap. 2003. Continuing long-term studies of the TROPICS Panama oil and dispersed oil spill sites. In: Proceedings 2003 International Oil Spill Conference, April 6-11, 2003, Vancouver, Canada. Washington, DC: American Petroleum Institute.

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

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

Webb, J.W., S.K. Alexander, and J.K. Winters. 1985. Effects of autumn application of oil on *Spartina alterniflora* in a Texas salt marsh. Environ. Poll., Series A 38(4):321-337.

Wesseling, I., A.J. Uychiaoco, P.M. Aliño, T. Aurin, and J.E. Vermaat. 1999. Damage recovery of four Philippine corals from short-term sediment burial. Marine Ecology Progress Series 176:11-15.

Wetz, J.J., A.D. Blackwood, J.S. Fries, Z.F. Williams, and R.T. Noble. 2008. Trends in total *Vibrio* spp. and *Vibrio vulnificus* concentrations in the eutrophic Neuse River estuary, North Carolina, during storm events. Aquatic Microbial Ecology 53:141-149.

Widger, W.R., G. Golovko, A.F. Martinez, E.V. Ballesteros, J.J. Howard, Z. Xu, U. Pandya, V.Y. Fofanov, M. Rojas, C. Bradburne, T. Hadfield, N.A. Olson, J.L. Santarpia, and Y. Fofanov. 2011. Longitudinal metagenomic analysis of the water and soil from Gulf of Mexico beaches affected by the *Deepwater Horizon* oil spill. Nature Proceedings hdl:10101/npre.2011.5733.1.

Wiese, F.K., W.A. Montevecchi, G.K. Davoren, F. Huettman, A.W. Diamond and J. Linke. 2001. Seabirds at risk around offshore oil platforms in the Northwest Atlantic. Marine Pollution Bulletin 42:1285-1290.

Wiese, F.K. and G.J. Robertson. 2004. Assessing impacts of chronic oil discharges at sea on seabirds: a general oiled seabird mortality model applied to Eastern Canada. Journal of Wildlife Management 68:627–638.

Williams, R., S. Gero, L. Bejder, J. Calambokidis, S. Kraus, D. Lusseau, A. Read, and J. Robbins. 2011. Underestimating the damage: interpreting cetacean carcass recoveries in the context of the *Deepwater Horizon*/BP Incident. Conservation Letters, DOI: 10.1111/j.1755-263x2011.00168x.

Wright, S.D., B.B. Ackerman, R.K. Bonde, C.A. Beck, and D.J. Banowetz. 1995. Analysis of watercraft-related mortality of manatees in Florida, 1979-1991. In: O'Shea, T.J., B.B. Ackerman, and H.F. Percival, eds. Population biology of the Florida manatee. National Biological Service Information and Technology Report 1. Pp. 259-268.

Wyers, S.C., H.R. Frith, R.E. Dodge, S.R. Smith, A.H. Knap, and T.D. Sleeter. 1986. Behavioral effects of chemically dispersed oil and subsequent recovery in *Diploria strigosa*. Marine Ecology 7:23-42.

Zeller, T., Jr. 2010. Drill ban means hard times for rig workers. Internet website: http://www.nytimes.com/2010/06/18/business/18rig.html?_r=1. Accessed June 29, 2010.

Zieman, J.C., R. Orth, R.C. Phillips, G. Thayer, and A. Thorhaug. 1984. The effects of oil on seagrass ecosystems. In: Cairns, J., Jr. and A.L. Buikema, Jr., eds. Restoration of habitats impacted by oil spills. Boston, MA: Butterworth Publishers.

APPENDIX C

BOEMRE-OSRA CATASTROPHIC RUN

APPENDIX C. BOEMRE-OSRA CATASTROPHIC RUN

A special Oil-Spill Risk Analysis (OSRA) run was conducted in order to estimate the impacts of a possible future catastrophic or high-volume, long-duration oil spill. Thus, assuming a hypothetical high-volume, long-duration oil spill occurred, this analysis emphasized modeling a spill that continued for 90 consecutive days, with each trajectory tracked for up to 120 days. The OSRA for this analysis was conducted for only the trajectories of oil spills from five hypothetical spill locations to various land segments. The probability of an oil spill contacting a specific land segment within a given time of travel from a certain location or spill point is termed a *conditional probability*; the condition being that a spill is assumed to have occurred. Each trajectory was allowed to continue for as long as 120 days. However, if the hypothetical spill contacted shoreline sooner than 30 days after the start of the spill, the spill trajectory was terminated, and the contact was recorded. Although, overall OSRA is designed for use as a risk-based assessment, for this analysis, only the *conditional probability*, the probability of contact to the resource, was calculated. The probability of a catastrophic spill occurring was not calculated; thus, the combination of the probability of a spill and the probability of contact to the resources from the hypothetical spill locations were not performed. Results from this trajectory analysis provide input to the final product by estimating where spills might travel on the ocean's surface and what land segments might be contacted if and when another catastrophic spill occurs, but it does not provide input on the probability of another catastrophic spill occurring.

OSRA Overview

The OSRA model, originally developed by Smith et al. (1982) and enhanced by this Agency over the years (Ji et al., 2002, 2004a, 2004b), simulates oil-spill transport using model-simulated winds and ocean currents in the Gulf of Mexico. An oil spill on the ocean surface moves around by the complex surface ocean currents exerting a shear force on the spilled oil from below. In addition, the prevailing wind exerts an additional shear force on the spill from above, and the combination of the two forces causes the transportation of the oil spill away from its initial spill location. In the OSRA model, the velocity of a hypothetical oil spill is the linear superposition of the surface ocean current and the wind drift caused by the winds. The model calculates the movement of hypothetical spills by successively integrating time sequences of two spatially gridded input fields: the surface ocean currents and the sea-level winds. Thus, the OSRA model generates time sequences of hypothetical oil-spill locations—essentially, oil-spill trajectories.

At each successive time step, the OSRA model compares the location of the hypothetical spills against the geographic boundaries of shoreline. The frequencies of oil-spill contact are computed for designated oil-spill travel times (e.g., 3, 10, 30, or 120 days) by dividing the total number of oil-spill contacts by the total number of hypothetical spills initiated in the model from a given hypothetical spill location. The frequencies of oil-spill contact are the model-estimated probabilities of oil-spill contact. The OSRA model output provides the estimated probabilities of contact to segments of shoreline from the five launch points (LP) in the Gulf of Mexico, which are explained below.

There are factors not explicitly considered by the OSRA model that can affect the transport of spilled oil as well as the dimensions, volume, and nature of the oil spills contacting environmental resources or the shoreline. These include possible cleanup operations, chemical composition or biological weathering of oil spills, or the spreading and splitting of oil spills. The OSRA analysts have chosen to take a more environmentally conservative approach by presuming persistence of spilled oil over the selected time duration of the trajectories.

In the trajectory simulation portion of the OSRA model, many hypothetical oil-spill trajectories are produced by numerically integrating a temporally and spatially varying ocean current field, and superposing on that an empirical wind-induced drift of the hypothetical oil spills (Samuels et al., 1982). Collectively, the trajectories represent a statistical ensemble of simulated oil-spill displacements produced by a field of numerically derived winds and ocean currents. The winds and currents are assumed to be statistically similar to those that will occur in the Gulf during future offshore activities. In other words, the oil-spill risk analysts assume that the frequency of strong wind events in the wind field is the same as what will occur during future offshore activities. By inference, the frequencies of contact by the simulated oil spills are the same as what could occur from actual oil spills during future offshore activities.

Another portion of the OSRA model tabulates the contacts by the simulated oil spills. A contact to shore will stop the trajectory of an oil spill; no re-washing is assumed in this model. After specified periods of time, the OSRA model will divide the total number of contacts to the coastline segments by the total number of simulated oil spills from each of the five LP's. These ratios are the estimated probabilities of oil-spill contact from offshore activities at that geographic location, assuming spill occurrence.

Conducting an oil-spill risk analysis needs detailed information on ocean currents and wind fields (Ji, 2004). The ocean currents used are numerically computed from an ocean circulation model of the Gulf of Mexico driven by analyzed meteorological forces (the near-surface winds and the total heat fluxes) and observed river inflow into the Gulf of Mexico (Oey et al., 2004; Oey, 2005). The models used are versions of the Princeton Ocean Model, which is an enhanced version of the earlier constructed Mellor-Blumberg Model.

The ocean model calculation was performed by Princeton University (Oey et al., 2004). This simulation covered the 7-year period, 1993 through 1999, and the results were saved at 3-hour intervals. This run included the assimilation of sea-surface altimeter observations to improve the ocean model results. The surface currents were then computed for input into the OSRA model, along with the concurrent wind field. The OSRA model used the same wind field to calculate the empirical wind drift of the simulated spills. The statistics for the contacts by the trajectories forced by the currents and winds were combined for the average probabilities.

Catastrophic OSRA Run Overview

A special OSRA run was conducted in order to estimate the impacts of a possible future catastrophic spill. Thus, assuming a hypothetical catastrophic oil spill occurred, this analysis emphasized modeling a spill that continued for 90 consecutive days with each trajectory tracked for up to 120 days. The OSRA for this analysis was conducted for only the trajectories of oil spills from five hypothetical spill locations to various land segments (**Figure C-1 and C-2**). The probability that an oil spill will contact a specific land segment within a given time of travel from a certain location or spill point is termed a *conditional probability*; the condition being that a spill is assumed to have occurred. Each trajectory was allowed to continue for as long as 120 days. However, if the hypothetical spill contacted shoreline sooner than 30 days after the start of the spill, the spill trajectory was terminated, and the contact was recorded. Although, overall the OSRA is designed for use as a risk-based assessment, for this analysis, only the *conditional probability*, the probability of contact to the resource, was calculated. The probability of a catastrophic spill occurring was not calculated, thus the combination of the probability of a spill and the probability of contact to the resources from the hypothetical spill locations was not performed. Results from this trajectory analysis provide input to the final product by estimating where spills might travel on the ocean's surface and what land segments might be contacted if and when another catastrophic spill occurs, but it does not provide input on the probability of another catastrophic spill occurring.

Trajectories of hypothetical spills were initiated every 1.0 day from each of the launch points over the simulation period from January 1, 1993, to December 31, 1998 (**Figure C-1**). The chosen number of trajectories per site was small enough to be computationally practical and large enough to reduce the random sampling error to an insignificant level. Also, the weather-scale changes in the winds are at least minimally sampled, with simulated spills started every 1.0 day.

These launch point locations were developed within the Gulf of Mexico region for the purpose of this analysis. Five launch points were identified and encompassed the approximate areas with the possibility of finding the largest oil volume within the following regions:

- Central Gulf of Mexico shelf area west of the Mississippi River;
- Central Gulf of Mexico shelf area east of the Mississippi River;
- Central Gulf of Mexico slope area;
- Western Gulf of Mexico shelf area; and

- Western Gulf of Mexico slope area.

Longitude	Latitude	Launch Point (LP)
-92.17851	28.98660	1
-88.15338	29.91388	2
-90.22203	27.31998	3
-96.76627	27.55423	4
-94.51836	27.51367	5

The methodology used for launch point selection is not part of the OSRA model in the manner it has been typically run for this Agency's spill analyses. Gulf of Mexico OCS Region geologists and engineers used the following methodology to select the five points. For each geologic play currently recognized, the undiscovered technically recoverable resource volume was allocated throughout the play area based on the likelihood of future oil discovery potential. The probability factor used to allocate undiscovered oil volumes to areas within the geologic play was based on the density of existing discoveries, the density of undrilled prospects on leased acreage, and the results from recent exploration activity. In areas where the potential for undiscovered technically recoverable resource volume exists for more than one geologic play, the oil volumes were aggregated. Results from the aggregation were used to identify five geographic areas of high potential for future oil discoveries: three in the Central Planning Area and two in the Western Planning Area of the Gulf of Mexico. Although these areas may encompass hundreds of square miles, the coordinates for the five launch points were selected qualitatively to correspond with the centroid of these areas. After their selection, the five points were given to the OSRA analysts for use with the OSRA model.

Additionally, the total estimated oil-contacted area of water was also determined. The OSRA model integrates the spill velocities (a linear superposition of surface ocean currents and empirical wind drift) by integrating in time to produce the spill trajectories. The time step selected was 1 hour to fully utilize the spatial resolution of the ocean current field and to achieve a stable set of trajectories. The velocity field was bilinearly interpolated from the 3-hour grid to get velocities at 1-hour intervals.

The trajectories simulated by the model represent only hypothetical pathways of oil slicks; they do not involve any direct consideration of cleanup, dispersion, or weathering processes that could alter the quantity or properties of oil that might eventually contact the environmental resource locations. However, an implicit analysis of weathering and spill degradation can be considered by choosing a travel time for the simulated oil spills when they contact environmental resource locations that represent the likely persistence of the oil slick on the water surface. Therefore, OSRA model trajectories were analyzed up to 120 days. Any spill contacts occurring during this elapsed time are reported in the probability tables. Conditional probabilities of contact with land segments within 120 days of travel time were calculated for each of the hypothetical spill sites.

The probability estimates were tabulated as 90-day groupings of the 120-day trajectories, as averages for the 6 years of the analysis from 1993 to 1998. These groupings were treated as seasonal probabilities that corresponded with quarters of the year: Winter, Q1 (January, February, and March); Spring, Q2 (April, May, and June); Summer, Q3 (July, August, and September); and Fall, Q4 (October, November, and December). These 3-month probabilities can be used to estimate the average number of land segments (counties/parishes) contacted during a spill, treated as one spill occurring each day for 90 days, within the quarter. The seasonal quarterly groupings take account of the differing meteorological and oceanographic conditions (wind and current patterns) during the year. The latest meteorological and oceanographic information in the Gulf of Mexico available to BOEMRE were for the years 1993-1998.

The area of ocean surface contacted by oil from the hypothetical spills was estimated by creating a grid of 1/6 degree longitude by 1/6 degree latitude. As the trajectories were computed, contact to the grid cells was tabulated. To estimate the area, the number of grid cells was multiplied by the approximate area of 342 square kilometers per grid cell. The number of grid cells and the approximate area of the ocean contacted by the spills were summarized at the same time intervals that were used for the land segment (county/parish boundary) tables (3, 10, 30, and 120 days).

Catastrophic OSRA Results and Discussion

It should be noted that the study area only extends somewhat into the Atlantic Ocean, where oil spills in the Gulf might be transported via the exiting Loop Current. However, on average, less than 0.5 percent of the simulated spills made it across the northern or southern Florida Straits boundary within 30 days, and only 1-2 percent within 120 days. The hypothetical spill trajectories from launch points in the western Gulf of Mexico (e.g., LP1, LP4, and LP5) have a much less chance of being transported through the Florida Straits than those in the central Gulf of Mexico (LP2 and LP3).

As one might expect, land segments closest to the spill sites had the greatest risk of contact. As the model run duration increases, more of the shoreline segments could have meaningful probabilities of contact (≥0.5%) (See **Tables C-1 through C-5** for the probabilities expressed as percent chance of one or more offshore spills ≥1,000 bbl contacting the areas noted in **Figure C-2**.). It should be reiterated that these are *conditional probabilities*; the condition being that a spill is assumed to have occurred. The longer transit times up to 120 days allowed by the model enable hypothetical spills to reach the environmental resources and the shoreline from more distant spill locations. With increased travel time, the complex patterns of wind and ocean currents produce eddy-like motions of the oil spills and multiple opportunities for a spill to make contact with shoreline segments. For some launch points and for the travel times greater than 30 days, the probability of contact to land decreases very slowly or remains constant because the early contacts to land have occurred within 30 days, and the trajectories that have not contacted land within 30 days will remain at sea for 120 days or more.

To summarize the differences between the LP's, a chart showing the estimated square area of each launch point for the 6-day intervals is shown (see **Figures C-3 through C-7** corresponding to LP's 1-5, respectively). The differences between the estimated spill areas from each LP can be explained by meteorological and oceanographic conditions.

- LP1—CPA, shelf area, west of the Mississippi River Delta, offshore south-central Louisiana, deepwater. Launch Point 1 is located near the Louisiana coast, and the fall circulation results in persistent and recurring coastal current from Louisiana waters toward Texas waters.
- LP2—CPA, shelf edge area, east of the Mississippi River Delta, south of the Alabama-Mississippi border, ultra-deepwater. Launch Point 2 is located near the Mississippi River Delta on the eastern side. The trajectories contact the coastline of Louisiana, Mississippi, Alabama, and Florida. Many of the trajectories are forced offshore by the wind drift and interact with the Loop Current and Loop Current eddies.
- LP3—CPA, shelf area, west of the Mississippi River delta, due south of New Orleans, deepwater. Launch Point 3 is located relatively far offshore and west of the Mississippi River Delta. The estimated area contacted by the spill is the largest of all the selected points, and the trajectories are influenced by the deepwater Loop Current eddies and offshore currents.
- LP4—WPA, shelf area, deepwater. Launch Point 4 is near the Texas coast in the western Gulf of Mexico. The trajectories from this launch point frequently contact land. The coastal flow near Texas, but to the south of the U.S./Mexico border, has a high fraction of northward currents, the wind is relatively persistent with a westward component, and the trajectories remain in a relatively smaller area.
- LP5—WPA, slope area, ultra-deepwater. Launch Point 5 is in the western Gulf of Mexico between the coast (LP4) and the central Gulf (LP3). The trajectories are forced by the Loop Current eddies that are somewhat weaker in this part of the Gulf of Mexico because these eddies dissipate kinetic energy as they drift to the west from their original separation zone.

REFERENCES CITED

Ji, Z.-G. 2004. Use of physical sciences in support of environmental management. Environmental Management 34(2). Pp. 159-169.

Ji, Z.-G., W.R. Johnson, C.F. Marshall, G.B. Rainey, and E.M. Lear. 2002. Oil-spill risk analysis: Gulf of Mexico outer continental shelf (OCS) lease sales, Central Planning Area and Western Planning Area, 2003-2007, and Gulfwide OCS program, 2003-2042. U.S. Dept. of the Interior, Minerals Management Service, Herndon, VA. OCS Report MMS 2002-032. 61 pp.

Ji, Z.-G., W.R. Johnson, and C.F. Marshall. 2004a. Deepwater oil-spill modeling for assessing environmental impacts. Coastal Environment V. Southampton, MA: WIT Press. Pp. 349-358.

Ji, Z.-G., W.R. Johnson, C.F. Marshall, and E.M. Lear. 2004b. Oil-spill risk analysis: Contingency planning statistics for Gulf of Mexico OCS activities. U.S. Dept. of the Interior, Minerals Management Service, Herndon, VA. OCS Report MMS 2004-026. 62 pp.

Oey, L.-Y. 2005. Circulation model of the Gulf of Mexico and the Caribbean Sea: Development of the Princeton Regional Ocean Forecast (& Hindcast) System—PROFS and Hindcast experiment for 1992-1999: Final report. U.S. Dept. of the Interior, Minerals Management Service, Environmental Division, Herndon, VA. OCS Study MMS 2005-049. 174 pp.

Oey, L.-Y., P. Hamilton, and H. C.-Lee. 2004. Modeling and data analyses of circulation processes in the Gulf of Mexico: Final report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2003-074. 129 pp.

Samuels, W. B., N. E. Huang, and D.E. Amstutz. 1982. An oil spill trajectory analysis model with a variable wind deflection angle. Ocean Engineering 9:347-360.

Smith, R.A., J.R. Slack, T. Wyant, and K.J. Lanfear. 1982. The oil spill risk analysis model of the U.S. Geological Survey. U.S. Dept. of the Interior, Geological Survey Professional Paper 1227.

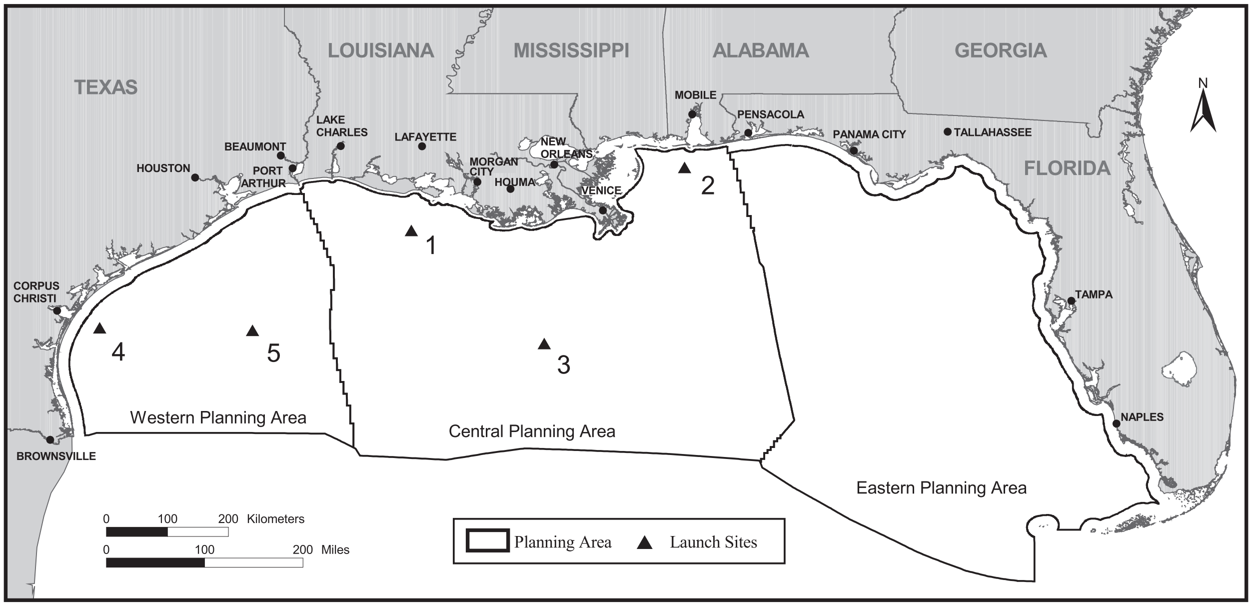

Figure C-1. Location of Five Hypothetical Oil-Spill Launch Points for OSRA within the Study Area.

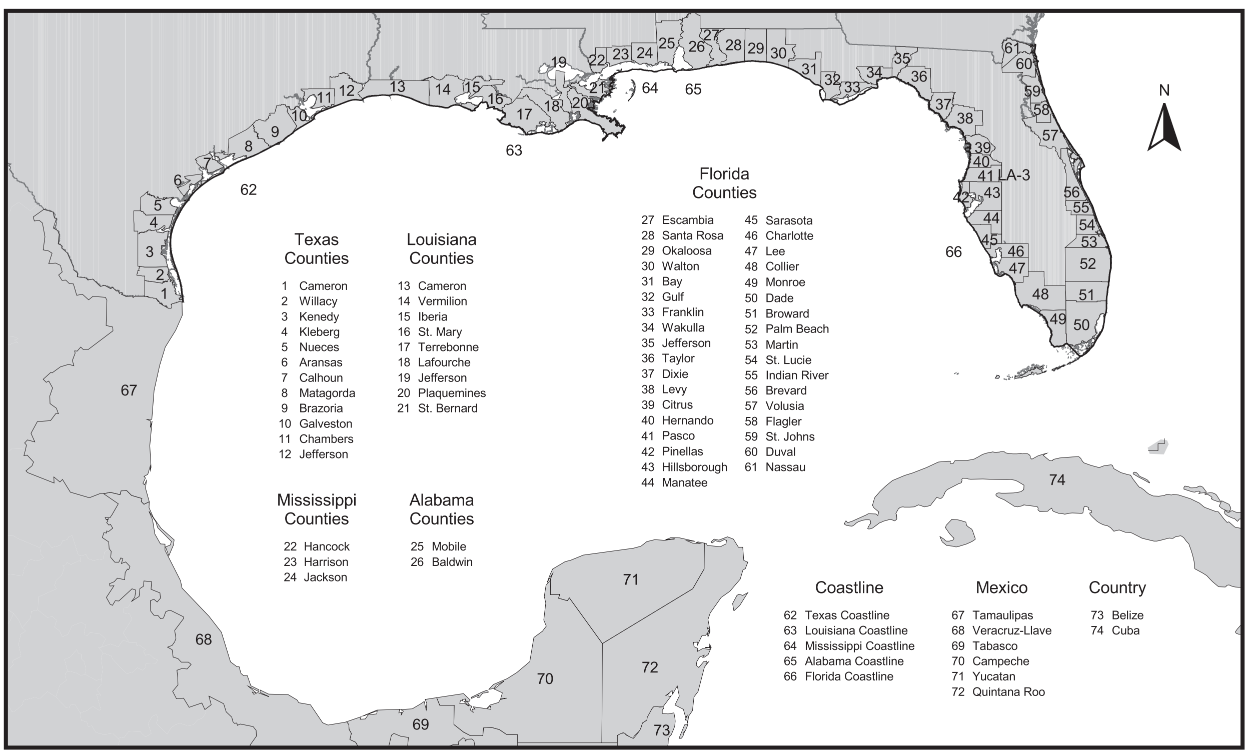

Figure C-2. Locations of Parishes, Counties, and Coastlines Examined in the Special OSRA Run Conducted in Order to Estimate the Impacts of a Possible Future Catastrophic Spill.

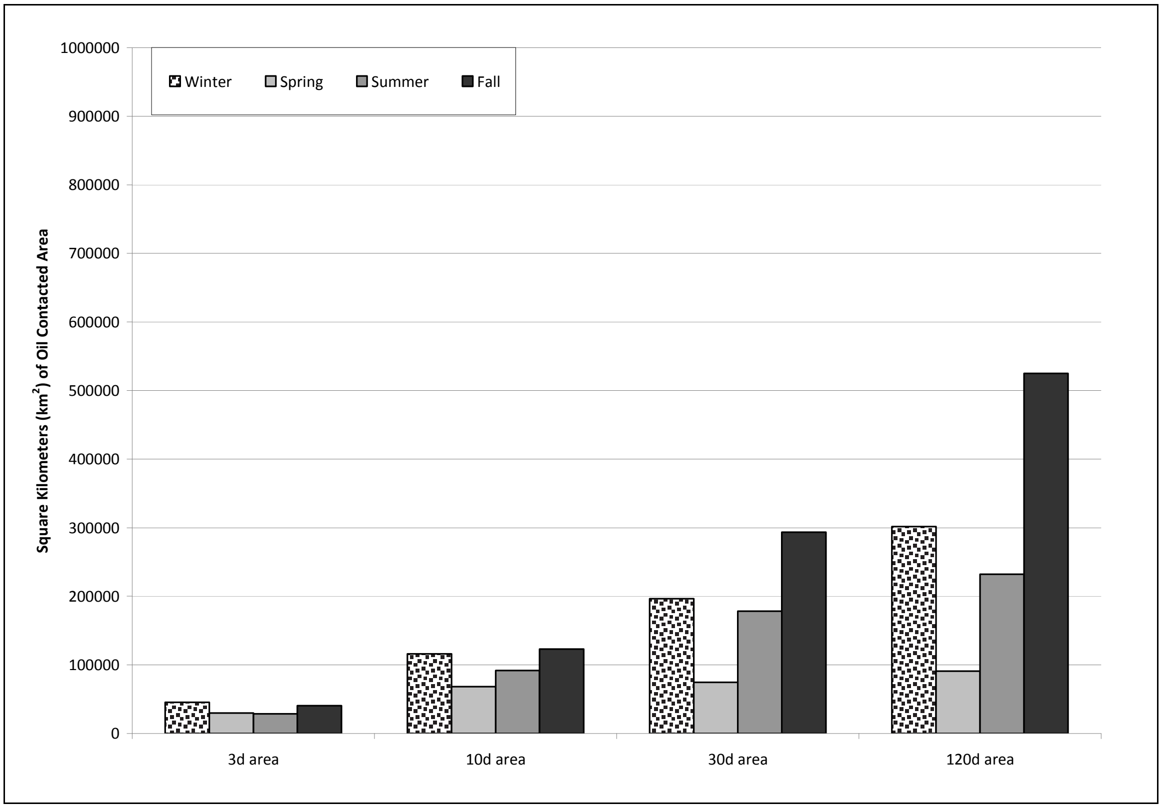

Figure C-3. Estimated Square Area of Launch Point One (LP 1) for 3, 10, 30, and 120 Days in Winter, Spring, Summer, and Fall.

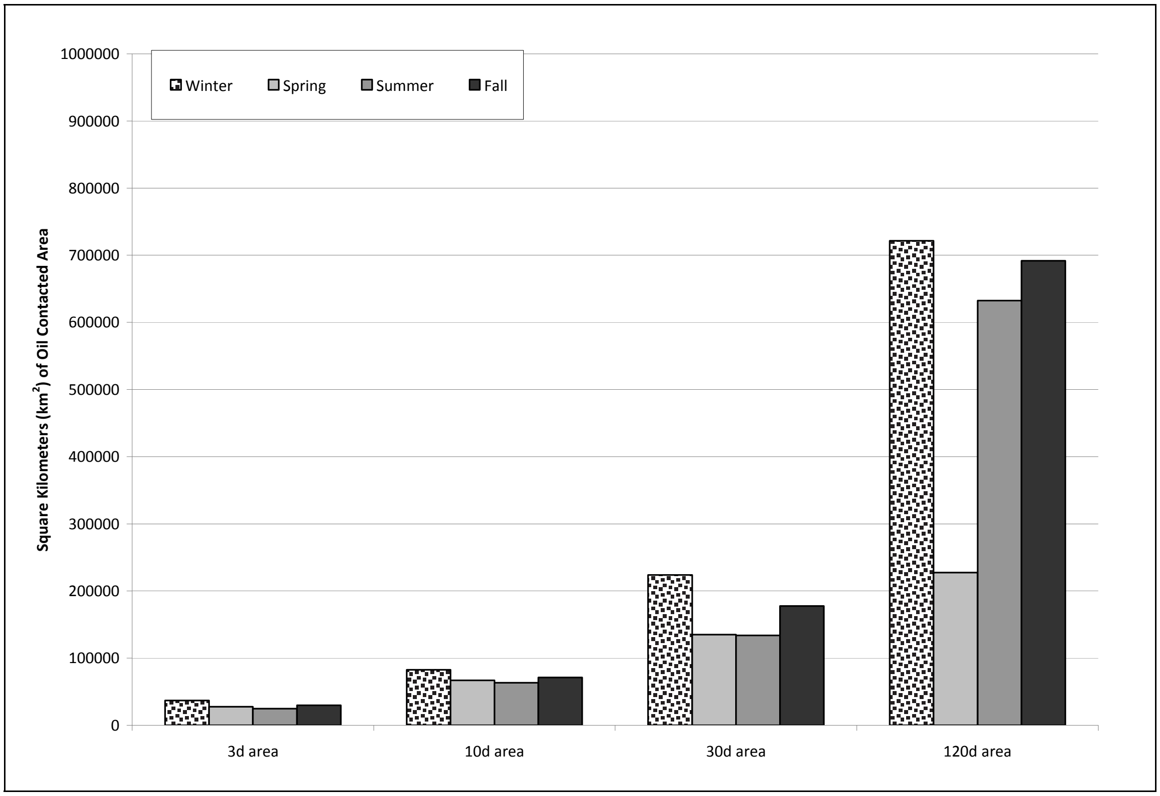

Figure C-4. Estimated Square Area of Launch Point Two (LP 2) for 3, 10, 30, and 120 Days in Winter, Spring, Summer, and Fall.

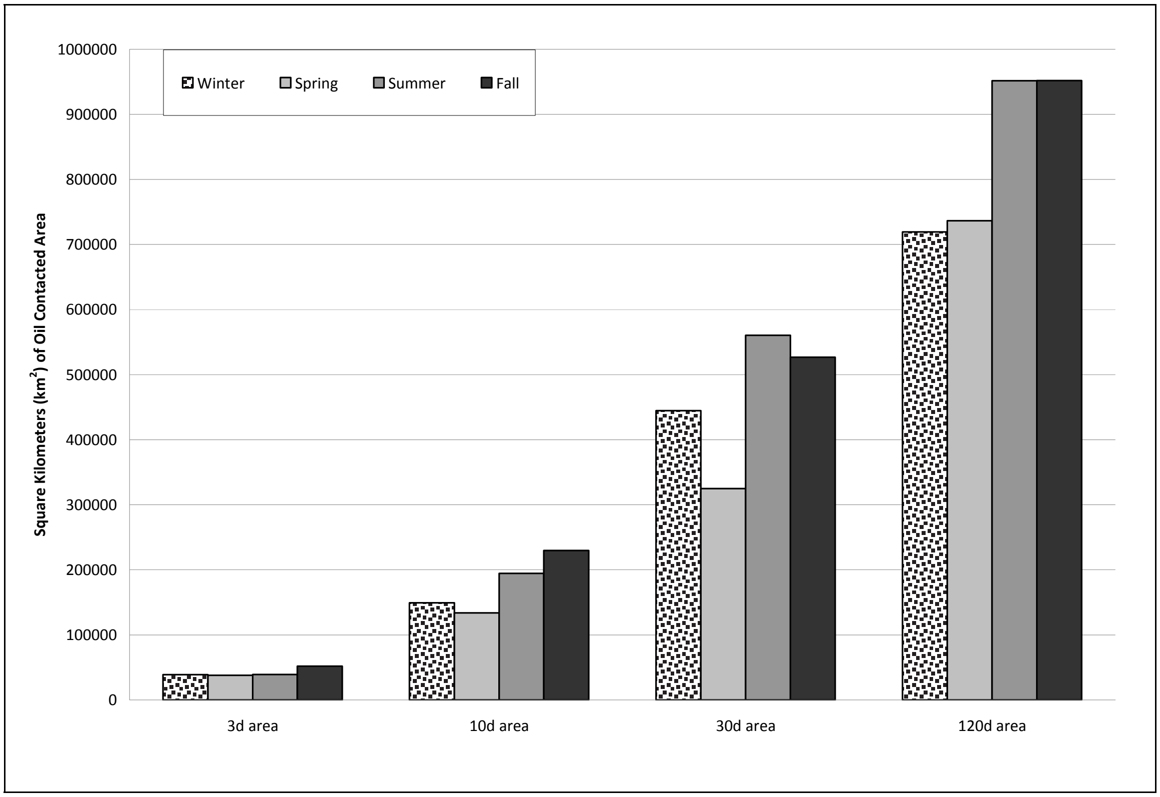

Figure C-5. Estimated Square Area of Launch Point Three (LP 3) for 3, 10, 30, and 120 Days in Winter, Spring, Summer, and Fall.

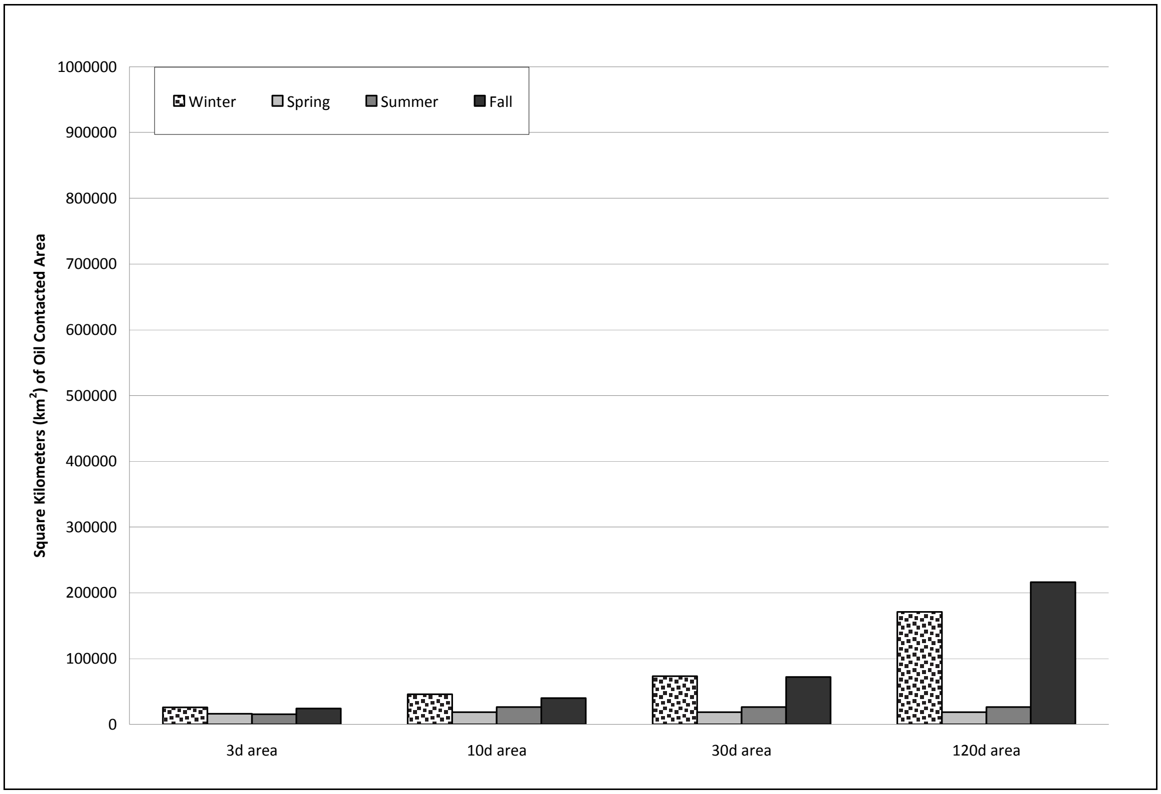

Figure C-6. Estimated Square Area of Launch Point Four (LP 4) for 3, 10, 30, and 120 Days in Winter, Spring, Summer, and Fall.

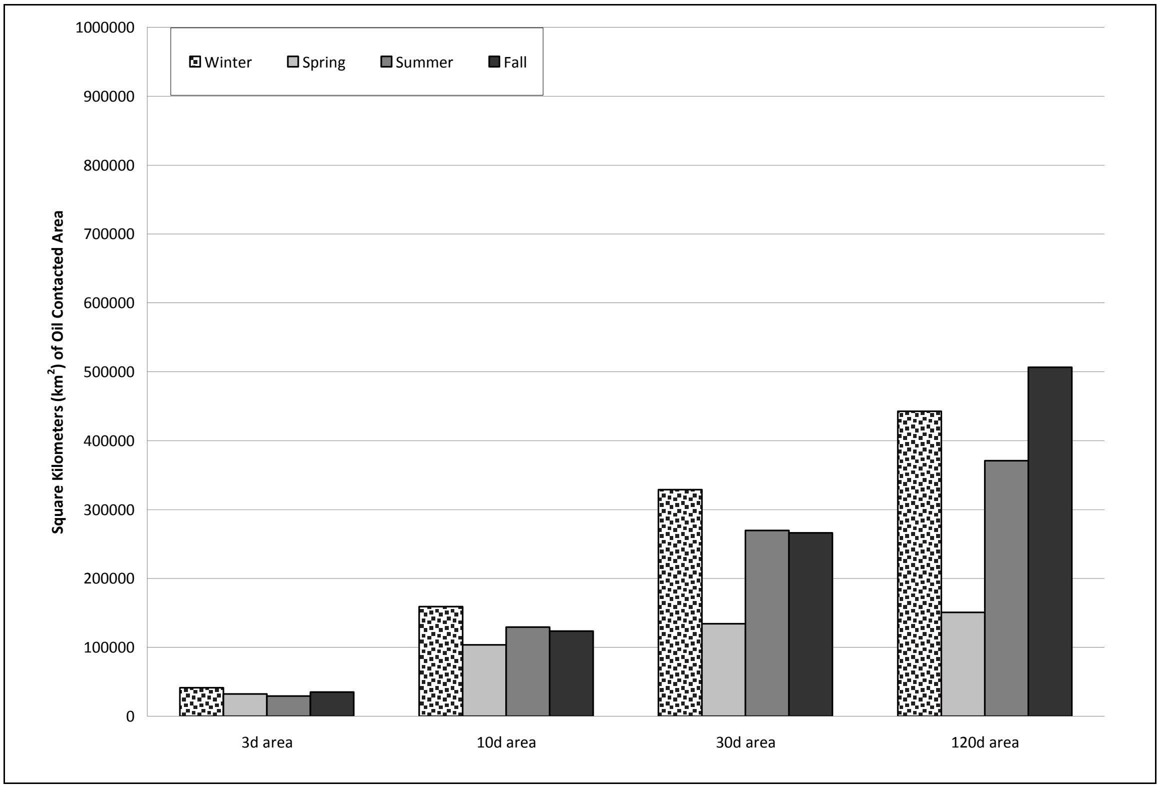

Figure C-7. Estimated Square Area of Launch Point Five (LP 5) for 3, 10, 30, and 120 Days in Winter, Spring, Summer, and Fall.

Table C-1

Conditional Probabilities Expressed as Percent Chance that an Oil Spill Starting at Launch Point One Will Contact a Certain Parish, County, or Coastline within 120 Days

	Season	Winter				Spring				Summer				Fall			
	Day	3	10	30	120	3	10	30	120	3	10	30	120	3	10	30	120
ID	Name	Percent Chance															
1	Cameron, TX	-	-	1	2	-	-	-	-	-	-	-	1	-	-	-	2
2	Willacy, TX	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
3	Kenedy, TX	-	-	1	3	-	-	-	-	-	-	1	1	-	-	2	4
4	Kleberg, TX	-	-	-	1	-	-	-	1	-	-	1	1	-	-	1	3
5	Nueces, TX	-	-	1	4	-	-	-	-	-	-	1	2	-	-	1	3
6	Aransas, TX	-	-	2	4	-	-	-	-	-	-	2	2	-	-	2	4
7	Calhoun, TX	-	-	5	10	-	-	-	-	-	-	4	4	-	-	2	3
8	Matagorda, TX	-	1	13	17	-	-	1	1	-	-	3	4	-	1	9	11
9	Brazoria, TX	-	1	9	10	-	1	3	3	-	-	4	6	-	-	6	6
10	Galveston, TX	-	2	9	11	-	2	8	9	-	2	12	15	-	1	9	9
11	Chambers, TX	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-
12	Jefferson, TX	-	2	5	6	-	5	9	9	-	2	9	10	-	3	6	6
13	Cameron, LA	2	10	13	15	5	35	41	41	-	7	18	20	2	13	16	19
14	Vermilion, LA	4	9	10	10	8	22	24	24	1	9	12	12	4	8	9	9
15	Iberia, LA	1	2	3	3	1	5	6	6	-	5	7	7	1	2	3	3
16	St. Mary, LA	-	1	1	1	-	1	1	1	-	-	-	-	-	-	-	-
17	Terrebonne, LA	-	1	1	1	-	2	2	2	-	-	5	6	-	1	1	1
18	Lafourche, LA	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-
19	Jefferson, LA	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
21	St. Bernard, LA	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
62	Texas Coastline	-	6	45	68	-	8	23	24	-	5	37	47	-	6	38	52
63	Louisiana Coastline	8	23	28	30	14	64	75	76	2	21	43	49	6	23	30	32
64	Mississippi Coastline	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
67	Tamaulipas, Mexico	-	-	-	1	-	-	-	-	-	-	2	2	-	-	1	3

Note: Values of <0.5% are indicated by "-". Any areas where the percent chance within 120 days of all seasons are all <0.5% are not shown. See Figure C-1 for the location of Launch Point One. See Figure C-2 for the location of the named land areas.

Table C-2

Conditional Probabilities Expressed as Percent Chance that an Oil Spill Starting at Launch Point Two Will Contact a Certain Parish, County, or Coastline within 120 Days

	Season	Winter				Spring				Summer				Fall			
	Day	3	10	30	120	3	10	30	120	3	10	30	120	3	10	30	120
ID	Name	Percent Chance															
1	Cameron, TX	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
2	Willacy, TX	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
3	Kenedy, TX	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
4	Kleberg, TX	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
7	Calhoun, TX	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
8	Matagorda, TX	-	-	-	2	-	-	-	-	-	-	-	1	-	-	-	2
9	Brazoria, TX	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
10	Galveston, TX	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-
12	Jefferson, TX	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
13	Cameron, LA	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
14	Vermilion, LA	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
17	Terrebonne, LA	-	-	3	4	-	-	-	-	-	-	-	1	-	-	-	1
18	Lafourche, LA	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	1
19	Jefferson, LA	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1
20	Plaquemines, LA	1	14	21	23	-	3	4	6	1	8	20	25	2	21	27	28
21	St. Bernard, LA	-	4	5	5	-	1	2	3	1	7	14	16	-	8	9	10
22	Hancock, MS	-	1	2	4	-	2	2	2	-	2	3	3	1	3	5	5
23	Harrison, MS	2	3	4	5	-	4	4	4	1	3	4	4	1	2	3	3
24	Jackson, MS	7	11	11	13	5	11	12	12	1	3	4	4	6	12	13	14
25	Mobile, AL	11	14	14	15	11	16	17	17	4	8	9	10	8	11	12	13
26	Baldwin, AL	4	7	7	9	6	14	16	17	1	8	10	10	1	2	2	3
27	Escambia, FL	-	1	1	2	1	5	11	13	1	3	5	6	-	-	1	1
29	Okaloosa, FL	-	-	-	1	-	1	2	3	-	-	1	1	-	-	-	-
30	Walton, FL	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-	1
31	Bay, FL	-	-	-	1	-	2	3	5	-	-	1	2	-	-	-	-
32	Gulf, FL	-	-	-	-	-	1	3	5	-	-	1	1	-	-	-	-
33	Franklin, FL	-	-	-	-	-	-	-	3	-	-	1	2	-	-	-	-
34	Wakulla, FL	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
36	Taylor, FL	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
38	Levy, FL	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
49	Monroe, FL	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-
50	Dade, FL	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
62	Texas Coastline	-	-	-	7	-	-	-	-	-	-	-	5	-	-	1	6
63	Louisiana Coastline	2	18	29	37	-	4	6	9	1	15	34	43	2	29	39	41
64	Mississippi Coastline	9	15	17	22	5	16	18	19	3	7	11	12	7	16	21	22
65	Alabama Coastline	15	21	21	24	18	30	34	34	5	16	19	20	9	13	14	15
66	Florida Coastline	-	2	2	6	1	10	20	36	1	3	10	14	-	-	1	2
67	Tamaulipas, Mexico	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	1

Note: Values of <0.5% are indicated by "-". Any areas where the percent chance within 120 days of all seasons are all <0.5% are not shown. See Figure C-1 for the location of Launch Point Two. See Figure C-2 for the location of the named land areas.

Table C-3

Conditional Probabilities Expressed as Percent Chance that an Oil Spill Starting at Launch Point Three Will Contact a Certain Parish, County, or Coastline within 120 Days

	Season	Winter				Spring				Summer				Fall			
	Day	3	10	30	120	3	10	30	120	3	10	30	120	3	10	30	120
ID	Name	Percent Chance															
1	Cameron, TX	-	-	-	2	-	-	-	-	-	-	-	2	-	-	-	2
2	Willacy, TX	-	-	-	3	-	-	-	-	-	-	-	2	-	-	-	3
3	Kenedy, TX	-	-	-	8	-	-	-	1	-	-	-	9	-	-	-	5
4	Kleberg, TX	-	-	1	6	-	-	-	-	-	-	-	4	-	-	1	6
5	Nueces, TX	-	-	1	6	-	-	-	-	-	-	-	2	-	-	1	2
6	Aransas, TX	-	-	-	5	-	-	-	1	-	-	-	3	-	-	-	2
7	Calhoun, TX	-	-	1	6	-	-	-	-	-	-	-	6	-	-	1	4
8	Matagorda, TX	-	-	2	17	-	-	3	4	-	-	-	11	-	-	1	6
9	Brazoria, TX	-	-	3	12	-	-	1	3	-	-	2	8	-	-	1	5
10	Galveston, TX	-	-	3	10	-	-	3	6	-	-	2	5	-	-	1	4
12	Jefferson, TX	-	-	1	4	-	-	7	9	-	-	1	1	-	-	-	2
13	Cameron, LA	-	-	1	4	-	-	11	12	-	1	1	4	-	-	-	4
14	Vermilion, LA	-	-	1	2	-	-	5	6	-	1	1	2	-	-	-	-
15	Iberia, LA	-	-	-	1	-	-	4	4	-	-	-	-	-	-	-	-
17	Terrebonne, LA	-	1	2	3	-	4	12	14	-	-	-	2	-	-	-	-
18	Lafourche, LA	-	-	1	1	-	2	8	10	-	-	1	2	-	-	-	-
19	Jefferson, LA	-	-	-	1	-	-	2	2	-	-	1	1	-	-	-	-
20	Plaquemines, LA	-	-	-	1	-	2	10	12	-	-	1	2	-	-	-	-
24	Jackson, MS	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
26	Baldwin, AL	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
31	Bay, FL	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
33	Franklin, FL	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
49	Monroe, FL	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
50	Dade, FL	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
62	Texas Coastline	-	-	12	78	-	-	14	24	-	-	6	54	-	-	4	41
63	Louisiana Coastline	-	1	6	14	-	9	52	60	-	1	4	13	-	-	-	6
64	Mississippi Coastline	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
65	Alabama Coastline	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
66	Florida Coastline	-	-	-	1	-	-	1	4	-	-	-	2	-	-	-	2
67	Tamaulipas, Mexico	-	-	-	4	-	-	-	1	-	-	-	10	-	-	-	10
68	Veracruz-Llave, Mexico	-	-	-	-	-	-	-	-	-	-	1	7	-	-	-	1
69	Tabasco, Mexico	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-

Note: Values of <0.5% are indicated by "-". Any areas where the percent chance within 120 days of all seasons are all <0.5% are not shown. See Figure C-1 for the location of Launch Point Three. See Figure C-2 for the location of the named land areas.

Table C-4

Conditional Probabilities Expressed as Percent Chance that an Oil Spill Starting at Launch Point Four Will Contact a Certain Parish, County, or Coastline within 120 Days

	Season	Winter				Spring				Summer				Fall			
	Day	3	10	30	120	3	10	30	120	3	10	30	120	3	10	30	120
ID	Name	Percent Chance															
1	Cameron, TX	1	3	3	3	-	-	-	-	-	-	-	-	-	2	3	3
2	Willacy, TX	3	4	4	4	1	1	1	1	-	1	1	1	3	7	8	8
3	Kenedy, TX	10	22	23	23	7	9	9	9	3	9	9	9	10	21	22	23
4	Kleberg, TX	9	14	15	16	12	14	14	14	9	17	17	17	7	13	14	14
5	Nueces, TX	10	16	17	18	21	26	26	26	8	17	18	18	11	16	17	17
6	Aransas, TX	11	15	16	16	28	33	33	33	17	26	26	26	9	12	13	13
7	Calhoun, TX	7	12	13	14	12	15	15	15	18	25	26	26	7	11	12	12
8	Matagorda, TX	1	3	3	4	1	2	2	2	-	2	2	2	-	1	2	3
9	Brazoria, TX	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
62	Texas Coastline	51	90	94	98	82	99	100	100	56	98	100	100	48	84	91	93
67	Tamaulipas, Mexico	-	1	2	2	-	-	-	-	-	-	-	-	-	-	1	1

Note: Values of <0.5%.are indicated by "-". Any areas where the percent chance within 120 days of all seasons are all <0.5% are not shown. See Figure C-1 for the location of Launch Point Four. See Figure C-2 for the location of the named land areas.

Table C-5

Conditional Probabilities Expressed as Percent Chance that an Oil Spill Starting at Launch Point Five Will Contact a Certain Parish, County, or Coastline within 120 Days

	Season	Winter				Spring				Summer				Fall			
	Day	3	10	30	120	3	10	30	120	3	10	30	120	3	10	30	120
ID	Name	Percent Chance															
1	Cameron, TX	-	-	2	4	-	-	-	-	-	-	2	3	-	-	3	5
2	Willacy, TX	-	-	1	4	-	-	-	-	-	-	2	3	-	-	2	3
3	Kenedy, TX	-	1	8	14	-	-	1	1	-	-	4	7	-	-	6	9
4	Kleberg, TX	-	-	5	7	-	1	2	2	-	-	1	3	-	-	4	5
5	Nueces, TX	-	1	5	9	-	1	2	2	-	-	1	1	-	-	3	5
6	Aransas, TX	-	1	5	10	-	-	3	3	-	-	2	3	-	-	4	6
7	Calhoun, TX	-	2	10	20	-	3	11	12	-	-	7	9	-	1	5	7
8	Matagorda, TX	-	1	8	14	-	18	29	30	-	2	12	21	-	2	9	15
9	Brazoria, TX	-	-	3	4	-	9	13	13	-	-	7	12	-	1	4	6
10	Galveston, TX	-	1	2	4	-	3	11	13	-	-	5	12	-	1	2	3
12	Jefferson, TX	-	-	-	1	-	-	12	15	-	-	1	4	-	-	-	1
13	Cameron, LA	-	-	-	1	-	1	5	6	-	-	6	8	-	-	-	-
14	Vermilion, LA	-	-	-	-	-	-	2	3	-	-	1	2	-	-	-	-
20	Plaquemines, LA	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
62	Texas Coastline	-	7	50	91	-	35	85	90	-	2	43	79	-	5	43	65
63	Louisiana Coastline	-	-	-	1	-	1	8	9	-	-	8	11	-	-	-	-
67	Tamaulipas, Mexico	-	-	1	6	-	-	-	-	-	-	3	7	-	-	2	11
68	Veracruz-Llave, Mexico	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-

Note: Values of <0.5% are indicated by "-". Any areas where the percent chance within 120 days of all seasons are all <0.5% are not shown. See Figure C-1 for the location of Launch Point Five. See Figure C-2 for the location of the named land areas.

APPENDIX D

RECENT PUBLICATIONS OF THE ENVIRONMENTAL STUDIES PROGRAM, GULF OF MEXICO OCS REGION, 2006–PRESENT

APPENDIX D. RECENT PUBLICATIONS OF THE ENVIRONMENTAL STUDIES PROGRAM, GULF OF MEXICO OCS REGION, 2006–PRESENT

Published in 2011	
BOEMRE 2011-001 (in press)	*Analysis of the Oil Services Contract Industry in the Gulf of Mexico Region*
BOEMRE 2011-002 (in press)	*Status and Applications of Acoustic Mitigation and Monitoring Systems for Marine Mammals: Workshop Proceedings, November 17-19, 2009, Boston, Massachusetts*
BOEMRE 2011-003 (in press)	*Impact of Recent Hurricane Activity on Historic Shipwrecks in the Gulf of Mexico Outer Continental Shelf*
BOEMRE 2011-004 (in press)	*Archival Investigations for Potential Colonial-Era Shipwrecks in Ultra-Deepwater within the Gulf of Mexico*
BOEMRE 2011-011 (in press)	*User's Guide for the 2011 Gulfwide Offshore Activities Data System (GOADS-2011)*
BOEMRE 2011-012 (in press)	*Literature Synthesis for the North and Central Atlantic Ocean*
BOEMRE 2011-028 (in press)	*Assessment of Opportunities for Alternative Uses of Hydrocarbon Infrastructure in the Gulf of Mexico*

Published in 2010	
Study Number	Title
MMS 2010-001	*Proceedings: USA-Mexico Workshop on the Deepwater Physical Oceanography of the Gulf of Mexico, June 2007*
MMS 2010-002	*Proof of Concept for Platform Recruited Reef Fish, Phase 1: Do Platforms Provide Habitat for Subadult Red Snapper?*
MMS 2010-007	*Assessment of Marginal Production in the Gulf of Mexico and Lost Production from Early Decommissioning*
MMS 2010-015	*Low-Frequency Variability of Currents in the Deepwater Eastern Gulf of Mexico*
MMS 2010-016	*Trophic Aspects of Sperm Whales (*Physeter macrocephalus*) in the Northern Gulf of Mexico Using Stable Isotopes of Carbon and Nitrogen*
BOEMRE 2010-039	*Bank Erosion of Navigation Canals in the Western and Central Gulf of Mexico*
BOEMRE 2010-044 (in press)	*Full-Water Column Current Observations in the Western Gulf of Mexico*
BOEMRE 2010-045 (in press)	*Year 2008 Gulfwide Emission Inventory Study*
BOEMRE 2010-046	*Multicomponent and Multifrequency Seismic for Assessment of Fluid-Gas Expulsion Geology and Gas-Hydrate Deposits: Gulf of Mexico Hydrates*

BOEMRE 2010-052 BOEMRE 2010-053 (in press)	*Long-Term Monitoring at the East and West Flower Garden Banks: 2004-2008* *Volume 1: Technical Report* *Volume 2: Appendices*
Published in 2009	
Study Number	Title
MMS 2009-010	*Quality Control and Analysis of Acoustic Doppler Current Profiler Data Collected on Offshore Platforms of the Gulf of Mexico*
MMS 2009-013	*Foraminiferal Communities of Bathyal Hydrocarbon Seeps, Northern Gulf of Mexico: A Taxonomic, Ecologic, and Geologic Study*
MMS 2009-023	*Loop Current Frontal Eddies Based on Satellite Remote Sensing and Drifter Data*
MMS 2009-032	*Post-Hurricane Assessment of Sensitive Habitats of the Flower Garden Banks Vicinity*
MMS 2009-039	*Northern Gulf of Mexico Continental Slope Habitats and Benthic Ecology Study: Final Report*
MMS 2009-043	*Blue Crab (*Callinectes sapidus*) Use of the Ship/Trinity/Tiger Shoal Complex as a Nationally Important Spawning/Hatching/Foraging Ground: Discovery, Evaluation, and Sand Mining Recommendations Based on Blue Crab, Shrimp, and Spotted Seatrout Findings*
MMS 2009-046	*Investigations of Chemosynthetic Communities on the Lower Continental Slope of the Gulf of Mexico, Interim Report 2*
MMS 2009-048	*Outer Continental Shelf (OCS)-Related Pipelines and Navigation Canals in the Western and Central Gulf of Mexico: Relative Impacts on Wetlands Habitats and Effectiveness of Mitigation*
MMS 2009-050	*Observation of the Deepwater Manifestation of the Loop Current and Loop Current Rings in the Eastern Gulf of Mexico*
MMS 2009-051	*Proceedings: Twenty-fifth Gulf of Mexico Information Transfer Meeting, January 2009*
  MMS 2009-055 MMS 2009-056 MMS 2009-057 MMS 2009-058	*Synthesis, Analysis, and Integration of Meteorological and Air Quality Data for the Gulf of Mexico Region* *Volume I: User's Manual for the Gulf of Mexico Air Quality Database (Version 1.0)* *Volume II: Technical Reference Manual for the Gulf of Mexico Air Quality Database* *Volume III: Data Analysis* *Volume IV: Cart Analysis of Modeling Episode Days*
MMS 2009-059	*Evaluation of Oil and Gas Platforms on the Louisiana Continental Shelf for Organisms with Biotechnology Potential*
MMS 2009-060	*Modeling Waves and Currents Produced by Hurricanes Katrina, Rita, and Wilma*

Published in 2008	
Study Number	Title
MMS 2008-001	*Deepwater Currents in the Eastern Gulf of Mexico: Observations at 25.5°N and 87°W*
MMS 2008-006	*Sperm Whale Seismic Study in the Gulf of Mexico: Synthesis Report*
MMS 2008-009	*Investigations of Chemosynthetic Communities on the Lower Continental Slope of the Gulf of Mexico: Interim Report 1*
MMS 2008-012	*Proceedings: Twenty-Fourth Gulf of Mexico Information Transfer Meeting, January 2007*
MMS 2008-015	Lophelia *Reef Megafaunal Community Structure, Biotopes, Genetics, Microbial Ecology, and Geology (2004-2006)* NOTE: This study was conducted by the U.S. Geological Survey (USGS) for the Agency's Headquarters' Office, and it was funded by USGS.
MMS 2008-017	*Examination of the Development of Liquefied Natural Gas on the Gulf of Mexico*
MMS 2008-018	*Viosca Knoll Wreck: Discovery and Investigation of an Early Nineteenth-Century Wooden Sailing Vessel in 2,000 Feet of Water*
MMS 2008-019	*Post-Hurricane Assessment at the East Flower Garden Bank Long-Term Monitoring Site: November 2005*
MMS 2008-022	*Effects of Subsea Processing on Deepwater Environments in the Gulf of Mexico*
MMS 2008-024	*Executive Summary: 3rd International Deep-Sea Coral Symposium in Miami*
  MMS 2008-027 MMS 2008-028	*Long-Term Monitoring at the East and West Flower Garden Banks, 2004-2005—Interim Report* *Volume I: Technical Report* *Volume II: Appendices*
MMS 2008-029	*Five-Year Meteorological Datasets for CALMET/CALPUFF and OCD5 Modeling of the Gulf of Mexico Region*
 MMS 2008-030 MMS 2008-031	*Study of Deepwater Currents in the Northwestern Gulf of Mexico* *Volume I: Executive Summary* *Volume II: Technical Report*
 MMS 2008-042 MMS 2008-043 MMS 2008-044 MMS 2008-045 MMS 2008-046 MMS 2008-047	*History of the Offshore Oil and Gas Industry in Southern Louisiana* *Volume I: Papers on the Evolving Offshore Industry* *Volume II: Bayou Lafourche—Oral Histories of the Oil and Gas Industry* *Volume III: Morgan City's History in the Era of Oil and Gas—Perspectives of Those Who Were There* *Volume IV: Terrebonne Parish* *Volume V: Guide to the Interviews* *Volume VI: A Collection of Photographs*
MMS 2008-048	*Platform Debris Fields Associated with the Blue Dolphin (Buccaneer) Gas and Oil Field Artificial Reef Sites Offshore Freeport, Texas: Extent, Composition, and Biological Utilization*
 MMS 2008-050 MMS 2008-051	*Labor Needs Survey* *Volume I: Technical Report* *Volume II: Survey Instruments*

MMS 2008-052	*Benefits and Burdens of OCS Activities on States, Labor Market Areas, Coastal Counties, and Selected Communities*
MMS 2008-058	*Cumulative Increment Analysis for the Breton National Wilderness Area*
Published in 2007	
Study Number	Title
MMS 2007-015	*Archaeological and Biological Analysis of World War II Shipwrecks in the Gulf of Mexico; Artificial Reef Effect in Deepwater*
MMS 2007-019	*Mixtures of Metals and Polynuclear Aromatic Hydrocarbons May Elicit Complex, Nonadditive Toxicological Interactions*
MMS 2007-022	*Full-Water Column Current Observations in the Central Gulf of Mexico: Final Report*
MMS 2007-030	*Incorporation of Gulf of Mexico Benthic Survey Data into the Ocean Biogeographic Information System*
MMS 2007-031	*Idle Iron in the Gulf of Mexico*
MMS 2007-033	*Cooperative Research to Study Dive Patterns of Sperm Whales in the Atlantic Ocean*
MMS 2007-034	*Competition and Performance in Oil and Gas Lease Sales and Development in the U.S. Gulf of Mexico OCS Region, 1983-1999*
MMS 2007-035	*Seafloor Characteristics and Distribution Patterns of* Lophelia pertusa *and Other Sessile Megafauna at Two Upper-Slope Sites in the Northeastern Gulf of Mexico*
MMS 2007-044	*Characterization of Northern Gulf of Mexico Deepwater Hard-Bottom Communities with Emphasis on* Lophelia *Coral*
MMS 2007-056	*Full-Water Column Currents Near the Sigsbee Escarpment (91-92º W. Longitude) and Relationships with the Loop Current and Associated Warm- and Cold-Core Eddies*
MMS 2007-061	*Study of Barite Solubility and the Release of Trace Components to the Marine Environment*
MMS 2007-067	*Year 2005 Gulfwide Emission Inventory Study*
MMS 2007-068	*User's Guide for the 2008 Gulfwide Offshore Activities Data System (GOADS-2008)*
Published in 2006	
Study Number	Title
MMS 2006-005	*Fidelity of Red Snapper to Petroleum Platforms and Artificial Reefs in the Northern Gulf of Mexico*
MMS 2006-011	*Sustainable Community in Oil and Gas Country: Final Report*
MMS 2006-028	*Degradation of Synthetic-Based Drilling Mud Base Fluids by Gulf of Mexico Sediments, Final Report*
MMS 2006-030	*Accounting for Socioeconomic Change from Offshore Oil and Gas: Cumulative Effects on Louisiana's Coastal Parishes, 1969-2000*
MMS 2006-034	*Sperm Whale Seismic Study in the Gulf of Mexico, Summary Report: 2002-2004*

MMS 2006-035	*Long-Term Monitoring at the East and West Flower Garden Banks National Marine Sanctuary, 2002-2003*
MMS 2006-036	*Study to Conduct National Register of Historic Places Evaluations of Submerged Sites on the Gulf of Mexico Outer Continental Shelf*
MMS 2006-037	*Effect of Depth, Location, and Habitat Type, on Relative Abundance and Species Composition of Fishes Associated with Petroleum Platforms and Sonnier Bank in the Northern Gulf of Mexico*
MMS 2006-044 MMS 2006-045 MMS 2006-046	*Effects of Oil and Gas Exploration and Development at Selected Continental Slope Sites in the Gulf of Mexico;* *Volume I: Executive Summary* *Volume II: Technical Report* *Volume III: Appendices*
MMS 2006-063	*Economic Effects of Petroleum Prices and Production in the Gulf of Mexico OCS on the U.S. Gulf Coast Economy*
MMS 2006-064	*Capital Investment Decisionmaking and Trends in Petroleum Resource Development in the U.S. Gulf of Mexico*
MMS 2006-067	*Sperm Whale Seismic Study in the Gulf of Mexico, Annual Report: Years 3 and 4*
MMS 2006-071	*Annotated Bibliography of the Potential Environmental Impacts of Chlorination and Disinfection Byproducts Relevant to Offshore Liquefied Natural Gas Port Facilities*
MMS 2006-072	*Mica Shipwreck Project Report: Deepwater Archaeological Investigation of a 19th Century Shipwreck in the Gulf of Mexico*
MMS 2006-073 MMS 2006-074	*Exploratory Study of Deepwater Currents in the Gulf of Mexico* *Volume I: Executive Summary* *Volume II: Technical Report*

APPENDIX E

AGENCY-FUNDED HURRICANE RESEARCH AND STUDIES

APPENDIX E. AGENCY-FUNDED HURRICANE RESEARCH AND STUDIES

Project/Study Number	Title
Hurricanes Katrina and Rita	
BOEMRE 2011-003 (in press)	*Impacts of Recent Hurricane Activity on Historic Shipwrecks in the Gulf of Mexico Outer Continental Shelf*
MMS 2009-060	*Modeling Waves and Currents Produced by Hurricanes Katrina, Rita, and Wilma*
MMS 2009-032	*Post-Hurricane Assessment of Sensitive Habitats of the Flower Garden Banks Vicinity*
MMS 2008-019	*Post-Hurricane Assessment at the East Flower Garden Bank Long-Term Monitoring Site: November 2005*
GM-07-x12	Assessing Impact of OCS Activities on Public Infrastructure, Service, and Population in Coastal Communities Following Hurricanes Rita and Katrina
GM-92-42-124	Post-Hurricane Assessment of OCS-Related Infrastructure and Communities in the Gulf of Mexico Region
GM-92-42-125	Spatial Restructuring and Fiscal Impacts in the Wake of Disaster: The Case of the Oil and Gas Industry Following Hurricanes Katrina and Rita
GM-92-42-137	Socioeconomic Responses to Coastal Landloss and Hurricanes: Measuring Resilience Among OCS-Related Coastal Communities in Louisiana
GM-92-42-131	Gulf Coast Subsidence and Wetland Loss: A Synthesis of Recent Research
Project No. 578	Assessment of Fixed Offshore Platform Performance in Hurricanes Katrina and Rita
Project No. 580	Hindcast Data on Winds, Waves and Currents in Northern Gulf of Mexico in Hurricanes Katrina and Rita
Project No. 581	Pipeline Damage Assessments from Hurricanes Katrina and Rita
Project No. 591 (completed December 5, 2007)	Evaluate Accuracy of Polyester Subrope Damage Detection Performed by Remotely-Operated Vehicles (ROV's) Following Hurricanes and Other Events
Project No. 593	Evaluate and Assess the Performance of Jackup Rigs That Were Subject to Hurricanes Katrina or Rita
Project No. 599	JIP to Quantify Risks in Deepwater Production Facilities and Flowlines in the GOM
Project No. 603	Stability of Tension-Leg Platforms (TLP's) with Damaged Tendons

Project No. 604	Evaluation of Fatigue Life Models and Assessment Practice for Tension-Leg Platforms (Phase 1: Tendon System Fatigue)
Project No. 605	Cooperative Research on Extreme Seas and Their Impact to Floating Structures
Project No. 609	Reliability vs. Consequence of Failure for API RP 2A Platforms Using RP2MET
Hurricane Ivan	
GM-05-x12	Ocean Currents under Hurricane Ivan on the Mississippi/Alabama Shelf
Project No. 548	Examination and Review of Mobile Offshore Drilling Unit (MODU) Loss of Station-keeping Ability during Hurricane Ivan and Assessment of Current Mooring Standards and Criteria to Prevent Similar Failures
Project No. 549	Assessment of Fixed Offshore Platforms in Hurricane Ivan, Andrew
Project No. 550	A Pilot Study for Regionally-Consistent Hazard Susceptibility Mapping of Submarine Mudslides, Offshore Gulf of Mexico
Project No. 551	Assessment of Drilling and Workover Rig Storm Sea Fastenings on Offshore Floating Platforms during Hurricane Ivan
Project No. 552	Mudslides during Hurricane Ivan and an Assessment of the Potential for Future Mudslides in the GOM
Project No. 553	Pipeline Damage Assessment from Hurricane Ivan
Project No. 559	Offshore Hurricane Readiness and Recovery Conference
Hurricane Lili	
Project No. 466	Validation and Calibration of API RP2A Using Hurricane Lili to Update the Hurricane Andrew JIP Results that Provided the Basis for API Section 17
Project No. 467	Hindcast Study of Winds, Waves, and Currents in Northern GOM in Hurricane Lili (2002)
Project No. 469	Post-Mortem Failure Assessment of Drilling Rigs during Hurricane Lili
Project No. 471	Assessment of Performance of Deepwater Floating Production Facilities
Project No. 503	Evaluate and Compare Hurricane-Induced Damage to Offshore Pipelines for Hurricane Lili—Rev. A
Hurricane Andrew	
Project No. 193	Study and Hindcast of Wind and Wave Fields for Hurricane Andrew
Project No. 199	Hurricane Andrew Calibration Study
Project No. 201	Evaluation of Hurricane Pipeline Damage

Project No. 203	Performance of Safety and Pollution Control Devices in the Aftermath of Hurricane Andrew (Part of the Hurricane Andrew OCS Damage Assessment Program)
Project No. 204	Post-Mortem Platform Failure Evaluation Study
Project No. 206	Shallow-Water Wave and Current Field Study
Project No. 207	API/Hurricane Foundation Study
Project No. 209	Development of Acceptance Criteria for Caisson Structures Damaged during Hurricane Andrew
Project No. 210	Hurricane Andrew Effects on Offshore Platforms
Project No. 224	Dynamic Nonlinear Loading Effects on Offshore Platforms
Project No. 229	Hurricane Andrew Effects on Offshore Platforms (Phase II – JIP)

KEYWORD INDEX

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