4.1.3.4.7. Produced Water

The OCS operations routinely discharge small amounts of oil in wastewater discharges, primarily in produced waters. Produced water, when discharged overboard (after treatment that removes the majority of the entrained oil content), is limited by the USEPA effluent limitation guidelines to a monthly average of 29 mg/l oil content (USEPA, 1993). A typical annual amount of OCS-produced water to be discharged in the future was estimated based on annual historical quantities reported to MMS for the last 6 years **Chapter 4.1.1.4.2.**, Produced Waters). The average annual value of 532 MMbbl per year was converted to liters than multiplied by the monthly average oil and grease (29 mg/l) to estimate the contribution to the petroleum levels in GOM waters from OCS discharged produced waters. This calculation results in an estimate of 0.002 Mta of petroleum hydrocarbons entering GOM waters from operational, OCS produced-water discharges (**Table 4-14**).

4.1.3.4.8. Other Sources

There are other sources of petroleum hydrocarbons not estimated in this exercise and, therefore, a complete mass balance cannot be done. For example, vessel operational discharges have changed due to new regulations. In 1985, operational discharges (bilge and ballast water and oily tank wastes) from vessels dominated the major sources of oil inputs. Since then, the MARPOL regulations have significantly reduced the levels of operational discharges associated with vessel operations. Terminals are now required to maintain onshore disposal facilities for receipt of this waste; although full compliance with these requirements is not yet attained. At this time, a review of the effectiveness of the more restrictive discharge requirements is still ongoing, so no new numbers are available to estimate vessel contributions. The MMS expects that National Academy of Science's 1985 projection, 47 percent of the amount of oil entering the world ocean is from operational discharges from vessels, to be reduced significantly when they publish their updated projections. Other minor inputs from erosion of sedimentary rocks, atmospheric inputs, and dredged material disposal are not quantified. The contribution from international petroleum sources, such as Mexico and Cuba, was not calculated.

4.2. ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS - ROUTINE OPERATIONS

4.2.1. Alternative A – The Proposed Actions

The proposed actions are proposed Lease Sales 189 and 197. The lease sales are scheduled to be held in December 2003 and March 2005, respectively. Each lease sale would offer for lease all unleased blocks in the proposed lease sale area in the EPA. It is estimated that each proposed lease sale could result in the discovery and production of 0.065-0.085 BBO and 0.265-0.340 Tcf of gas during the period 2003-2042. A description of the proposed actions is included in **Chapter 1.2.** Alternatives to the proposed actions and mitigating measures are also described in **Chapters 2.3.2. and 2.3.1.3.**, respectively.

The analyses of the potential impacts are based on a scenario for a typical proposed action. These scenarios provide assumptions and estimates on the amounts, locations, and timing for OCS exploration, development, and production operations and facilities, both offshore and onshore. A detailed discussion of the development scenarios and major impact-producing factors from routine activities associated with a proposed action is included in **Chapter 4.1.** The two proposed mitigating measures (Marine Protected Species and Military Areas Stipulations) are considered part of the proposed action(s) for analysis purposes.

The scenario and analysis of potential impacts of oil spills and other accidental events are discussed in **Chapter 4.3.** The Gulfwide OCS Program and cumulative scenarios are discussed in **Chapter 4.1.** The cumulative impact analysis is presented in **Chapter 4.5.**

4.2.1.1. Impacts on Air Quality

The following activities potentially degrade air quality: platform construction and emplacement; platform operations; drilling activities; flaring and burning; survey and support vessel operations; pipeline laying operations; evaporation of volatile petroleum hydrocarbons during transfers and from surface oil slicks; and fugitive emissions. Supporting materials and discussions are presented in **Chapter 3.1.1.** (Air Quality), **Appendix A.3.** (Meteorological Conditions), **Chapter 4.1.1.9.** (Hydrogen Sulfide and Sulfurous Petroleum), and **Chapter 4.1.1.6.** (Air Emissions). The parameters of this analysis are emission rates, surface winds, atmospheric stability, and mixing height.

Emissions of certain air pollutants are known to be detrimental to public health and welfare. Some of these pollutants are directly emitted into the air, while others are formed in the atmosphere through chemical reactions. Nitric oxide and NO_2 constitute NO_x emissions. Nitrogen dioxide, a by-product of all combustion processes, is emitted from sources such as internal combustion engines, natural gas burners, and flares. Nitrogen dioxide is a precursor pollutant involved in photochemical reactions that yield ozone. Nitrogen dioxide is an irritating gas that may increase susceptibility to infection and may constrict the airways of people with respiratory problems. Further, nitrogen dioxide can react with water to form nitric acid, which is harmful to vegetation and materials, as a result of increased acidity in precipitation.

Carbon monoxide is a by-product of incomplete combustion and is primarily contained in engine exhaust. Carbon monoxide is readily absorbed into the body through the lungs, where it reacts with hemoglobin in the blood reducing the transfer of oxygen within the body. Carbon monoxideparticularly affects people with cardiovascular and chronic lung diseases.

Sulfur dioxide may cause constriction of the airways and particularly affects individuals with respiratory diseases. Sulfur dioxide can combine with water and oxygen, thus increasing the acidity in precipitation, which can be harmful to vegetation and materials. The flaring of H_2S, which is found naturally occurring in "sour" gas and the burning of liquid hydrocarbons, results in the formation of SO_2. The amount of SO_2 produced is directly proportional to the sulfur content of the hydrocarbons being flared or burned. The concentration of the H_2S varies substantially from hydrocarbon reservoir to reservoir, and even varies to some degree within the same reservoir. Flaring or burning of sour production is also of concern because it could significantly impact onshore areas, particularly when considering the short duration averaging periods (3 and 24 hr) for SO_2. The combustion of liquid fuels is the primary source of sulfur oxides (SO_x) when considering the annual averaging period.

Impacts from cleanup operations on high-rate wells can be significant. To prevent inadvertently exceeding established criteria for SO_2 for the 3-hr and 24-hr averaging periods, all incinerating events involving H_2S or liquid hydrocarbons are evaluated individually during the MMS review process for OCS plans.

Volatile organic compounds are precursor pollutants involved in a complex photochemical reaction with NO_x in the atmosphere to produce ozone. The primary sources of VOC's are venting and evaporative losses that occur during the processing and transporting of natural gas and petroleum products. A more concentrated source of VOC's comes from glycol dehydrator still vents.

Particulate matter is comprised of finely divided solids or liquids such as dust, soot, fumes, and aerosols. PM_{10} particles are small enough to bypass the human body's natural filtration system and can be deeply inhaled into the lungs, affecting respiratory functions. PM_{10} can also affect visibility, primarily by scattering of light by particles, and by light absorption to a lesser extent. This analysis considers mainly PM_{10} matter.

Ozone is a nearly colorless gas with a faint but distinctive odor, somewhat similar to chlorine. It is formed in the atmosphere from complex chemical reactions involving hydrocarbons and nitrogen oxides in the presence of sunlight. At ground level, ozone can cause or aggravate respiratory problems, interfere with photosynthesis, and can damage vegetation and crack rubber. Children, the elderly, and healthy people who exercise strenuously outdoors are +particularly sensitive to ozone concentrations. In the upper atmosphere, ozone is essential to life as we know it. The upper ozone layer shields the Earth's surface from harmful ultraviolet radiation. Depletion of the upper ozone layer is one of the most complex environmental issues facing the world today. This analysis would not include impacts on upper atmospheric ozone.

Emissions of air pollutants would occur during exploration, development, and production activities. Typical emissions for OCS exploratory and development drilling activities presented in **Chapter 4.1.1.6.** show that emissions of NO_x are the primary pollutant of concern. These emission estimates are based on a drilling scenario of a 4,115-m hole during exploration activities and a 3,050-m hole during development activities. Emissions during exploration drilling are higher than emissions during development drilling due to increased power requirements and the longer time required for drilling a deeper hole.

Platform emission rates for the GOM Region (**Chapter 4.1.1.6.**) are provided from the 1992 emission inventory of OCS sources compiled by MMS (Steiner et al., 1994). The primary pollutants of concern are NO_x and VOC, both considered precursors to ozone. Emission factors for other activities, such as support vessels, helicopters, tankers, and loading and transit operations, were obtained from Jacobs Engineering Group, Inc. (1989) and USEPA AP-42 (1985).

Once pollutants are released into the atmosphere, atmospheric transport and dispersion processes begin circulating the emissions. Transport processes are carried out by the prevailing net wind circulation. Dispersion depends on emission height, atmospheric stability, mixing height, exhaust gas temperature and velocity, and wind speed. For emissions inside the atmospheric boundary layer, the vertical heat flux, which includes effects from wind speed and atmospheric stability (via air-sea temperature differences), is a better indicator of turbulence available for dispersion (Lyons and Scott, 1990). Heat flux calculations in the EPA (USDOI, MMS, 1988) indicate a year-round upward flux, being highest during winter and lowest in summer.

The mixing height is very important because it determines the space available for spreading the pollutants. The mixing height is the height, above the surface, of the top of the layer through which vigorous vertical mixing occurs. Vertical mixing is most vigorous during unstable conditions. Vertical motion is suppressed during stable conditions and, hence, the mixing height for such times is undefined; these stagnant conditions generally result in the worst periods of air quality. The mixing height tends to be higher in the afternoon, more so over land than over water. Further, the mixing height tends to be lower in winter, with daily changes smaller than in summer.

Proposed Action Analysis

The total OCS emissions (over the life of a proposed action) for the criteria pollutants are indicated in **Table 4-16**. NO_x is the major emittent, while PM_{10} is the least emitted pollutant. Combustion intensive operations such as platform operations, well drilling, and service-vessel activities contribute mostly NO_x; platform operations are also the major contributors of VOC emissions. Platform construction emissions contribute appreciable amounts of all pollutants over the life of a proposed action. These emissions are temporary in nature and generally occur for a period of 3-4 months. Typical construction emissions result from the derrick barge placing the jacket and various modular components and from various service vessels supporting this operation. Exploratory wells and developmental wells contribute considerable amounts of all pollutants. Well emissions are temporary in nature and typically occur over a 100-day drilling period. Support for OCS activities includes crew and supply boats, helicopters, and pipeline vessels; emissions from these sources consist mainly of NO_x and CO. These emissions are directly proportional to the number and type of OCS operations requiring support activities. Most support emissions occur during transit between port and offshore oil and gas development activities, while a smaller percentage result from idling at the platform. Platform and well emissions were calculated using the integration of projected well and platform activities over time.

Projected total emissions for each offshore subarea due to a proposed action are presented in **Table 4-17**. Pollutants are distributed to subareas proportional to the projected number of wells and production structure installations slated for those areas.

The total pollutant emissions per year are not uniform. During the early years of a proposed action, emissions would be small and would increase over time with full platform emplacements and production. After reaching a maximum, emissions would decrease as all platforms and wells are removed and service-vessel trips and other related activities are no longer needed.

The peak-year emissions in tons per year for the criteria pollutants are indicated in **Table 4-18**. The peak-year emissions for a proposed action are projected to occur 7 years after the proposed lease sale. The peak emissions are calculated by combining peak-year activity total emissions for exploratory wells, development wells, and platforms over the life of a proposed action, and superimposing peak projected activity for support vessels and other emissions onto that peak year. Well drilling activities and platform peak emissions are not necessarily simultaneous. However, it is assumed for this analysis that total well and platform peak-year emissions combined with vessels and other emissions occur simultaneously. Use of the peak emissions shall provide the most conservative estimates of potential impacts to onshore air quality. NO_x is the main pollutant emitted, with service vessels being the primary source.

To provide the most conservative estimation, it is assumed that emissions from a potential oil spill and a potential blowout both occur in the peak year.

Projected peak emissions for each offshore subarea due to a proposed action are presented in **Table 4-19**. Pollutants are distributed to subareas proportional to the number of production structure installations projected for those areas.

The MMS regulations (30 CFR 250.303-304) do not establish annual significance levels for CO and VOC for the OCS areas under MMS jurisdiction. For CO, a comparison of the projected emission rate to the MMS exemption level would be used to assess impacts. The formula to compute the emission rate in tons/yr for CO is $3,400 \bullet D^{2/3}$; D represents distance in statute miles from the shoreline to the source. This formula is applied to each facility. The CO exempt emission level is 7,072 tons/yr at the State boundary line of 3 mi, which is greater than CO peak emissions from a proposed action.

The VOC emissions are best addressed as their corresponding ozone impacts, which were studied in the Gulf of Mexico Air Quality Study (GMAQS). The GMAQS indicated that OCS activities have little impact on ozone exceedance episodes in coastal nonattainment areas. Total OCS contributions to the exceedance (greater than 120 ppb) episodes studied were less than 2 ppb. In the GMAQS, the model was also run using double emissions from OCS petroleum production activities associated with offshore facilities and the resulting attributable ozone concentrations, during modeling exceedance episodes, were still small, ranging 2-4 ppb. The activities under a proposed action would not result in a doubling of the emissions and because the proposed activities are substantially smaller than this worst-case scenario, it is logical to conclude that their impact would be substantially smaller as well (Systems Applications International et al., 1995).

It is projected that all of the gas and oil produced as a result of a proposed action would be piped to shore terminals. Thus, no fugitive emissions associated with tanker and barge loadings and transfer are expected.

The Breton National Wilderness Area is a Class I air quality area administered by FWS (**Figure 3-2**). Under the Clean Air Act, MMS would notify the National Park Service and FWS if emissions from proposed projects may impact the Breton Class I area. Mitigating measures, including low sulphur diesel fuels and stricter air emissions monitoring and reporting requirements, are required for sources that are located within 100 km of the Breton Class I Area and that exceed emission levels agreed upon by the administering agencies.

The MMS studied the impacts of offshore emissions using the OCD model. Modeling was performed using OCD version 5. Three years of meteorological data (i.e., 1992, 1993, and 1994) were used. Over-water data are from Buoy 42007, onshore meteorology from the New Orleans NWS station, and upper air data from the Slidell, Louisiana, radiosonde station. Default values of 500 m for the mixing height and 80 percent for the relative humidity were used for the over-water meteorological data. Receptors were set at Breton Island, along the coastline, and also a short distance inland in order to capture coastal fumigation. The receptor at Breton Island (**Figure 3-2**) was chosen to represent the Class I area. For the Class I and Class II areas (all areas exclusive of the Class I area), the calculated concentrations are reported in **Tables 4-20 and 4-21** and are compared with the maximum allowable concentration increases, as regulated by 30 CFR 250.45(g) and 40 CFR 51.166(c).

Tables 4-20 and 4-21 list the predicted contributions to onshore pollutant concentrations from activities associated with the proposed lease sale (including all phases of activities, i.e., exploration, development, and production) and compares them with the maximum allowable increases over a baseline concentration established under the air quality regulations. While the tables show that the proposed lease sale by itself would result in concentration increases that are well within the maximum allowable limits for Class I and Class II areas, a direct comparison between the two sets of figures is not possible. This is because the actual maximum allowable increase depends on the net change in emissions from all other sources in the area, both offshore and onshore, since the date the baseline level was established. Sources that were already in place at the applicable baseline date are included in the establishment of the baseline and corresponding concentration and do not count in the determination of the maximum allowable increment. The PM_{10} are emitted at a substantially smaller rate than NO_2 and SO_2 and, hence, impacts from PM_{10} would be expected to be even smaller since chemical decay was not considered in this plume dispersion model.

Suspended particulate matter is important because of its potential in degrading the visibility in national wildlife refuges or recreational parks designated as PSD Class I areas. The impact depends on emission rates and particle size. Particle size represents the equivalent diameter, which is the diameter of a sphere that would have the same settling velocity as the particle. Particle distribution in the atmosphere has been characterized as being largely trimodal (Godish, 1991), with two peaks located at diameters smaller than 2 m and a third peak with diameters larger than 2 m. Particles with diameters of 2 m or larger settle very close to the source (residence time of approximately ½ day) (Lyons and Scott, 1990). For particles smaller than 2 m, which do not settle fast, wind transport determines their impacts. Projected PM_{10} concentrations are expected to have a low impact on the visibility of PSD Class I areas.

Summary and Conclusion

Emissions of pollutants into the atmosphere from the activities associated with a proposed action are not expected to have significant impacts on onshore air quality because of the prevailing atmospheric conditions, emission heights, emission rates, and the distance of these emissions from the coastline. Emissions from proposed action activities are not expected to have concentrations that would change onshore air quality classifications. Increases in onshore annual average concentrations of NO_x, SO_x, and PM_{10} are estimated to be less than the maximum increases allowed under the PSD program.

4.2.1.2. Impacts on Water Quality

Activities that are projected to result from a proposed lease sale are given in **Tables 4-8(a) and 4-8(b)**. The routine activities that would impact water quality include the following:

- discharges during drilling of exploration and development wells;
- workover of a well;
- structure installation and removal;
- discharges during production;
- installation of pipelines;
- service vessel discharges; and
- nonpoint-source runoff.

4.2.1.2.1. Coastal Waters

Proposed Action Analysis

In coastal waters, the water quality would be impacted by the discharges from the service vessels in port. The types of discharges and regulations were discussed in **Chapters 4.1.1.4.8. and 4.1.2.2.2.** Most discharges are treated prior to release, with the exception of ballast water. In coastal waters, bilge water may be discharged with an oil content of 15 ppm or less. The discharges would affect the water quality locally. Estimates of the volume of bilge water that may be discharged are not available.

Supporting infrastructures discharge into local waterways during routine operations. The types of onshore facilities were discussed in **Chapter 4.1.2.2.2.** All point-source discharges are regulated by the USEPA, which is the agency responsible for coastal water quality. The USEPA NPDES storm water effluent limitations control storm water discharges from support facilities. Nonpoint-source runoff, such as rainfall, which has drained from a public road, may contribute hydrocarbon and trace-metal pollutants. Data are not available to make estimates of the impact from this type of discharge.

Summary and Conclusion

The primary impacting sources to water quality in coastal waters are point-source and storm water discharges from support facilities, vessel discharges, and nonpoint-source runoff. The impacts to coastal water quality from a proposed action should be minimal as long as all existing regulatory requirements are met.

4.2.1.2.2. Marine Waters

Proposed Action Analysis

Drilling Muds and Cuttings

The drilling of exploratory and development wells results in the discharges of drilling fluids, called "muds," and cuttings. The USEPA NPDES permits restrict the type and amount of mud and cuttings that can be discharged. In the Eastern GOM, USEPA Region 4, WBF and cuttings can be discharged; OBF and cuttings and SBF and cuttings cannot be discharged.

Tables 4-8 (a) and (b) show the calculated average volumes of drilling fluids and cuttings generated drilling a typical shallow and deep exploration well, respectively, in the EPA. It is assumed that the shallow and deep wells are drilled using treated seawater and/or WBF and SBF (Richardson and Trocquet, personal communication, 2002). Although the discharge of SBF adhered to cuttings is not currently permitted, the volume of SBF and SBF cuttings is included in **Tables 4-8 (a) and (b)** for informational purposes. The MMS estimates that a proposed action would result in 11-13 exploratory and delineation wells and 19-27 development wells being drilled over 37 years.

The drilling of a single exploratory well in the EPA would result in the discharge of 2,300-2,720 bbl of WBF cuttings, depending upon the well depth (**Tables 4-8(a) and 4-8(b)**). The drilling of the proposed 11-13 exploration and delineation wells would generate 25,000-35,500 bbl of WBF cuttings. The drilling of a single development well would generate 1,000-1,225 bbl of WBF cuttings. The drilling of 19-27 development wells would generate 19,000-33,000 bbl of WBF cuttings.

The fate and effects of WBF have been extensively studied throughout the world (Engelhardt et al., 1989). The primary environmental concerns associated with WBF are the increased turbidity in the water column, alteration of sediment characteristics because of the addition of coarse material in cuttings, and trace metals. Occasionally, formation fluids may be discharged with the cuttings, adding hydrocarbon contamination, which may require treatment before discharge. The WBF are rapidly dispersed in the water column immediately after discharge, and the solids descend to the seafloor (Neff, 1987). The greatest effects to the benthos are within 100-200 m, primarily due to the increased coarsening of the sediment by cuttings. Most of the components of the WBF have low toxicity with the exception of some trace metals. Barium is the major element in the mud because of the high barite level, but trace amounts of chromium, copper, cadmium, mercury, lead, and zinc are also present. The trace mercury concentrations in barite are bound in sulfur compounds and not available for biological methylation or subsequent bioconcentration (Trefrey, et al., 1986). Significant elevations of all these metals except chromium were observed within 500 m of six GOM drilling sites on the continental shelf (Boothe and Presley, 1989). The USEPA guidelines limit the levels of cadmium and mercury in stock barite to 3.0 mg per kilogram (kg) and 1.0 mg/kg (dry weight), respectively. A study of chronic impacts from oil and gas activities (Kennicutt, 1995) determined that metals from discharges, including mercury and cadmium, were localized to within 150 m of the structure. Highest levels of metal contaminants were attributed to a platform where discharges are shunted to within 10 m of the bottom.

A recent literature review (Neff et al., 2000) discusses the current knowledge about the fate and effects of SBF on the seabed. Like OBF, the SBF do not disperse in the water column and therefore are not expected to adversely affect water quality. The SBF settle very close to the discharge point, thus affecting the local sediments. Unlike OBF, the SBF do not typically contain toxic aromatic compounds. The primary affects are smothering of benthic organisms, alteration of sediment grain size, and addition of organic matter, which can result in localized anoxia while the SBF degrade. Different formulations of SBF use different base fluids that degrade at different rates, thus affecting the impact. Bioaccumulation tests also indicate that SBF and their degradation products should not significantly bioaccumulate. It is expected that discharged cuttings should degrade within 2-3 years after cessation of discharge. The MMS is currently jointly funding a study of the spatial and temporal effects of discharged WBF, SBF and drill cuttings to evaluate the effects.

The February 2002, USEPA, Region 6 permit modifications describe the additional limits and monitoring requirements used to control potential environmental impacts of cuttings discharges with adhered SBF. The additional requirements include sediment toxicity testing of the SBF stock base fluid and the relative sediment toxicity of the SBF adhered to cuttings. The biodegradation rate, measured by gas production, of the SBF stock base fluid and SBF adhered to cuttings has also been added to the

USEPA Region 6 general permit. Additionally, a limit has been set on the concentration of PAH's in the stock base fluid and the percent of SBF retained on the cuttings (USEPA, 2002).

Produced Water

During production, produced water is the primary discharge and would impact water quality by adding hydrocarbons and trace metals to the environment. As discussed in **Chapter 4.1.1.4.2.**, the volume of produced water discharged from a facility ranges from 2 to 150,000 bbl/day. One to two million bbl per year are projected to be discharged overboard from the 16 to 22 producing wells expected from a proposed action. During the years of peak activity, a maximum of 3 million bbl of produced water may be discharged. The amount of oil and grease resulting from a proposed action can be estimated from the projected annual produced water volume. Assuming a monthly oil and grease average of 29 milligrams/liter (the NPDES permit limit for oil and grease), the volume of added hydrocarbons would be 30-90 bbl/yr as the result of a proposed action.

The MMS estimates that two production structures would be installed as the result of a proposed action (**Table 4-2**). Each structure may have the capacity to receive and treat greater volumes of produced water from multiple wells than structures in shallower waters. Discharges from workovers and other activities are generally mixed with the produced water and therefore must meet the same criteria.

Several studies have been conducted to evaluate the effects of produced-water discharges from platforms on the surrounding water column, sediments, and biota (e.g., Rabalais et al., 1991; Kennicutt, 1995; CSA, 1997b). The GOOMEX study (Kennicutt, 1995) examined the effects of discharges at three natural gas platforms. Effects, including increased hydrocarbons, trace metals, and coarser grain size sediments, were observed within 150 m of the platforms. Localized hypoxia was observed during the summer months and attributed to stratification of the water column and increased organic material near the platform. The distribution of contaminants was patchy and there were several variables that could contribute to the observations, specifically sand from cuttings, hydrocarbons, and trace metals in the porewater. It was not possible to make a definitive judgement as to the precise source of observed toxic effects in the benthic community.

A bioaccumulation study (CSA, 1997b) examined trace metals and hydrocarbons in several fish and invertebrate species near platforms on the continental shelf. The produced-water discharge and ambient seawater were also analyzed for the same compounds. Of the 60 target chemicals, only two (arsenic and cadmium) were measured in the edible tissues of mollusks at levels above the USEPA risk-based concentrations. The target organic compounds were not present in most tissue samples above the target level. However, radium isotopes were measured in 55 percent of the samples, but at low concentrations.

Measurements of radium in formation water range from 40 to 1,000 pCi/l. These values are greater than marine waters, but when formation waters are discharged offshore, the radium is rapidly diluted to ambient concentrations and the higher levels are not seen as a problem (Reid, 1980).

Other Impacting Activities

Platform installation and removal result in localized sediment suspension. Also, the installation of pipelines can increase the local total suspended solids in the water. These activities result in only a temporary adverse effect on water quality.

Supply-vessel traffic affects water quality through discharges of bilge water, ballast water, and domestic and sanitary wastes. Bilge water and sanitary wastes are treated before discharge. Ballast water is uncontaminated water but may come from a source with properties, such as lower or higher salinity, different from those of the receiving waters. Estimates of the volumes of these discharges are not available.

Summary and Conclusion

During exploratory activities, the primary impacting sources to marine water quality are discharges of drilling fluids and cuttings. Any change in NPDES permit limitations would impact the volumes of fluids and cuttings discharges. Impacting discharges during production activities are produced water and supply-vessel discharges. Impacts to marine waters from a proposed action should be minimal as long as regulatory requirements are followed.

4.2.1.3. Impacts on Sensitive Coastal Environments

Impacts to the general vegetation and physical aspects of coastal environments by activities resulting from a proposed action are considered in **Chapters 4.2.1.3.1., 4.2.1.3.2., and 4.2.1.3.3.** Potential impacts to barrier islands seaward of the barrier-dune system are considered in the coastal barrier beaches and associated dunes analysis. Potential impacts to barrier islands landward of the barrier-dune system are considered in the wetlands analysis. Impacts to animals that use these environments, the recreational value of beaches, and archaeological resources found there are described in impact analysis sections for those specific resources.

The major, non-accidental, impact-producing factors associated with a proposed action that could affect these environments include navigational traffic, maintenance dredging of navigational canals, pipeline maintenance, and expansions of port facilities and processing facilities. The MMS has no direct regulatory authority over potential impact-producing factors or mitigation activities that may occur or be needed in the States' coastal zones.

4.2.1.3.1. Coastal Barrier Beaches and Associated Dunes

This section considers impacts from a proposed action to the physical shape and structure of barrier beaches and associated dunes found between Galveston Island, Texas, and the mouth of Tampa Bay, Florida. Barrier features that are found along this approximately 3,200 km of coast can be divided into two groups: sand beaches, which fringe most shores of the GOM, and the marsh coast of the Big Bend area of Florida.

The major impact-producing factors associated with a proposed action that could affect barrier beaches and dunes include pipeline emplacement, navigation channel use and maintenance dredging, and use and expansion of support infrastructure in these coastal areas.

The portions of navigation channels through the sandbars that form at the mouths of most flowing channels (bar channels) (**Chapters 3.3.5.8.2. and 4.1.2.1.8.**) generally capture and remove sediments from the longshore sediment drift, if the cross-sectional area of the channel is too large for natural tidal and storm exchanges to keep swept clear. Periodic maintenance dredging is expected in existing OCS-related navigation channels through barrier passes and associated bars. Jetties designed to reduce channel shoaling and maintenance dredging of bar channels affect the stability of barrier landforms if those jetties or the bar channel serve as sediment sinks that intercept sediment in longshore drift. Materials from maintenance dredging of bar and pass channels are typically discharged to nearby, ocean dump sites in the GOM (**Chapter 4.1.3.2.1.**, Dredged Material Disposal). This dredging usually removes sediment from the littoral sediment drift or routes it around the beach immediately downdrift of the involved channel. Placement of dredged material in shallow coastal waters forms sandbars that can impair coastal navigation.

Adverse impacts of navigation channels can be mitigated by discharging dredged materials onto barrier beaches or strategically into longshore sediment currents downdrift of maintained channels. Adverse impacts of sediment sinks created by jetties can be further mitigated by reducing the jetty length to the minimum needed and by filling the updrift side of the jetty with appropriate sediment. Sediment traps that are created by unnecessarily large bar channels may also be mitigated by reassessing the navigational needs of the port and by appropriately reducing the depth of the channel. Mitigating adverse impacts should be addressed in accordance with requirements set forth by the appropriate Federal and State permitting agencies.

A proposed action would contribute to the need to maintain the navigation channels. In the past, OCS-related facilities were built in the vicinity of barrier shorelines of the WPA, CPA, and western portion of the EPA excluding Florida. The use of some existing facilities in support of a proposed action may extend the useful lives of those facilities. During that extended life, erosion-control structures may be installed to protect a facility. Although these measures may initially protect the facility as intended, such structures may accelerate erosion elsewhere in the vicinity. They may also cause accumulation of sediments updrift of the structures, sediments that might have alleviated erosion downdrift of the structure. These induced erosion impacts would be most damaging locally. In Louisiana where the sediment supply is critically low, these impacts may be distributed much more broadly. These impacts would last as long as the interruption of the sediment drift continues, which may continue after the structure is removed if the hydrodynamics of the area are permanently modified.

Expansions of existing facilities located on barrier beaches or in associated dunes would cause loss and disturbance of additional habitat. Abandoned facility sites must be cleared in accordance with Federal, State, and local government and landowner requirements. Materials and structures that would impair or divert sediment drift among the dunes and on the beach must be removed.

Proposed Action Analysis

The use of some existing facilities in support of activities resulting from a proposed action may extend the useful life and continued presence of those facilities. During that extended life, induced erosion impacts may occur from the use of erosion-control structures. These impacts would last as long as the interruption of the sediment drift continues, which may continue after the structure is removed if the hydrodynamics of the area are permanently modified. The severity of the impact would depend upon the site and would increase with the duration of the facility-accelerated erosion. Particularly in deltaic Louisiana, recoverability from these impacts would decrease with duration. Any impacts that result from armoring these would be proportionally attributable to a proposed action.

The primary service bases projected to support a proposed action are Port Fourchon and Venice, Louisiana, and Mobile, Alabama. Secondary service bases include Cameron, Houma, Intracoastal City, and Morgan City, Louisiana; and Pascagoula, Mississippi. The average contribution of a proposed action to navigation canals associated with these service bases is expected to be small. Correspondingly, impacts resulting from maintenance dredging, wake erosion, and other secondary impacts of navigation traffic resulting from a proposed action would be inconsequential.

Sediments from maintenance dredging of bar channels and tidal inlets can benefit barrier beaches if placed strategically downstream of the channel and in the interrupted longshore sediment drift. Strategic placement would help mitigate adverse impacts caused by the presence of jetties and artificially deepened tidal passes. Strategic placement of sediments may also offset adverse impacts resulting from a proposed action. A percentage of any such benefits would be attributable to a proposed action.

Summary and Conclusion

Existing facilities originally built inland may, through natural erosion and shoreline recession, be located in the barrier beach and dune zone and contribute to erosion there. A proposed action may contribute to the continued use of such facilities. Maintenance dredging of barrier inlets and bar channels is expected to occur, which combined with channel jetties, generally causes minor and very localized impacts on adjacent barrier beaches downdrift of the channel due to sediment deprivation. The worst of these situations is found on the sediment-starved coasts of Louisiana, where sediments are largely organic. A proposed action would use navigation canals associated with the primary service bases (Port Fourchon and Venice, Louisiana, and Mobile, Alabama) and secondary service bases (include Cameron, Houma, Intracoastal City, and Morgan City, Louisiana; and Pascagoula, Mississippi). Based on use, a proposed action would account for a very small percentage of these impacts, which would occur whether a proposed action is implemented or not.

In conclusion, a proposed action is not expected to adversely alter barrier beach configurations significantly beyond existing, ongoing impacts in very localized areas downdrift of artificially jettied and maintained channels. A proposed action may extend the life and presence of facilities in eroding areas, which can accelerate erosion. Strategic placement of dredged material from channel maintenance, channel deepening, and related actions can mitigate adverse impacts upon these localized areas.

4.2.1.3.2. Wetlands

The area of interest in Louisiana contains about 708,570 ha of coastal wetlands. About 32,570 ha of this area are freshwater marsh and forests; 175,560 ha are intermediate salinity marsh; and 207,440 ha are brackish marsh (Louisiana Dept. of Wildlife and Fisheries, 1997). Presumably, the remaining 293,000 ha are saline marsh. These wetlands largely occur as broad expanses.

Less than 10 percent of this land is more than 3 ft above sea level, and only where five salt domes rise above the surrounding wetlands do natural elevations exceed 35 ft above mean sea level. This region contains 25 percent of the Nation's coastal wetlands and accounts for 40 percent of all salt marshes in the lower 48 states (Dunbar et al., 1992). Because more than 90 percent of the coast is less than 3 ft above sea level, an extra 1 or 2 ft of elevation loss through subsidence or erosion would have drastic effects on the available wetland habitat. Current estimates predict that nearly 640,000 acres of existing wetlands (an area nearly the size of Rhode Island) will be under water in less than 50 years (Louisiana Coastal Wetlands Conservation and Restoration Task, 1993). Mississippi contains about 64,000 ac (25,920 ha) of vegetated, coastal wetlands (Coastal Preserves Program, 1999). According to Wallace (1996), Alabama has about 75,000 ac (30,375 ha) of forested wetlands, 4,400 ac (1,782 ha) of freshwater marsh, and 35,400 ac (14,337 ha) of estuarine marsh. Finally, within the area of interest, the coastal counties of Florida contain about 2,448,725 ac (994,950 ha) of wetlands. Hardwood swamps represent the largest percentage (32.5%) of those wetlands. Hardwood swamps there are largely associated with the river deltas, such as those associated with Pensacola, Choctawatchee, and St. Andrews Bays. Estuarine wetlands, such as marsh and mangroves, represent 7.4 percent of that total (Florida Game and Freshwater Fish Commission, 1996).

The OCS oil and gas activities that could potentially impact these wetland types and their associated habitats include pipeline maintenance, maintenance dredging of navigation channels and canals, vessel usage of navigation channels, and maintenance of inshore facilities. Other potential impacts that are indirectly associated with OCS oil and gas activities are wake erosion resulting from navigational traffic, levee construction that prevents necessary sedimentary processes, saltwater intrusion that changes the hydrology leading to unfavorable conditions for wetland vegetation, and vulnerability to storm damage from eroded wetlands.

Pipelines

A proposed action is expected to contribute slightly to the overall impacts to wetlands and associated coastal habitats from OCS-related coastal required pipeline maintenance. As previously discussed in **Chapter 4.1.1.8.1.**, Pipelines, petroleum reservoirs in deepwater areas might require their own pipeline landfall. No new pipelines in coastal waters or pipeline landfalls are projected as a result of a proposed action.

As of August 2001, there were more than 45,000 km of pipelines in Federal offshore lands and approximately 16,000 km of OCS pipelines extend into State waters and onshore. Many OCS pipelines make landfall on Louisiana's barrier island and wetland shorelines (Falgout, 1997). Louisiana wetlands protect pipelines from waves and ensure that the lines stay buried and in place.

Secondary impacts of pipeline channels can be even more damaging to coastal wetlands and associated habitats than the primary impacts (Tabberer et al., 1985). Secondary impacts include expansion of tidal influence, saltwater intrusion, hydrodynamic alteration, erosion, sediment export, flank subsidence, and habitat conversion. During reviews of pipeline projects for Federal and State permits, agencies consistently comment with concern upon the extent of these secondary impacts. As a result, structures engineered to mitigate secondary adverse impacts are included as permit requirements. The number of OCS-related mitigative structures around the Gulf Coast is unknown.

Frequently, the non-maintenance of structures used to mitigate adverse impacts of pipeline construction allows the structures to deteriorate and eventually fail. Consequently, the indirect and adverse impacts upon wetlands that the structures were designed to prevent or mitigate could resume and possibly proceed at an accelerated rate. No known effort has been made to document the frequency or extent of these failures or the severity of the resulting impacts. Quantifying indirect impacts have proven to be difficult and highly debatable. The widening of pipeline canals over time is one of the more obvious secondary impacts; however, extricating secondary impacts of canals from all other losses remains a challenge. A number of studies have examined the correlative evidence linking wetland loss to canal densities (Turner et al. 1982; Saife et al., 1983; Turner and Cahoon, 1988; Turner, 1987; Bass and Turner, 1997). In general, it appears that for most of the Louisiana coast a positive relationship exists between canal density and wetland loss. The limitation of this suggestion is that it fails to identify any cause and effect relationship; however, it may provide a basis upon which to support a hypothesis about the secondary impacts of canals on wetland loss rates.

Craig et al. (1980) studied a series of canals in Louisiana and determined that the canals widened at rates of 2-14 percent per year. Dead-end canals with little vessel traffic or significant flow were shown to widen at rates within this range. Based on the 1980 study and due to their shallow nature, OCS-related pipeline canals were expected to widen at an average rate of approximately 4 percent per year. One current line of research in coastal Louisiana involves either (1) an estimate of the percent of total wetland loss or (2) determining a ratio of the relative contribution of direct to indirect wetland losses. Turner and Cahoon (1988) suggest that 20-60 percent of wetland loss is from secondary oil impacts, with 4-13 percent attributed to OCS activities. More recently, Penland (1999), in a detailed GIS analysis of causes of wetland loss in the Louisiana Deltaic Plain, concluded that approximately 20 percent of wetland loss could be attributed to secondary impacts of OCS activities. Day et al. (in press) suggest that in some basins in Louisiana as much as 32 percent of wetland loss may be indirectly caused by canals (i.e., Barataria, Mermenteau basins); however, Day et al. also found that no or minimal wetland loss may be attributable to secondary canal impacts in other basins such as the Atchafalaya.

The length and width of OCS-related pipeline canals around the Gulf Coast are unknown. The results of an MMS/USGS-BRD study investigating coastal wetland impacts from the widening of OCS-related pipeline canals and the effectiveness of mitigation reveal the following preliminary data: (1) Total length of OCS pipelines from offshore – 3 mi (State/Federal boundary) to the inland coastal zone boundary was approximately 16,000 km. Sources of data were PennWell Mapsearch, National Pipeline Mapping System, and Louisiana Geological Survey pipeline data. (2) Total increase in water versus land within a 300-m buffer for each OCS pipeline from 1956 to 1990 was 37,709 ha. This number represented 9.7 percent of the total increase in water versus land for coastal Louisiana from 1956 to 1990. It should be mentioned that a great number of these pipelines were installed prior to implementation of NEPA (1969) and, more recently, the State of Louisiana's Coastal Permit Program in 1981. Additionally, given the width of buffer (300 m) versus actual pipeline width, which may be a 100 to 200 ft wide, a portion of water increase may be attributed to other factors unrelated to OCS activities. To address this issue, selected OCS pipelines are being studied in greater detail to ascertain direct and secondary impacts to the extent possible. The information from the analysis will be forthcoming. At present, there is no known study addressing the effectiveness or longevity of canal-related mitigation. Recently, MMS identified and mapped existing onshore OCS-related pipelines in the GOM coastal regions, including the Chenier Plain. With the OCS pipelines identified, the MMS/USGS-BRD study provides basic information for the EIS's developed by MMS and for mitigative measures implemented by other Federal and State permitting agencies.

Dredging

No new navigational channels are expected to be dredged/constructed as a result of a proposed action. Deepwater activities, such as those anticipated with a proposed action, require the use of larger service vessels for efficient operations. This may put substantial emphasis on shore bases associated with deeper channels. Some of the ports that have navigation channels deep enough to accommodate deeper-draft vessels may expand port infrastructure to accommodate these deeper-draft vessels. An example of a significant expansion of a service base is Port Fourchon in coastal Louisiana. Port Fourchon has deepened the existing channel and has dredged additional new channels to facilitate this expansion. Dredging and dredged-material disposal can be detrimental to coastal wetlands and associated fish and wildlife that use these areas for nursery grounds, protection, etc. Periodic maintenance dredging of navigation channels deposits material on existing dredged-material disposal banks and disposal areas; the effects of dredged-material disposal banks on wetland drainage is expected to continue unchanged, although there may be some localized and minor exacerbation of existing problems. Typically, some dredged material intended for placement on a dredged-material disposal bank is placed in adjacent wetlands or shallow water. Wetland loss due to dredge material deposition is expected to be offset by wetland creation as adjacent margins of shallow water are filled. In both cases, areas impacted are considered small. Maintenance dredging would also temporarily increase turbidity levels in the vicinities of the dredging and disposal of materials, which can impact emergent wetlands, seagrass communities, and associated habitats. Two different methods are generally used to dredge and transport sediments from channels to open-water sites: (1) hydraulic cutterhead suction dredge with transfer of the sediments via connecting pipelines; and (2) clamshell bucket dredge with transfer of the sediments via towed bottom-release scows. Each method produces a distinctly different deposit. Hydraulic dredging creates a slurry of sediment and water, which is pumped through a pipeline to a basin-like depression in proximity to the channel. The majority of the sediment settles to the bottom where it spreads outward under the force of gravity and tends to fill the basin. The clamshell dredge scoops sediments relatively intact into scows, which are then towed to the designated area, and then releases the sediment onto the specified area for disposal. This method usually produces positive relief features in the placement area.

Access canals, as well as pipeline canals, are commonly surrounded by levees created using dredged materials (Rozas, 1992). Placement of this material alongside canals converts marsh to upland, an environment unavailable to aquatic organisms except during extreme tides. Dredge material can also form a barrier causing ponding behind levees and limiting exchanges between canal waters and marshes to infrequent, high-water events (Swenson and Turner 1987; Cox et al., 1997). This and similar disruptions to marsh hydrology are believed to change coastal habitat structure as well as accelerate marsh erosion and conversion to open water (Kuhn et al., 1999; Turner et al., 1994; Rozas, 1992; Turner and Cahoon, 1987). The MMS/USGS-BRD study previously mentioned above (pipelines) will attempt to quantify the impacts of dredge material deposition as well as other canal-related impacts, which should provide insights for identifying past and future impacts.

Executive Order 11990 requires that material from maintenance dredging be considered for use as a sediment supplement in deteriorating wetland areas to enhance and increase wetland acreage, where appropriate. Disposal of dredged material for marsh enhancement has been done only on a limited basis (**Chapter 4.1.3.2.1.**, Dredged Material Disposal). Given the "mission statement" of the COE, which requires it to take environmental impacts into consideration during its decisionmaking processes, increased emphasis has been placed on the use of dredged material for marsh creation. For a proposed action, increased use of dredged material to enhance wetland habitats is encouraged as mitigation.

Vessel Traffic and Saltwater Intrusion

Vessel traffic that may support a proposed action is discussed in **Chapter 4.1.1.8.2.**, Service Vessels. Navigation channels projected to be used in support of a proposed action are discussed in **Chapter 4.1.2.1.8.**, Navigation Channels. Navigation channels that support the OCS Program are listed in **Table 3-33**. Waves generated by boats, ships, barges, and other vessels erode unprotected shorelines and accelerate erosion in areas already affected by natural erosion process. An increase in the number of vessels creating wakes could potentially impact coastal habitat including wetlands.

According to Johnson and Gosselink (1982), canals that have high navigation usage in coastal Louisiana widen about 2.58 m/yr, compared with 0.95 m/yr for little used canals. The OCS-related navigation canals are assumed to generally widen at an average rate of 1.5 m/yr. Approximately 3,200 km of OCS-related navigation canals, bayous, and rivers are found in the coastal regions around the GOM, exclusive of channels through large bays, sounds, and lagoons. About 2,000 km is found in the CPA.

Specific to navigation channels is the effects from saltwater intrusion (Gosselink et al., 1979; Wang, 1987). Wang developed a model demonstrating that, under certain environmental conditions, saltwater penetrates farther inland in deep navigation type channels than in shallower channels, suggesting that navigation channels act as "salt pumps." The Calcasieu Ship Channel is a good example of how saltwater intrustion, as a consequence of channelization, results in significant habitat transition from freshwater to brackish and ultimately to salt or open water systems. Another example is the construction of the Mississippi River Gulf Outlet (MRGO) that has lead to the transition of many of the taxodium swamps east of the Mississippi River below New Orleans to open water, which are largely composed of Spartina with old Taxodium trunks.

There are two major waterways that support vessel traffic associated with OCS activities: (1) the GIWW completed in 1949, and as previously mentioned, (2) the MRGO opened through the wetlands of St. Bernard Parish in 1963. The GIWW carries barges of crude oil, petroleum, bulk cargoes, and miscellaneous items along a 12-ft deep channel protected from the storms, waves, and winds of the GOM. Maintenance dredging of the MRGO has always been necessary, especially in areas such as Breton Sound where the channel crosses open water. Continued use of this navigation channel, annual dredging, and the instability of the banks has caused the main channel of the MRGO to widen from 500 to 2,000 ft in some places.

Much of the service-vessel traffic that is a necessary component of OCS activities uses the channels and canals along the Louisiana coast. An increase in the number of vessels creating wakes could potentially increase impacts to coastal habitats including wetlands.

Disposal of OCS-Related Wastes

Produced sands, oil-based drilling muds and cuttings, and some fluids from well treatment, workover, and completion activities would be transported to shore for disposal. Sufficient disposal capacity exists at the disposal site near Lacassine, Louisiana (coastal Subarea LA-1) and at other disposal sites in Subareas TX-2, LA-1, LA-2, and MA-1 (**Chapter 4.1.2.1.6.**, Disposal and Storage Facilities for Offshore Operational Wastes). Discharging OCS-related produced water into inshore waters has been discontinued. All OCS-produced waters are discharged into offshore waters in accordance with NPDES permits or transported to shore for injection. Produced waters are not expected to affect coastal wetlands (**Chapter 4.1.1.4.**, Operational Waste Discharged Ofshore).

Because of wetland protection regulations, no new waste disposal site would be developed in wetlands. Some seepage from waste sites into adjacent wetland areas may occur and result in damage to wetland vegetation. State requirements are expected to be enforced to prevent and correct such occurrences.

Onshore Facilities

Various kinds of onshore facilities service OCS development. These facilities are described in **Chapter 4.1.2.1.**, Coastal Infrastructure, and **Table 4-7**. State and Federal permitting agencies discourage the placement of new facilities and the expansion of existing facilities in wetlands. Any impacts upon wetlands are usually mitigated. All projected new facilities are attributed to the OCS Program, with an appropriate proportion attributed to a proposed action.

Proposed Action Analysis

Direct causes of Louisiana wetland loss may be attributed to the following activities associated with a proposed action:

- dredging and stream channelization for navigation channels and pipeline canals;
- filling for dredged material and other solid-waste disposal;
- roads and highways; and
- industrial expansion.

Indirect causes of wetland loss may be attributed to:

- sediment diversion by deep channels;
- hydrologic alterations by canals, dredged-material disposal banks, roads, and other structures; and
- subsidence due to extraction of groundwater.

Oil production from a proposed action is expected to be commingled in pipelines with other OCS production before going ashore. No new pipelines in coastal waters or pipeline landfalls are projected as a result of a proposed action.

A proposed action is projected to contribute a small amount to the usage of OCS-related navigation channels; therefore, impact related to a proposed action should remain minimal. Since the number of OCS-related mitigative structures is unknown, impacts creditable to a proposed action cannot be calculated. Impacts associated with canals and mitigation structures include altered hydrology and flank subsidence, for which methods of projecting rates of occurrence and extent of influence have not yet been developed. An MMS study of canal-impact issues is expected in the spring of 2002.

Summary and Conclusion

A proposed action is projected to result in the construction of no new pipeline landfalls and would use the existing pipeline system. Secondary impacts, such as continued widening of existing pipeline and navigation channels and canals, as well as the failure of mitigation structures, are also expected to convert wetlands to open water.

Maintenance dredging of navigation channels and canals is expected to occur with minimal impacts; a proposed action is expected to contribute minimally to the need for this dredging. Alternative dredged-material disposal methods can be used to enhance and create coastal wetlands. By artificially keeping navigation channels open and with larger dimensions than the region's natural hydrodynamic processes, maintenance dredging maintains tidal and storm flushing potential of inland regions at maximum capacities as they relate to the described needs of the canal project. Without maintenance dredging, these channels would naturally fill in, reducing the channels' cross-sectional areas and their capacities to flush or drain a region when under the influences of storms and tides.

In conclusion, adverse initial impacts and more importantly secondary impacts of maintenance, continued existence, and the failure of mitigation structures for pipeline and navigation canals are considered the most significant OCS-related and proposed-action-related impacts to wetlands. Although initial impacts are considered locally significant and largely limited to where OCS-related canals and channels pass through wetlands, secondary impacts may have substantial, progressive, and cumulative adverse impacts to the hydrologic basin or subbasin in which they are found. The broad and diffuse distribution of OCS-related activities offshore and along the Central Gulf Coast makes it difficult to distinguish proposed action impacts from other ongoing OCS and non-OCS impacts to wetlands. The MMS has initiated studies to better evaluate these impacts and related mitigative efforts.

4.2.1.3.3. Seagrass Communities

Seagrasses are restricted to small shallow areas behind barrier islands in Mississippi and Chandeleur Sounds and to smaller, more scattered populations elsewhere. Lower-salinity, submerged seagrass beds are found inland and discontinuously throughout the coastal zone. Most seagrass communities and associated habitat are located between the Southwest Pass of the Mississippi River and Cape San Blas, Florida and are inland of the barrier shorelines. Most seagrass habitat in this region usually remains submerged because of the micro-tidal regime of the northern GOM. Only during extremely low, wind-driven tidal events would seagrass beds be exposed to the air. Even then, their roots and rhizomes remain buried in the water bottom. Activities that may result from a proposed action that could adversely affect submerged vegetation beds include maintenance dredging of navigational channels, vessel traffic, oil spills, and spill response and cleanup. The potential impacts of oil spills on seagrass communities and spill-response and cleanup activities are discussed in **Chapter 4.4.3.3.**

Maintenance Dredging

No new navigational channels are expected to be dredged as a result of a proposed action. Maintenance dredging schedules vary from yearly to rarely and would continue indefinitely into the future. Deepwater activities are anticipated to increase, which would likely require greater use of larger service vessels for efficient operations and may cause greater use of shore bases associated with deeper channels.

Some of the ports that have navigation channels deep enough to accommodate deeper-draft vessels may expand the port infrastructure to accommodate these deeper-draft vessels. A small portion of this need would be attributable to a proposed action. An example of a significant expansion of a service base is Port Fourchon in coastal Louisiana. Port Fourchon has deepened existing channels and has dredged additional new channels to facilitate this expansion. Light attenuation is responsible for most landscape-level losses. The amount of light reaching the bottom of a seagrass bed is the crucial factor determining seagrass meadow extent and productivity. Reduced light has been linked to reductions of both seagrass cover and productivity (Orth and Moore 1983; Kenworthy and Haunert 1991; Dunton 1994; Czerny and Dunton 1995). It has been determined that one of the major causes of light reduction that results in changes in seagrass cover, composition, and biomass is dredging. Changes in species composition are usually the result of natural processes (i.e., succession), but they can be caused by salinity moderation resulting from dredging. Changes in species composition resulting from dredging activities may affect resource availability for some fish and waterfowl that use seagrass habitat as nursery grounds. Turbidity caused by maintenance dredging has been implicated in the decline of shoalgrass and increased bare areas in the lower Laguna Madre (Onuf, 1994) located behind the south Texas barrier islands.

Maintenance dredging keeps navigation channels open and artificially maintains larger channel dimensions than would occur naturally under regional hydrodynamics. Dredging also increases the potential for tidal and storm flushing of inland regions. Without maintenance dredging, these channels would naturally fill in, reducing the channels' cross-sectional areas and their capacities to flush or drain a region when under the influence of storms and tides.

Vessel Traffic

Navigation traffic that may support a proposed action is discussed in **Chapter 4.1.1.8.2.**, Service Vessels. Navigation channels projected to be used for a proposed action are used by vessels that support the OCS Program (**Table 3-33**). The GIWW is dredged to 4 m, but it is actually about 5.5 m deep between the Pascagoula Channel and the Bayou LaBatre Channel and generally about 3.7 m deep between the Bayou LaBatre and Mobile Bay Channels. Prop wash of shallow navigation channels by vessel traffic dredges up and resuspends sediments, increasing the turbidity of nearby coastal waters.

Proposed Action Analysis

Maintenance Dredging

Because much of the dredged material resulting from maintenance dredging would be placed on existing dredged-material disposal sites or used for other mitigative projects, no significant adverse impacts are expected to occur to seagrass communities from maintenance dredging related to a proposed action.

Vessel Traffic

Navigational traffic through the GIWW between the Bayou LaBatre Channel and Mobile Bay Channel would resuspend sediments. A proposed action would contribute to a percentage of traffic through that stretch. However, seagrass habitat within the area of influence of that channel and other channels has already adjusted their configurations in response to turbidity generated there.

Vessels that vary their inland route from established navigation channels can directly scar beds of submerged vegetation with their props, keels (or flat bottoms), and anchors. Many vessel captains may cut corners of channel intersections or navigate across open water where they would unexpectedly encounter shallow water where beds of submerged aquatic vegetation may occur. Propellers may damage a bed superficially by leaving a few narrow cuts. Damage may be as extensive as broadly plowed scars from the keel of a large boat accompanied by extensive prop washing; trampling by waders; and additional keel, prop, and propwash scars left by other vessels that assisted in freeing the first boat.

Depending upon the submerged plant species involved, scars about 0.25-m wide cut through the middle of beds would take 1-7 years to recover. Similar scars through sparser areas would take 10 years or more to recover. The broader the scar, the longer the recovery period. Extensive damage to a broad area may never be corrected (Sargent et al., 1995; Durako et al., 1992).

Denser dredged materials fall out of suspension more quickly. Less dense sediments settle to the water bottom more slowly, which concentrates at the surface of the water bottom. These lighter bottom sediments are generally more easily resuspend by storms than were the original surface sediments. Hence, for a period of time after dredging occurs, water turbidity would be greater than usual in the vicinity of the dredging. With time, this reoccurring, increased turbidity would decrease to pre-project conditions, as the lighter materials are either dispersed to deeper water by currents, where they are less available for resuspension, or they are consolidated into or under denser sediments.

For estuarine species that thrive in salinities of about 0.5-25 ppt, this elevated turbidity may not pose a significant problem, since they have adapted to turbid, estuarine conditions. For seagrasses in higher salinities and even freshwater submerged aquatic vegetation that requires clearer waters, significantly reduced water clarity or shading, as may be caused by an oil slick, for longer than about 4 days would decrease chlorophyll production. If such conditions continue for longer than about 2 weeks, plant density in the bed would begin to decrease. If plant density reduces significantly, further increases in turbidity would occur as the root, thatch, and leaf coverage decline. Such impacts can be mitigated in several ways. Activities over grass beds should be closely monitored to avoid digging into the bed. Trampling or repeatedly walking over a path through the bed should be avoided.

Summary and Conclusion

Beds of submerged vegetation within a channel's area of influence would have already adjusted to bed configurations in response to turbidity generated there. Very little, if any, damage would then occur as a result of typical channel traffic. Generally, propwash would not resuspend sediments in navigation channels beyond pre-project conditions.

Depending upon the submerged plant species involved, narrow scars in dense portions of the beds would take 1-7 years to recover. Scars through sparser areas would take 10 years or more to recover. The broader the scar, the longer the recovery period. Extensive damage to a broad area may never be corrected.

Because much of the dredged material resulting from maintenance dredging would be placed on existing dredged-material disposal sites or used for other mitigative projects, no significant adverse impacts are expected to occur to seagrass communities from maintenance dredging related to a proposed action.

4.2.1.4. Impacts on Sensitive Offshore Benthic Resources

4.2.1.4.1. Continental Shelf

4.2.1.4.1.1. Live Bottoms (Pinnacle Trend)

Seventy blocks are within the region defined as the pinnacle trend, which contains live bottoms that may be sensitive to oil and gas activities. These blocks are located in the northeastern portion of the CPA and are located between 53- and 110-m water depths in the Main Pass and Viosca Knoll lease areas. There are also four blocks containing pinnacles in adjacent areas of the EPA. Potential pipelines from the proposed lease sale area could traverse leases in the pinnacle trend in the CPA; however, the Live Bottom (Pinnacle Trend) Stipulation placed on these CPA leases is designed to prevent drilling activities and anchor emplacement (the major potential impacting factors on these live bottoms resulting from offshore oil and gas activities) from damaging the pinnacles. Accidental impacts may be caused by operator positioning errors or when studies and/or geohazards information are inaccurate in mapping or fail to note the presence of pinnacle features.

A number of OCS-related factors may cause adverse impacts on the pinnacle trend communities and features. Damage caused by pipeline emplacement, blowouts, and oil spills can cause the immediate mortality of live-bottom organisms or the alteration of sediments to the point that recolonization of the affected areas may be delayed or impossible. Impacts from oil spills and blowouts on live bottoms are discussed in **Chapter 4.4.4.1.1.**

Proposed Action Analysis

The pinnacles are not located within the proposed lease sale area; however, pipelines that would support a proposed action may go through the pinnacle trend. Pipeline emplacement has the potential to cause considerable disruption to the bottom sediments in the vicinity of the pinnacles (**Chapter 4.1.1.8.1.**, Pipelines); however, the Live Bottom Stipulation, or a similar protective measure, would restrict pipeline-laying activities in the vicinity of the pinnacle communities. Data gathered for the Mississippi-Alabama Continental Shelf Ecosystem Study (Brooks, 1991) and the Mississippi/Alabama Pinnacle Trend Ecosystem Monitoring, Final Synthesis Report (Continental Shelf Associates, Inc. and Texas A&M University, Geochemical and Environmental Research Group, 2001) document dense biological communities (i.e., live-bottom communities, fish habitat, etc.) on the high- and medium-relief pinnacle features themselves and live-bottom organisms more sparsely distributed in unconsolidated bottom sediments surrounding the pinnacles. The actual effect of pipeline-laying activities on the biota of the pinnacle communities would be restricted to the resuspension of sediments. The Live Bottom Stipulation would help to minimize the impacts of pipeline-laying activities throughout the pinnacle region. Two pipelines are projected to result under a proposed action. The severity of these actions has been judged at the community level to be slight, and impacts from these activities to be such that there would be no measurable interference to the general ecosystem.

Summary and Conclusion

Activities resulting from a proposed action are not expected to adversely impact the pinnacle trend environment because of the Live Bottom Stipulation. No community-wide impacts are expected. The Live Bottom Stipulation would minimize the potential for mechanical damage. Potential impacts would be from pipeline emplacement only and would be minimized because of the proposed Live Bottom Stipulation. The frequency of impacts on the pinnacles would be rare, and the severity should be slight because of the widespread nature of the features.

4.2.1.4.2. Continental Slope and Deepwater Resources

4.2.1.4.2.1. Chemosynthetic Communities

Physical

The greatest potential for adverse impacts on deepwater chemosynthetic communities would come from those OCS-related, bottom-disturbing activities associated with pipelaying (**Chapter 4.1.1.8.1.**), anchoring (**Chapter 4.1.1.3.4.1.**), and structure emplacement (**Chapter 4.1.1.3.3.2.**, Bottom Area Disturbance), as well as from an accidental seafloor blowout (**Chapter 4.3.2.**). Potential impacts from blowouts on chemosynthetic communities are discussed in **Chapter 4.4.4.2.1.** These activities cause localized bottom disturbances and disruption of benthic communities in the immediate area.

Considerable mechanical damage could be inflicted upon the bottom by routine OCS drilling activities. The physical disturbance by structures related to a drilling operation itself affects a small area of the sea bottom. The presence of a conventional structure can also cause scouring of the surficial sediments by near-bottom ocean currents (Caillouet et al., 1981), although this phenomenon has not been demonstrated around structures in deep water. However, there is a great deal of evidence that strong currents do occur in deep water (Hamilton and Lugo-Fernandez, 2001).

Anchors from support boats and ships (or, as assumed for deeper water depths, from any buoys set out to moor these vessels), floating drilling units, barges used for construction of platform structures, and pipelaying vessels also cause severe disturbances to small areas of the seafloor. The areal extent and severity of the impact are related to the size of the mooring anchor and the length of chain resting on the bottom. Excessive scope and the movement of the mooring chain could disturb a much larger bottom area than an anchor alone, depending on the variety of prevailing wind and current directions. A 50-m radius of chain movement on the bottom around a mooring anchor could destroy chemosynthetic communities in an area of nearly 8,000 m^2. A large area of bottom could also be disturbed by bottom contacts of the entire length of chain or cable for each anchor prior to and during the anchor cable tensioning from the central drilling structure. Larger anchors, longer anchor chains/cables and mooring lines, and greater scope for anchoring configurations are expected for operations in deep water as compared to operations on the shelf. Therefore, the areal extent of impacts, both for individual anchors and for the entire footprint, is expected to be greater for operations that employ anchoring in deep water. Many oil and gas support operations involving ships and boats would not result in anchor impacts on deepwater chemosynthetic communities because the vessels would tie-up directly to rigs, platforms, or mooring buoys. In addition, there are drillships, construction barges, and pipelaying vessels operating in the GOM that rely on dynamic positioning rather than conventional anchors to maintain their position during operations (anchoring would not be a consideration in these situations). The area affected by anchoring operations would depend on the water depth, length of the chain, size of the anchor, and current. Anchoring would destroy those sessile organisms actually hit by the anchor or anchor chain during anchoring and anchor weighing, or it could cause destruction of underlying carbonate structures on which chemosynthetic organisms rely for dispersion of hydrocarbon sources. While such an area of disturbance may be small in absolute terms, it may be large in relation to the area inhabited by dense chemosynthetic communities.

Normal pipelaying activities in deepwater areas could destroy large areas of chemosynthetic organisms (it is assumed that 0.32 ha of bottom is disturbed per kilometer of pipeline installed). Since pipeline systems are not as established in deepwater as in shallow water, new installations are required, which would tie into existing systems. Pipelines would also be required to transport product from subsea systems to platforms.

In addition to physical impacts, structure removals and other bottom-disturbing activities could resuspend bottom sediments. The potential effects of resuspended bottom sediments are similar to those from the discharge of muds and cutting discussed below.

The impacts from bottom-disturbing activities are expected to be relatively rare. Should they occur, these impacts could be quite severe to the immediate area affected, with recovery times as long as 200 years for mature tube-worm communities, with the possibility of the community never recovering.

Discharges

In deep water, discharges of drilling fluids and cuttings at the surface are spread across broader areas of the seafloor and are, in general, distributed in thinner accumulations than in shallower areas on the continental shelf. Gallaway and Beaubien (1997) have reported recent information about the effects of surface discharge of drilling fluids (muds) and cuttings at a well in 565 m. In this instance, a veneer of cuttings was observed scattered over the bottom, in some cases as thick as 20-25 cm. Chemical evidence of SBF components (used during this operation) was found at distances of at least 100 m from the well site (sampling distance was limited by the ROV tether length). Other information from a geophysical survey documented the extent of drilling discharges at several previously drilled oil and gas sites in about 400 m water depths (Nunez, personal communication, 1994). At these sites, the areal coverage of cuttings was found extending from the previous well locations in splay or finger-like projections to a maximum of about 610 m, with an average of about 450 m. An examination of side-scan-sonar records of these splays indicates that they were distributed in accumulations less than 30 cm thick. Effluents from routine OCS operations (not muds or cuttings) in deep water would be subject to rapid dilution and dispersion and are not projected to reach the seafloor at depths greater than 100 m.

Impacts from muds and cuttings are also expected from two additional sources: (1) initial well drilling and installation of casing prior to the use of a riser to circulate returns to the surface; and (2) the potential use of various dual-gradient or subsea mudlift drilling techniques in the deep sea. Pre-riser casing installation typically involves 36-in (91-cm) casing that may be set to a depth of 300 ft (91 m) and 26-in (66-cm) casing that may be set to a depth of 1,600 ft (488 m). Jetted or drilled cuttings from the initial wellbore could total as much as 226 m^3 (Halliburton Company, 1995). With dual-gradient drilling techniques, the upper portion of the wellbore would be “drilled” similar to conventional well initiation techniques with cuttings being discharged at the seafloor. After the BOP stack is installed, subsea mudlift pumps would circulate the drilling fluid and cuttings to the surface for conventional well solids control. Discharges from the dual-gradient drilling operations are expected to be similar to conventional drilling operations. Although the full areal extent and depth of burial from these initial activities are not known, the potential impacts are expected to be localized and short term. Since these areas would occupy a minuscule portion of the available seafloor in the deepwater GOM, these impacts are not considered significant provided that sensitive communities (e.g., chemosynthetic communities) are avoided.

MacDonald et al. (1995) indicates that the vulnerability of chemosynthetic communities to oil and gas impacts may depend on the type of community present. Tube-worm and mussel communities may be more vulnerable than clam communities because clam communities are vertically mobile (preventing burial) and sparsely distributed. The primary concern related to muds and cuttings discharges is that of burial. Although chemosynthetic organisms thrive with some part of their anatomy located next to or inside of toxic and/or anoxic environments, all chemosynthetic biota (including the symbiotic bacteria) also require oxygen to live. Burial by sediments or rock fragments originating from drilling fluids and cuttings discharges would smother and kill most chemosynthetic organisms (motile clams being one possible exception). Depending on the organism type, just a few centimeters of burial could cause mortality.

The tolerance of various community components to burial is not completely understood and would depend on the depth of burial. Detrimental effects due to burial are expected to decrease exponentially in the same manner that the depth of accumulations of discharges decreases exponentially with distance from the origin. The severity of these impacts is such that there may be incremental losses of productivity, reproduction, community relationships, and overall ecological functions of the community, and incremental damage to ecological relationships with the surrounding benthos.

High-density, Bush Hill-type communities are areas that are considered to be most at risk from oil and gas operations. The disturbance of a Bush Hill-type environment could lead to the destruction of a community from which recovery would occur only over long time intervals (200+ years for a mature tube-worm colony and 25-50 years for a mature mussel community) or would not occur at all. A long span of time is required for the precipitation of enough carbonate rock to support a large population of tube worms. As dense tube-worm communities require hard substrate as well as very active seepage at any point in space, existing communities covered by sediment that are physically damaged would likely never recover (Fisher, 1995).

Information is limited about the vulnerability of tube worms to sedimentation/smothering impact. Individual tube worms are often found buried for more than half the length of their tubes by hemipelagic sediment (MacDonald, 1992). Presumably, this burial occurs over long time intervals. Evidence of catastrophic burial of high-diversity chemosynthetic communities can be found in the paleorecord as documented by Powell (1995), but the importance of this in causing local extinctions was reported as minor. These burials were probably caused by catastrophic seismic events.

Methanotrophic mussel communities have strict chemical requirements that tie them directly to areas of the most active seepage. Physical disturbance of an active mussel bed is thought not to have a long-lasting effect on the community due to high growth rates of individuals (Fisher, 1995). Catastrophic mud burial would be one possible cause of a mussel community death. It is predicted that a mussel community completely eliminated by physical disturbance could be resettled and mature within 20 years.

Reservoir Depletion

There has been some speculation about the potential impact to chemosynthetic communities as a result of oil and gas withdrawal, causing a depletion of the energy source (hydrocarbons) sustaining the chemosynthetic organisms. There is evidence that both removal and reinjection of material into reservoirs that supply seeps on land in California affect the seepage rates. Quigley et al. (1996) reported evidence that suggested offshore California oil production resulted in reduced seepage due to reduction in reservoir pressure. The seeps and faults around which chemosynthetic animals live are supplied from the deep reservoirs that transport the gas or oil to the seafloor through combined effects of buoyancy and pressure. In the proposed lease sale area, when all of the recoverable hydrocarbons from these reservoirs are withdrawn by production operations (the amount that can be economically extracted by current technology is estimated to be 29-65% of the total hydrocarbons), it is possible that oil and gas venting or seepage would also slow or (less likely) stop. Based on current information, it is not possible to determine whether reduced reservoir pressure would actually reduce the seepage (as observed onshore) or whether there may be enough oil already in the conduit to the surface to continue adequate levels of seepage for long periods, perhaps thousands of years or more. The distribution of chemosynthetic communities is known to occur in association with precise levels and types of chemical gradients at the seafloor; alterations to these gradients may potentially impact the type and distribution of the associated community.

Proposed Action Analysis

Because high-density chemosynthetic communities are generally found only in water depths greater than 400 m, they could be found throughout the proposed lease sale area (1,600-3,000m) and the two projected pipeline routes (>500m). Of the 45 known communities, none are known to exist in a proposed action area. The closest known community is located in Viosca Knoll Block 926, approximately 23 nmi to the north-northeast of the proposed lease sale area. The levels of projected impact-producing factors for a proposed action are shown in **Table 4-2**. A total of only two oil and gas production structures are estimated to be installed as a result of a proposed action. These deepwater production structures are expected to be installed 3-4 years after a proposed lease sale.

The NTL 98-11 (superseded by NTL 2000-G20) has been a measure for the protection of chemosynthetic communities since February 1, 1989. Now, NTL 2000-G20 makes mandatory the search for and avoidance of dense chemosynthetic communities (such as Bush Hill-type communities) or areas that have a high potential for supporting these community types, as interpreted from geophysical records. The NTL is exercised on all applicable leases and is not an optional protective measure. Under the provisions of this NTL, lessees operating in water depths greater than 400 m (the entire area of a proposed action) are required to conduct geophysical surveys of the area of proposed activities and to evaluate the data for indications of conditions that may support chemosynthetic communities. If such conditions are indicated, the lessee must either move the operation to avoid the potential communities or provide photodocumentation of the presence or absence of dense chemosynthetic communities of the Bush Hill type. If such communities are indeed present, no drilling operations or other bottom-disturbing activities may take place in the area; if the communities are not present, drilling, anchoring, etc. may proceed. To date, in almost all cases, operators have chosen to avoid any areas that show the potential to support chemosynthetic communities. The basic assumptions underlying the provisions of this mitigation measure are (1) that dense chemosynthetic communities are associated with gas-charged sediments or seeps, (2) that the gas-charged sediment zones or seeps have physical characteristics that would allow them to be identified by geophysical surveys, and (3) that dense chemosynthetic communities are not found in areas where gas-charged sediments or seeps are not indicted on the geophysical survey data. These assumptions have not been totally verified. A definitive correlation between the geophysical characteristics recorded by geophysical surveys and the presence of chemosynthetic communities has not been proven.

Although there are few examples of field verification, the requirements set forth in NTL 2000-G20 are considered effective in identifying potential areas of chemosynthetic communities. Although there has generally been compliance with NTL 2000-G20, compliance does not guarantee avoidance of high-density communities without visual confirmation in every case. On rare occasions, high-density chemosynthetic community areas may not be properly identified using the geophysical systems and indicators specified in the existing NTL. Oil- or gas-saturated sediments and other related characteristic signatures cannot be determined without high-resolution acoustic records or the interpretation of subsurface 3D seismic data.

Improved definitions and avoidance distances are part of the new Chemosynthetic Community NTL 2000-G20. Requirements for specific separation distance between potential high-density chemosynthetic communities and both anchors (250-500 ft) and drilling discharge points (1,500 ft) have been included in the revision of the NTL. These guidelines have also been released in NTL 2002-G08, which became effective August 29, 2002. The potential for any impact could also be lessened by the refinement of techniques used in the interpretations of geophysical records. The use of differential global positioning system (GPS) has also been required on anchor handling vessels when placing anchors near an area that has potential for supporting chemosynthetic communities. As new information becomes available, the NTL would be further modified as necessary.

High-density, Bush Hill-type communities are, as noted above, largely protected from direct physical impacts by the provisions of NTL 2000-G20. A limited number of these communities have been found to date, but it is probable that additional communities exist. Observations of the surface expression of seeps from space images indicate numerous other communities may exist (MacDonald et al., 1993 and 1996). Most chemosynthetic communities are of low density and are relatively widespread throughout the deepwater areas of the GOM. Physical disturbance or destruction of a small, low-density area would not result in a major impact to chemosynthetic communities as an ecosystem. Low-density communities may occasionally sustain major or minor impacts from discharges of drill muds and cuttings, bottom-disturbing activities, or resuspended sediments. Areas so impacted could be repopulated from nearby undisturbed areas (although this process may be quite slow, especially for vestimentiferans). In light of probable avoidance of all chemosynthetic communities (not just high-diversity types), as required by NTL 2000-G20, the frequency of such impact is expected to be low, and the severity of such an impact is judged to result in minor disturbance to ecological function of the community, with no alteration of ecological relationships with the surrounding benthos. Recolonization after a disturbance would not exactly reproduce the preexisting community prior to the impact, but it could be expected that some similar pattern and species composition would eventually reestablish if similar conditions of sulfide or methane seepage persist after the disturbance.

Summary and Conclusion

Chemosynthetic communities are susceptible to physical impacts from structure placement (including templates or subsea completions), anchoring, and pipeline installation. The provisions of NTL 2000-G20 greatly reduce the risk of these physical impacts by requiring avoidance of potential chemosynthetic communities identified on required geophysical survey records or by requiring photodocumentation to establish the absence of chemosynthetic communities prior to approval of the structure emplacement.

If the presence of a high-density community were missed using existing procedures, potentially severe or catastrophic impacts could occur due to partial or complete burial by muds and cuttings associated with pre-riser discharges or some types of riserless drilling. To date, there are no known impacts from oil and gas activities on a high-density chemosynthetic community. Variations in the dispersal and toxicity of synthetic-based drilling fluids may contribute to the potential areal extent of these impacts. The severity of such an impact is such that there would be incremental losses of productivity, reproduction, community relationships, and overall ecological functions of the community, and incremental damage to ecological relationships with the surrounding benthos.

Studies indicate that periods as long as hundreds of years are required to reestablish a seep community once it has disappeared (depending on the community type), although it may reappear relatively quickly once the process begins, as in the case of a mussel community. Tube-worm communities may be the most sensitive of all communities because of the combined requirements of hard substrate and active hydrocarbon seepage. Mature tube-worm bushes have been found to be several hundred years old. There is evidence that substantial impacts on these communities would permanently prevent reestablishment.

A proposed action is expected to cause little damage to the ecological function or biological productivity of the widespread, low-density chemosynthetic communities. The rarer, widely scattered, high-density, Bush Hill-type chemosynthetic communities could experience minor impacts from drilling discharges or resuspended sediments located at more than 1,500 ft away as required by NTL 2000-G20.

4.2.1.4.2.2. Nonchemosynthetic Communities

Physical

Benthic communities other than chemosynthetic organisms could be impacted by OCS-related, bottom-disturbing activities associated with pipelaying (**Chapter 4.1.1.8.1.**), anchoring (**Chapter 4.1.1.3.4.1.**), and structure emplacement (**Chapter 4.1.1.3.3.2.**, Bottom Area Disturbance), as well as from a seafloor blowout (**Chapter 4.4.1.4.**). Potential impacts from blowouts on nonchemosynthetic communities are discussed in **Chapter 4.4.4.2.2.** These activities cause localized bottom disturbances and disruption of benthic communities in the immediate area. Considerable mechanical damage can be inflicted upon the bottom by routine OCS drilling activities. The physical disturbance by structures related to a drilling operation itself affects a small area of the sea bottom. These impacts are the same as those encountered in shallower continental shelf waters.

Anchors from support boats and ships (or, as assumed in these water depths, from any buoys set out to moor these vessels), floating drilling units, and pipelaying vessels also cause severe disturbances to small areas of the seafloor with the areal extent related to the size of the mooring anchor and length of chain that would rest on the bottom. Excessive scope (length) and movement of the mooring chain could disturb a much larger area of the bottom than would an anchor alone, depending on the prevailing wind and current directions. A 50-m radius of chain movement on the bottom around a mooring anchor could destroy communities in an area of nearly 8,000 m^2. A large area of bottom could also be disturbed by bottom contacts of the entire length of chain or cable for each anchor prior to and during the anchor cable tensioning from the central drilling structure. Larger anchors and additional scope of anchor chain are expected for operations in deep water as compared to operations on the shelf. Therefore, the areal extent of impacts, both for individual anchors and for the entire footprint, is expected to be greater for operations that employ anchoring in deep water. The area affected by anchoring operations would depend on the water depth, length of the chain, size of the anchor, and current. Many OCS-support operations and activities would not result in anchor impacts to deepwater benthic communities because vessels would tie-up directly to rigs, platforms, or mooring buoys or would use dynamic positioning. Anchoring would not necessarily directly destroy small infaunal organisms living within the sediment; the bottom disturbance would most likely change the environment to such an extent that the majority of the directly impacted infauna community would not survive (e.g., burial or relocation to sediment layers without sufficient oxygen). In cases of carbonate outcrops or reefs with attached epifauna, the impacted area of disturbance may be small in absolute terms, but it could be large in relation to the area inhabited by hard corals or other organisms that rely on exposed rock substrate.

As described in the previous section for chemosynthetic communities, normal pipelaying activities in deepwater areas could destroy large areas of benthic communities (it is assumed that 0.32 ha of bottom is disturbed per kilometer of pipeline installed.); although, without consideration of chemosynthetic organisms, there are no differences between this activity in deep water as compared to shallow-water operations.

In addition to direct physical impacts, structure removals and other bottom-disturbing activities could resuspend bottom sediments. The potential effects of resuspended bottom sediments are similar to those from the discharge of muds and cuttings discussed below.

Discharges

In deep water, discharges of drilling muds and cuttings at the surface are spread across broader areas of the seafloor and are, in general, distributed in thinner accumulations than in shallower areas on the continental shelf. Recent information about the effects of surface discharge of muds and cuttings at a well in 565 m is reported by Gallaway and Beaubien (1997) and is described in the previous section on chemosynthetic communities. In this instance and in another deepwater survey reported by Nunez (personal communication, 1994), muds and cuttings were documented in accumulations ranging up to 30 cm thick at distances up to 610 m from the well site.

Impact from muds and cuttings are also expected from two additional sources: (1) initial well drilling prior to the use of a riser to circulate returns to the surface; and (2) the potential use of various riserless drilling techniques in the deep sea. Jetted or drilled cuttings discharged at the bottom from the initial wellbore would total as much as 226 m^3 (Halliburton Company, 1995). In the case of some riserless drilling practices, all muds and cuttings from well spudding through total depth would be discharged at the seafloor. Although the full areal extent and depth of burial from these activities is not known, the potential impacts are expected to be localized and short term. Since these areas would occupy only a minuscule portion of the available seafloor in the deepwater GOM, these impacts are not considered significant provided that sensitive communities (e.g., chemosynthetic communities) are avoided.

Burial by sediments or rock fragments originating from drilling muds and cuttings discharges could smother and kill almost all community components of benthic organisms, with the exception of highly motile fish and possibly some crustaceans such as shrimp capable of moving away from the impacted area. Depending on the organism type, just a few centimeters of burial could cause death. The damage would be both mechanical and toxicological. Some types of macrofauna could burrow through gradual accumulations of overlying sediments depending on the toxicological effects of those added materials. Information on the potential toxic effects on various benthic organisms is limited and essentially nonexistent for deepwater taxa.

It can be expected that detrimental effects due to burial would decrease exponentially with distance from the origin. The physical properties of the naturally occurring surface sediment (grain size, porosity, and pore water) could also be changed as a result of discharges such that recolonizing benthic organisms would be comprised of different species than inhabited the area previous to the impact. Although the impacts could be considered severe to the nonmotile benthos in the immediate area affected, they would be considered very temporary. Due to the proximity of undisturbed bottom with similar populations of benthic organisms from microbenthos to megafauna, these impacts would be very localized and reversible at the population level and are not considered significant.

Carbonate outcrops not associated with chemosynthetic communities, such as the deepwater coral "reef" or habitat reported by Moore and Bullis (1960), are considered to be most at risk from oil and gas operations. Due to the fact that deepwater corals require hard substrate, existing communities completely buried by some amount of sediment would likely never recover.

Effluents other than muds or cuttings from routine OCS operations in deep water would be subject to rapid dilution and dispersion and are not projected to reach the seafloor at depths greater than 100 m.

Proposed Action Analysis

For a proposed action, two oil and gas structures are estimated to be installed. These deepwater production structures are expected to be installed 3-4 years after a proposed lease sale. Physical disturbance or destruction of a limited area of benthos or to a limited number of megafauna organisms, such as brittle stars, sea pens, or crabs, would not result in a major impact to the deepwater benthos ecosystem as a whole. Surface discharge of muds and cuttings, as opposed to seafloor discharge, would reduce or eliminate the impact of smothering the benthic communities on the bottom.

Under the current review procedures for chemosynthetic communities, carbonate outcrops are targeted as one possible indication (surface anomaly on 3D seismic survey data) that chemosynthetic seep communities are nearby. Unique communities that may be associated with any carbonate outcrops or other topographical features could be identified via this review along with the chemosynthetic communities. Typically, all areas suspected of being hard bottom are avoided as a geological hazard for any well sites. Any proposed activity in water depth greater than 400 m would automatically trigger the NTL 2000-G20 evaluation described above.

Summary and Conclusion

Some impact to soft-bottom, benthic communities from drilling and production activities would occur as a result of physical impact from structure placement (including templates or subsea completions), anchoring, and installation of pipelines regardless of their locations. Megafauna and infauna communities at or below the sediment/water interface would be impacted from the muds and cuttings normally discharged at the seafloor at the start of every new well prior to riser installation. The impact from muds and cuttings discharged at the surface are expected to be low in deep water. Drilling muds would not be expected to reach the bottom beyond a few hundred meters from the surface-discharge location, and cuttings would be dispersed. Even in situations where substantial burial of typical benthic communities occurred, recolonization from populations from neighboring 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 one year for most all macrofauna species.

Deepwater coral habitats and other potential high-density, hard-bottom communities not associated with chemosynthetic communities appear to be very rare. These unique communities are distinctive and similar in nature to protected pinnacles and topographic features on the continental shelf. Any hard substrate communities located in deep water would be particularly sensitive to impacts from OCS activities. Impacts to these sensitive habitats could permanently prevent recolonization with similar organisms requiring hard substrate; however, it is thought that deepwater hard-bottom communities are protected as an indirect result of the avoidance of potential chemosynthetic communities required by NTL 2000-G20. A new MMS-funded study of these habitats is planned in the near future.

A proposed action is expected to cause little damage to the ecological function or biological productivity of the widespread, typical deep-sea benthic communities.

4.2.1.5. Impacts on Marine Mammals

The major impact-producing factors resulting from the routine activities associated with a proposed action that may affect marine mammals include the degradation of water quality from operational discharges; noise generated by helicopters, vessels, seismic surveys, operating platforms, and drillships; vessel traffic; and jetsam and flotsam from service vessels and OCS structures. These major factors may affect marine mammals in the GOM at several temporal and spatial scales that result in acute or chronic impacts.

Discharges

Produced waters, drill muds, and drill cuttings are routinely discharged into offshore waters and contain trace metals (e.g., cadmium, chromium, lead, and mercury) and a suite of hazardous substances (e.g., sodium hydroxide, potassium hydroxide, ammonium chloride, hydrochloric acid, hydroflouric acid, and toluene). (See Boehm et al., 2001, or Ayers et al., 1980, for more complete lists.) Most operational discharges are diluted and dispersed when released offshore and are considered to have sublethal effects (API, 1989; NRC, 1983; Kennicutt, 1995). The impact to the environment is minimized through the permit requirements. The permit sets toxicity or volume limits on discharges. The permit sets a maximum concentration for several metals that are present in barite. The permit does allow the use of trace amounts of priority pollutants in well treatment, workover, and completion chemicals that are used downhole and on the surface as part of the produced water or waste drilling mud or cuttings stream.

Some hazardous chemicals are used offshore. Strong acid solutions are used to stimulate formation production. Corrosive base and salt solutions are used to maintain pH and condition the well. The acids, bases, and salts react with other waste streams and seawater and are gradually neutralized following use. Other chemicals, such as surfactants and solvents that may be toxic to aquatic life, are used in trace amounts. These chemicals often serve as carrier solutions to keep well treatment chemicals in a form so that they remain functional as it is pumped down the well. Biocides are used to prevent algal growth. These agents are preselected for use because of low toxicity, and in the case a biocide, a short half-life.

Contaminants may biomagnify and bioaccumulate in the food web, which may kill or debilitate important prey species of marine mammals or species lower in the marine food web. Marine mammals generally are inefficient assimilators of petroleum compounds in prey (Neff, 1990). Analyses of samples from stranded GOM bottlenose dolphins showed high levels of organochlorides and heavy metals (e.g., Salata et al., 1995; Kuehl and Haebler, 1995). Many heavy metals presumably are acquired from food, but the ultimate sources are poorly known (API, 1989). Adequate baseline data is not available to determine the significant sources of contaminants that accumulate in GOM cetaceans or their prey, due in no small part to the fact that contaminants are introduced into the GOM from a suite of national and international watersheds. Many cetaceans are wide-ranging animals, which also compounds the problem. There is, in many cases, a striking difference between the relatively high mercury levels in the toothed whales and the lower levels found in baleen whales, which is probably attributable to the different prey species consumed by baleen whales, as well as differences in the habitat (Johnston et al., 1996). It is also known that neritic cetacean species tend to have higher levels of some metals than those frequenting oceanic waters (Johnston et al., 1996). Oceanic cetaceans (e.g., sperm whales) feeding on cephalopods (e.g., squid) have higher levels of cadmium in their tissues than comparable fish-eating species (Johnston et al., 1996). Squid are attributed with the ability to retain some trace metals such as cadmium, copper and zinc, as well as polycyclic aromatic hydrocarbons (Reijnders and Aguilar, 2002). Therefore, sperm whales and other cetaceans that feed on squid in the northern GOM may be predisposed to bioaccumulating contaminants.

Aircraft

Aircraft overflights in proximity to cetaceans can elicit a startle response. Whales often react to aircraft overflights by hasty dives, turns, or other abrupt changes in behavior. Responsiveness varies widely depending on factors such as the activity the animals are engaged in and water depth (Richardson et al., 1995). Whales engaged in feeding or social behavior are often insensitive to overflights. Whales in confined waters, or those with calves, sometimes seem more responsive. This behavioral response could be a result of noise and/or visual disturbance. The effects appear to be transient, and there is no indication that long-term displacement of whales occur. Absence of conspicuous responses to an aircraft does not show that the animals are unaffected; it is not known whether these subtle effects are biologically significant (Richardson and Würsig, 1997).

Vessel Traffic

Of 11 species known hit by vessels, fin whales are struck most frequently, sperm whales are hit commonly, and records of collisions with Bryde’s whales are rare (Laist et al., 2001). Fin whales are rare, sperm whales are common, and Bryde’s whales are uncommon in the GOM. Data compiled of 58 collisions indicate that all sizes and types of vessels can collide with whales; the majority of collisions appear to occur over or near the continental shelf; most lethal or severe injuries are caused by ships 80 m or longer; whales usually are not seen beforehand or are seen too late to be avoided; and most lethal or severe injuries involve ships traveling 14 knots (kn) or faster. Vessel collisions can significantly affect small populations of whales, such as northern right whales in the western North Atlantic (Laist et al., 2001).

Increased traffic from support vessels involved in survey, service, or shuttle functions would increase the probability of collisions between vessels and marine mammals occurring in the area. These collisions can cause major wounds on cetaceans and/or be fatal (e.g., northern right whale, Kraus, 1990, and Knowlton et al., 1997; bottlenose dolphin, Fertl, 1994; sperm whale, Waring et al., 1997). Debilitating injuries may have negative effects on a population through impairment of reproductive output. Slow-moving cetaceans (e.g., northern right whale) or those that spend extended periods of time at the surface in order to restore oxygen levels within their tissues after deep dives (e.g., sperm whale) might be expected to be the most vulnerable. Smaller delphinids often approach vessels that are in transit to bow-ride. It would seem that delphinids are agile enough to easily avoid being struck by vessels. However, there are occasions that dolphins are either not attentive (due to behaviors they are engaged in or perhaps because of their age/health) or there is too much vessel traffic around them, and they are struck by screws. Nowacek and Wells (2001) found that bottlenose dolphins had longer interbreath intervals during boat approaches compared to control periods (no boats present within 100 m) in a study conducted in Sarasota Bay, Florida. They also found that dolphins decreased interanimal distance, changed heading, and increased swimming speed significantly more often in response to an approaching vessel than during control periods.

Toothed whales (and baleen whales, to a lesser extent) show some tolerance of vessels, but may react at distances of several kilometers or more when confined by environmental features or when they learn to associate the vessel with harassment. Evidence suggests that certain whales have reduced their use of certain areas heavily utilized by ships (Richardson et al., 1995), possibly avoiding or abandoning important feeding areas, breeding areas, resting areas, or migratory routes. The continued presence of various cetacean species in areas with heavy boat traffic indicates a considerable degree of tolerance to ship noise and disturbance. An experiment involving playback of low-frequency sound in the Canary Islands suggests that sperm whales from an area that has heavy vessel traffic have a high tolerance for noise (Andre et al., 1997). There is the possibility of short-term disruption of movement patterns and behavior, but such disruptions are unlikely to affect survival or growth, unless they occur frequently.

Long-term displacement of animals, in particular baleen whales, from an area is also a possibility. It is not known whether toothed whales exposed to recurring vessel disturbance are stressed or otherwise affected in a negative, but inconspicuous way (Richardson et al., 1995). Stress or “alert” responses could occur quite early during an encounter. For example, Myrick and Perkins (1995) found stress responses occurring as early as the chase stage in purse-seine netting on dolphins.

It is possible that manatees could occur in coastal areas where vessels traveling to and from the leased sites could affect them. If a manatee should be present where there is vessel traffic, they could be injured or killed by a boat striking them (Wright et al., 1995). Inadequate hearing sensitivity at low frequencies may be a contributing factor to the manatees’ inability to effectively detect boat noise and avoid collisions with boats (Gerstein et al., 1999).

Drilling and Production Noise

Exploration, delineation, and production structures, as well as drillships, produce an acoustically wide range of sounds at frequencies and intensities that can be detected by cetaceans. Some of these sounds could mask cetaceans’ reception of sounds produced for echolocation and communication. Odontocetes use sounds at frequencies that are generally higher than the dominant sounds generated by offshore drilling and production activities. Low-frequency hearing has not been studied in many species, but bottlenose dolphins can hear sounds at frequencies as low as 40-125 Hz. Below 1 kHz, where most OCS-industry noise energy is concentrated, sensitivity seems poor (Richardson et al., 1995). Pilot whales and sperm whales changed their behavior (in particular, ceased vocalizations) during low-frequency transmissions from the Heard Island Feasibility Test in the southern Indian Ocean (Bowles et al., 1994); this throws doubt on the assumed insensitivity of odontocete hearing at low frequencies. Baleen whales mainly utter low-frequency sounds that overlap broadly with the dominant frequencies of many OCS-industry sounds. There are indirect indications that baleen whales are sensitive to low- and moderate-frequency sounds (Richardson et al., 1995). Drilling noise from conventional metal-legged structures and semisubmersibles is not particularly intense and is strongest at low frequencies, averaging 5 Hz and 10-500 Hz, respectively (Richardson et al., 1995). There is particular concern for baleen whales that are apparently more dependent on low-frequency sounds than are other marine mammals; many industrial sounds are concentrated at low frequencies. Drillships produce higher levels of underwater noise than other types of platforms. There are few published data on underwater noise levels near production platforms and on the marine mammals near those facilities (Richardson et al., 1995). However, underwater strong noise levels may often be low, steady, and not very disturbing (Richardson et al., 1995). Stronger reactions would be expected when sound levels are elevated by support vessels or other noisy activities (Richardson et al., 1995).

Human-made sounds may affect the ability of marine mammals to communicate and to receive information about their environment (Richardson et al., 1995). Such noise may interfere with or mask the sounds used and produced by these animals and thereby interfere with their natural behavior. These sounds may frighten, annoy, or distract marine mammals and lead to physiological and behavioral disturbances. Response threshold may depend on whether habituation (gradual waning of behavioral responsiveness) or sensitization (increased behavioral responsiveness) occurs (Richardson et al., 1995). Sounds can cause reactions that might include disruption of marine mammals' normal activities (behavioral and/or social disruption) and, in some cases, short- or long-term displacement from areas important for feeding and reproduction (Richardson et al., 1995). The energetic consequences of one or more disturbance-induced periods of interrupted feeding or rapid swimming, or both, have not been evaluated quantitatively. Energetic consequences would depend on whether suitable food is readily available. Of the animals responding to noise, females in late pregnancy or lactating would probably be most affected. Human-made noise may cause temporary or permanent hearing impairment in marine mammals if the noise is strong enough. Such impairment would have the potential to diminish the individual's chance for survival. Tolerance of noise is often demonstrated, but this does not prove that the animals are unaffected by noise; for example, they may become stressed, making the animal(s) more vulnerable to parasites, disease, environmental contaminants, and/or predation. Noise-induced stress is possible, but little studied in marine mammals. Aversive levels of noise might cause animals to become irritable, affecting feed intake, social interactions, or parenting; all of these effects might eventually result in population declines (Bowles, 1995).

Seismic Surveys

The MMS has almost completed a programmatic EA on G&G permit activities in the GOM (USDOI, MMS, in preparation). The EA includes a detailed description of the seismic surveying technologies, energy output, and operations; these descriptions are incorporated here by reference. Seismic surveys use a high-energy noise source. During Irish Sea seismic surveys, pulses were audible on hydrophone recordings above the highly elevated background ship noise at least up to the 20-km range (Goold and Fish, 1998). Although the output of airgun arrays is usually tuned to concentrate low-frequency energy, a broad frequency spectrum is produced, with significant energy at higher frequencies (e.g., Goold and Fish, 1998). These energies encompass the entire audio frequency range of 20 Hz to 20 kHz (Goold and Fish, 1998) and extend well into the ultrasonic range up to 50 kHz.

Baleen whales seem quite tolerant of low- and moderate-level sound pulses from distant seismic surveys but exhibit behavioral changes in the presence of nearby seismic activity (Richardson et al., 1995). Subtle effects on surfacing, respiration, and dive cycles have been noted (Richardson et al., 1995; Richardson, 1997). Response appears to diminish gradually with increasing distance and decreasing sound level (Richardson, 1997). Bowhead and gray whales often show strong avoidance within 6-8 km of an airgun array. Humpback whales off western Australia were found to change course at 3-6 km from an operating seismic survey vessel, with most animals keeping a standoff range of 3-4 km (McCauley et al., 1998a and b). Humpback whale groups containing females involved in resting behavior in key habitat types were more sensitive than migrating animals and showed an avoidance response estimated at 7-12 km from a large seismic source (McCauley et al., 2000). Whales exposed to sound from distant seismic survey ships may be affected even though they remain in the area and continue their normal activities (Richardson et al., 1995). For baleen whales, in particular, it is not known (1) whether the same individuals return to areas of previous seismic exposure, (2) whether seismic work has caused local changes in distribution or migration routes, or (3) whether whales that tolerate strong seismic pulses are stressed (Richardson et al., 1995). Individually identified gray whales remained in Puget Sound long after the seismic survey (as is normal), despite being exposed to noise (Calambokidis and Osmek, 1998; Bain et al., 1999).

Goold (1996) found that acoustic contacts with common dolphins in the Irish Sea dropped sharply as soon as seismic activity began, suggesting a localized disturbance of dolphins. It was also estimated that seismic energy from the 2,120-in^3 airgun array in a shelf sea environment was safe to common dolphins at a radius from the gun array of 1 km (Goold and Fish, 1998). Given the high, broadband seismic-pulse power levels across the entire recorded bandwidth and the known auditory thresholds for several dolphin species, Goold and Fish (1998) considered such seismic emissions to be clearly audible to dolphins across a bandwidth of tens of kilohertz and at least out to the 8-km range.

Sperm whales during the Heard Island Feasibility Test were found to cease calling during some (but not all) times when seismic pulses were received from an airgun array more than 300 km away (Bowles et al., 1994) (whether sperm whales were responding directly to the seismic pulses is not known). In contrast, there are observations of sperm whales in the GOM continuing to vocalize while seismic pulses are ongoing (Evans, personal communication, 1999). One report of GOM sperm whales suggested that the animals may have moved 50+ km away in response to seismic pulses (Mate et al., 1994), but further work suggests that the animals may not have moved in response to the sound, but perhaps relative to oceanographic features and prey distribution. It is unclear whether the well-documented, continued occurrence of sperm whales in the area off the mouth of the Mississippi River is a consequence of low sensitivity to seismic sound or a high motivation to remain in the area. Sperm whales have historically occupied this area; their continued presence might suggest habituation to the seismic signals. During the MMS-sponsored GulfCet II study on marine mammals, results showed that the cetacean sighting rate did not change significantly due to seismic exploration signals (Davis et al., 2000). The analysis of the results was unable to detect small-scale (<100 km) changes in cetacean distribution. Results of passive acoustic surveys to monitor sperm-whale vocal behavior and distribution in relation to seismic surveys in the northeastern Atlantic revealed few, if any, effects of airgun noise (Swift et al., 1999). The authors suggested that sperm whales in that area may be habituated to seismic surveys and/or responses may occur at scales to which the research was not sensitive.

No obvious behavior modifications relative to the seismic activity were recorded during the majority of the small odontocete observations made during marine mammal monitoring carried out during a 3D seismic survey offshore California in late 1995 (Arnold, 1996). There was also no observable behavior modification or harassment of large whales attributable to the sound effects of the survey (Arnold, 1996).

There are no data on auditory damage in marine mammals relative to received levels of underwater sound pulses (Richardson et al., 1995). Indirect "evidence" suggests that extended or repeated exposure to seismic pulses is unlikely to cause permanent hearing damage in marine mammals given a study of damage risk criteria; the transitory nature of seismic exploration; the presumed ability of marine mammals to tolerate exposure to strong calls from themselves or other nearby mammals; and the avoidance responses that occur in at least some baleen whales, when exposed to certain levels of seismic pulses (Richardson et al., 1995).

Flotsam and Jetsam

In recent years, there has been increasing concern about manmade debris (discarded from offshore and coastal sources) and its impact on the marine environment (e.g., Shomura and Godfrey, 1990; Laist, 1997). Both entanglement in and ingestion of debris has caused the death or serious injury of marine mammals (Heneman and the Center for Environmental Education, 1988; MMC, 1998). The debris items most often found entangling animals are net fragments and monofilament line from commercial and recreational fishing boats, as well as strapping bands and ropes probably from all types of vessels. Plastic bags and small plastic fragments are the most commonly reported debris items in the digestive tracts of cetaceans and manatees (e.g., Barros and Odell, 1990; Tarpley and Marwitz, 1993; Laist, 1997; MMC, 1998). Many types of plastic materials are used during drilling and production activities; the offshore oil and gas industry was shown to contribute 13 percent of the debris found at Padre Island National Seashore (Miller et al., 1995). The MMS prohibits the disposal of equipment, containers, and other materials into coastal and offshore waters by lessees (30 CFR 250.40). Prohibition of the discharge and disposal of vessel- and offshore structure-generated garbage and solid waste items into both offshore and coastal waters was established January 1, 1989, via the enactment of MARPOL, Annex V, Public Law 100-220 (101 Statute 1458), which the USCG enforces. Accidental release of debris from OCS activities is known to occur offshore, and such flotsam may injure or kill cetaceans.

Proposed Action Analysis

The major impact-producing factors affecting marine mammals as a result of routine OCS activities as a result of a proposed action include the degradation of water quality from operational discharges; noise generated by helicopters, vessels, operating platforms, and drillships; vessel traffic; seismic surveys; and jetsam and flotsam from service vessels and OCS structures.

Information on drilling fluids, drill cuttings, and produced waters that would be discharged offshore as a result of a proposed action is provided in **Chapter 4.1.1.4.**, Operational Waste Discharged Offshore. Some effluents are routinely discharged into offshore marine waters. It is expected that cetaceans may have some interaction with these discharges. Direct effects to cetaceans are expected to be sublethal. It should be noted, however, that any pollution in the effluent could poison and kill or debilitate marine mammals and adversely affect the food chains and other key elements of the GOM ecosystem (Tucker & Associates, Inc., 1990). Because OCS discharges are diluted and dispersed in the offshore environment, impacts to cetaceans are expected to be negligible.

Helicopter activity projections are 7,000-9,000 trips over the life of a proposed action (**Table 4-2**) or 180-230 trips annually. The FAA Advisory Circular 91-36C encourages pilots to maintain higher than minimum altitudes (noted below) over noise-sensitive areas. Corporate helicopter policy states that helicopters should maintain a minimum altitude of 700 ft while in transit offshore and 500 ft while working between platforms. In addition, guidelines and regulations promulgated by NOAA Fisheries under the authority of the Marine Mammal Protection Act do include provisions specifying helicopter pilots to maintain an altitude of 1,000 ft within 100 yd (91 m) of marine mammals. It is unlikely that cetaceans would be affected by routine OCS helicopter traffic operating at these altitudes, provided pilots do not alter their flight patterns to more closely observe or photograph marine mammals that they see. It is expected that about 10 percent of helicopter trips would occur at altitudes below the specified minimums listed above as a result of inclement weather. Routine overflights may elicit a startle response from, and interrupt cetaceans nearby (depending on the activity of the animals) (Richardson et al., 1995). Occasional overflights probably have no long-term consequences on cetaceans; however, frequent overflights could have long-term consequences if they repeatedly disrupt vital functions, such as feeding and breeding. Frequent overflights are expected in coastal and Federal neritic waters. Generally, overflights become less frequent as the distance from shore of the OCS facilities being serviced increases; however, many offshore fields are supported by resident helicopters, resulting in increased localized overflights. The area supported by a resident helicopter is dependent in part on the size of the field that it supports. Temporary disturbance to cetaceans may occur on occasion as helicopters approach or depart OCS facilities, if animals are near the facility. Such disturbance is believed negligible.

An estimated 8,000-9,000 OCS-related, service-vessel trips are expected to occur over the life of a proposed action (**Table 4-2**). The rate of trips would be about 205-230 trips/yr. Noise from service-vessel traffic may elicit a startle and/or avoidance reaction from cetaceans or mask their sound reception. There is the possibility of short-term disruption of movement patterns and behavior, but such disruptions are unlikely to affect survival or productivity. Long-term displacement of animals from an area is also a consideration. It is not known whether toothed whales exposed to recurring vessel disturbance would be stressed or otherwise affected in a negative but inconspicuous way. Increased ship traffic could increase the probability of collisions between ships and marine mammals, resulting in injury or death to some animals. Smaller delphinids may approach vessels that are in transit to bow-ride. Limited observations on an NOAA Fisheries cruise off the mouth of the Mississippi River in the summer of 2000 indicated that sperm whales appeared to avoid passing service vessels. However, marine mammalogists conducting surveys in the CPA during the summer of 2001 documented an adult killer whale that bore conspicuous and aged scarring across its back that were indubitably the result of a collision with a motor vessel. A manatee was unintentionally hit and killed by a boat off Louisiana (Schiro et al., 1998). Another manatee was killed by vessel traffic (type of vessel unknown) in Corpus Christi Bay in October 2001 (Beaver, personal communication, 2001). It appears there is limited threat posed to smaller, coastal delphinids where the majority of OCS vessel traffic occurs; however, as exploration and development of petroleum resources in oceanic waters of the northern GOM increases, OCS vessel activity would increase in these waters, thereby increasing the risk of vessel strike to sperm whales and other deep-diving cetaceans (e.g., *Kogia* and beaked whales). Deep-diving whales are more vulnerable to vessel strikes because of the extended surface period required to recover from extended deep dives. Cetaceans engaging in social activity at or near the surface may be distracted by their associates and not detect approaching vessel traffic, making them more susceptible to vessel strikes. Manatees are uncommon to common in the central and eastern GOM, respectively. Manatees are not known to frequent oceanic waters of the GOM where OCS exploration and production operations associated with a proposed action would occur. Consequently, there is little risk posed by OCS vessel traffic in the EPA, although animals occurring in

State waters of the Central and Eastern GOM may be more vulnerable to vessel strikes from service vessels transiting to and from offshore exploration and production projects.

A total of 11-13 exploration wells and 19-27 development wells are projected to be drilled as a result of a proposed action (**Table 4-2**). Two production structures are projected to be installed as a result of a proposed action (**Table 4-2**). These wells and platforms could produce sounds at intensities and frequencies that could be heard by cetaceans. It is expected that noise from drilling activities would be relatively constant and last no longer than four months per well. Odontocetes echolocate and communicate at higher frequencies than the dominant sounds generated by drilling platforms. Sound levels in this range are not expected to be generated by drilling operations (Gales, 1982). Bottlenose dolphins, one of the few species in which low-frequency sound detection has been studied, have been found to have poor sensitivity levels at the level where most industrial noise energy is concentrated. There is some concern for baleen whales since they are apparently more dependent on low-frequency sounds than other marine mammals; however, except for the Bryde's whale, baleen whales are extralimital or accidental in occurrence in the GOM. During GulfCet surveys, Bryde's whale was sighted north and east of the proposed lease sale area; these sightings were in waters deeper than 100 m (Davis et al., 2000). Bryde's whale would likely be subjected to OCS drilling and production noise. Potential effects on GOM marine mammals include disturbance (subtle changes in behavior, interruption of previous activities, or short- or long-term displacement); masking of calls from conspecifics, reverberations from own calls, and other natural sounds (e.g., surf, predators); stress (physiological); and hearing impairment (permanent or temporary) by explosions and strong nonexplosive sounds.

Many types of materials, including plastics, are used during drilling and production operations. Some materials are accidentally lost overboard where cetaceans can consume it or become entangled in it. Entanglement with or ingestion of some materials lost overboard could be lethal; however, the probabilities of occurrence, ingestion, entanglement, and lethal effect are unknown.

Summary and Conclusion

Small numbers of marine mammals could be killed or injured by chance collision with service vessels, or by entanglement with or consumption of trash and debris lost from service vessels, drilling rigs, and fixed and floating platforms. Deaths due to structure removals are not expected. There is no conclusive evidence whether anthropogenic noise has or has not caused long-term displacements of, or reductions in, marine mammal populations. Contaminants in waste discharges and drilling muds might indirectly affect marine mammals through food-chain biomagnification, although the scope of effects and their magnitude are not known.

The routine activities of a proposed action is not expected to have long-term adverse effects on the size and productivity of any marine mammal species or population stock endemic to the northern GOM.

4.2.1.6. Impacts on Sea Turtles

The major impact-producing factors resulting from the routine activities associated with a proposed action that may affect loggerhead, Kemp's ridley, hawksbill, green, and leatherback turtles include water-quality degradation from operational discharges; noise from helicopter and vessel traffic, seismic surveys, operating platforms, and drillships; vessel collisions; brightly-lit platforms;; and OCS-related trash and debris.

Discharges

Produced waters, drill muds, and drill cuttings are routinely discharged into offshore waters and contain trace metals (e.g., cadmium, chromium, lead, and mercury) and a suite of hazardous substances (e.g., sodium hydroxide, potassium hydroxide, ammonium chloride, hydrochloric acid, hydroflouric acid, and toluene). (See Boehm et al., 2001, or Ayers et al., 1980, for more complete lists.) Most operational discharges are diluted and dispersed when released offshore and are considered to have sublethal effects (API, 1989; NRC, 1983; Kennicutt, 1995). The impact to the environment is minimized through the USEPA's NPDES permit requirements. The permit sets toxicity or volume limits on discharges. The permit sets a maximum concentration for several metals that are present in barite. The permit does allow the use of trace amounts of priority pollutants in well treatment, workover, and completion chemicals that are used downhole and on the surface as part of the produced water or waste drilling mud or cuttings stream.

Some hazardous chemicals are used offshore. Strong acid solutions are used to stimulate formation production. Corrosive base and salt solutions are used to maintain pH and condition the well. The acids, bases, and salts react with other waste streams and seawater and are gradually neutralized following use. Other chemicals, such as surfactants and solvents that may be toxic to aquatic life, are used in trace amounts. These chemicals often serve as carrier solutions to keep well treatment chemicals in a form so that they remain functional as it is pumped down the well. Biocides are used to prevent algal growth. These agents are preselected for use because of low toxicity and, in the case a biocide, a short half-life. Sea turtles may have some interaction with these discharges. Contaminants in discharges could contribute to the poisoning of sea turtles and, over time, kill or debilitate sea turtles or adversely affect the food chains and other key elements of the GOM ecosystem. Contaminants may biomagnify and bioaccumulate in the food web, which may kill or debilitate important prey species of sea turtles or species lower in the marine food web (for further information on bioaccumulation, see **Chapter 4.1.1.4.**, Operational Waste Discharged Offshore). Sea turtles may bioaccumulate chemicals such as heavy metals that occur in drilling muds. This might ultimately reduce reproductive fitness in the turtles, an impact that the already diminished population(s) cannot tolerate. Samples from stranded turtles in the GOM carry high levels of organochlorides and heavy metals (Sis et al., 1993). Because OCS discharges are diluted and dispersed in the offshore environment and are but one of multiple sources of contaminants introduced into the northern GOM, impacts to sea turtles from operational discharges are at most regarded as adverse but not significant.

Noise

There are no systematic studies published of the reactions of sea turtles to aircraft overflights, and anecdotal reports are scarce. However, it is assumed that aircraft noise could be heard by a sea turtle at or near the surface and cause the animal to alter its normal behavior pattern (Advanced Research Projects Agency, 1995). Noise from service-vessel traffic may elicit a startle reaction from sea turtles and produce a temporary sublethal stress (NRC, 1990). Startle reactions may result in increased surfacings, possibly causing an increase in risk of vessel collision. Reactions to aircraft or vessels, such as avoidance behavior, may disrupt normal activities, including feeding. Important habitat areas (e.g., feeding, mating, and nesting) may be avoided due to noise generated in the vicinity. There is no information regarding the consequences that these disturbances may have on sea turtles in the long term. If sound affects any prey species, impacts to sea turtles would depend on the extent that prey availability might be altered.

Drilling and production facilities produce an acoustically wide range of sounds at frequencies and intensities that could possibly be detected by turtles. Drilling noise from conventional metal-legged structures and semisubmersibles is not particularly intense and is strongest at low frequencies (Richardson et al., 1995). Sea turtle hearing sensitivity is not well studied. A few preliminary investigations using adult green, loggerhead, and Kemp's ridley turtles suggest that they are most sensitive to low-frequency sounds (Ridgway et al., 1969; Lenhardt et al., 1983; Moein Bartol et al., 1999). It has been suggested that sea turtles use acoustic signals from their environment as guideposts during migration and as a cue to identify their natal beaches (Lenhardt et al., 1983). Bone-conducted hearing appears to be a reception mechanism for at least some of the sea turtle species, with the skull and shell acting as receiving structures (Lenhardt et al., 1983).

Noise-induced stress has not been studied in sea turtles. Captive loggerhead and Kemp's ridley turtles exposed to brief, audio-frequency vibrations initially showed startle responses of slight head retraction and limb extension (Lenhardt et al., 1983). Sound-induced swimming has been observed for captive loggerheads and greens (O'Hara and Wilcox, 1990; Moein Bartol et al., 1993; Lenhardt, 1994). Some loggerheads exposed to low-frequency sounds responded by swimming towards the surface at the onset of the sound, presumably to lessen the effects of the transmissions (Lenhardt, 1994). Sea turtles have been seen to begin to noticeably increase their swimming in response to an operating seismic source at 166 dB re-1µPa-m (measurement of sound level in water) (McCauley et al., 2000). The MMS has almost completed a programmatic EA on G&G permit activities in the GOM (USDOI, MMS, in preparation). The EA includes a detailed description of the seismic surveying technologies, energy output, and operations; these descriptions are incorporated here by reference. An anecdotal observation of a free-ranging leatherback's response to the sound of a boat motor suggests that leatherbacks may be sensitive to low-frequency sounds, but the response could have been to mid- or high-frequency components of the sound (Advanced Research Projects Agency, 1995). The potential direct and indirect impacts of sound on sea turtles include physical auditory effects (temporary threshold shift), behavioral disruption, long-term effects, masking, and adverse impacts on the food chain. Low-frequency sound transmissions could potentially cause increased surfacing and avoidance from the area near the sound source (Lenhardt et al., 1983; O'Hara and Wilcox, 1990; McCauley et al., 2000). The potential for increased surfacing could place turtles at greater risk of vessel collisions and potentially greater vulnerability to natural predators.

Vessel Collisions

Data show that vessel traffic is one cause of sea turtle mortality in the GOM (Lutcavage et al., 1997). Stranding data for the Gulf and Atlantic Coasts, Puerto Rico, and the U.S. Virgin Islands show that between 1986 and 1993 about 9 percent of living and dead stranded sea turtles had boat strike injuries (n=16, 102) (Lutcavage et al., 1997). However, vessel-related injuries were noted in 13 percent of stranded turtles examined from strandings in the GOM and on the Atlantic Coast during 1993 (Teas, 1994), but this figure includes those that may have been struck by boats post-mortem. In Florida, where coastal boating is popular, 18 percent of strandings documented between 1991 and 1993 were attributed to vessel collisions (Lutcavage et al., 1997). Large numbers of loggerheads and 5-50 Kemp's ridley turtles are estimated to be killed by vessel traffic per year in the U.S. (NRC, 1990; Lutcavage et al., 1997). Numbers of OCS-related vessel collisions with sea turtles offshore are unknown, but it is expected that some sea turtles would be impacted.

Brightly-lit Platforms

Brightly-lit, offshore drilling facilities present a potential danger to hatchlings (Owens, 1983). Hatchlings are known to be attracted to light (Raymond, 1984; Witherington and Martin, 1996; Witherington, 1997) and may orient toward lighted offshore structures (Chan and Liew, 1988). If this occurs, hatchling predation might increase dramatically since large birds and predatory fishes also congregate around structures (Owens, 1983; Witherington and Martin, 1996).

Jetsam and Flotsam

A wide variety of trash and debris is commonly observed in the GOM. Marine trash and debris comes from a variety of land-based and ocean sources (Cottingham, 1988). Some material is accidentally lost during drilling and production operations. From March 1, 1994, to February 28, 1995, a total of 40,580 debris items were collected in a 16-mi transect made along the Padre Island National Seashore (Miller et al., 1995). The offshore oil and gas industry was shown to contribute 13 percent of the trash and debris found in the transect. Turtles may become entangled in drifting debris and ingest fragments of synthetic materials (Carr, 1987; USDOC, NOAA, 1988; Heneman and the Center for Environmental Education, 1988). Entanglement usually involves fishing line or netting (Balazs, 1985). Once entangled, turtles may drown, incur impairment to forage or avoid predators, sustain wounds and infections from the abrasive or cutting action of attached debris, or exhibit altered behavior that threaten their survival (Laist, 1987). Both entanglement and ingestion have caused the death or serious injury of individual sea turtles (Balazs, 1985). Balazs (1985) compiled dozens of records of sea turtle entanglement, ingestion, and impaction of the alimentary canal by ingested plastics, although tar was the most common item ingested. The marked tendency of leatherbacks to ingest plastic has been attributed to misidentification of the translucent films as jellyfish. Lutz (1990) concluded that turtles would actively seek out and consume plastic sheeting. Ingested debris may block the digestive tract or remain in the stomach for extended periods, thereby lessening the feeding drive, causing ulcerations and injury to the stomach lining, or perhaps even providing a source of toxic chemicals (Laist, 1987). Weakened animals are then more susceptible to predators and disease; they are also less fit to migrate, breed, or nest successfully.

The initial life history of sea turtles involves the hatching of eggs, evacuation of nests, and commencement of an open-ocean voyage. Some hatchlings spend their "lost years" in sargassum rafts; ocean currents concentrate or trap floating debris in sargassum (Carr, 1987). Witherington (1994) studied post-hatchling loggerheads in drift lines 8-35 nmi east of Cape Canaveral and Sebastian Inlet, Florida.

Out of 103 turtles captured, 17 percent of the animals contained plastic or other synthetic fibers in their stomachs or mouths. The GOM had the second highest number of turtle strandings affected by debris (35.9%) (Witzell and Teas, 1994). Although the Kemp's ridley is the second most commonly stranded turtle, they are apparently less susceptible to the adverse impacts of debris than the other turtle species for some unknown reason (Witzell and Teas, 1994). The MMS prohibits the disposal of equipment, containers, and other materials into offshore waters by lessees (30 CFR 250.40). In addition, MARPOL, Annex V, Public Law 100-220 (101 Statute 1458) prohibits the disposal of any plastics at sea or in coastal waters.

Proposed Action Analysis

Information on drilling fluids, drill cuttings, and produced waters that would be discharged offshore as a result of a proposed action is provided in **Chapter 4.1.1.4.**, Operational Waste Discharged Offshore. These effluents are routinely discharged into offshore marine waters and are regulated by the USEPA's NPDES permits. Turtles may have some interaction with these discharges. Very little information exists on the impact of drilling muds on GOM sea turtles (Tucker and Associates, Inc., 1990).

Structure installation, pipeline placement, dredging, and water quality degradation can impact seagrass bed and live-bottom communities that sea turtles sometimes inhabit. These impacts are analyzed in detail in **Chapter 4.2.1.3.**, Impacts on Sensitive Coastal Environments. A discussion of the causes and magnitude of wetland loss as a result of a proposed action can be found in **Chapter 4.2.1.3.2.** The seagrass and high-salinity marsh components of wetland loss would be indirectly important for sea turtles by reducing the availability of forage species that rely on these sensitive habitats. Little or no damage is expected to the physical integrity, species diversity, or biological productivity of live-bottom marine turtle habitat as a result of a proposed action because these sensitive resources are protected by several mitigation measures established by MMS.

An estimated 8,000-9,000 OCS-related, service-vessel trips are expected to occur over the life of a proposed action (**Table 4-2**). The rate of trips would be about 200-225 trips/yr. Transportation corridors would be through areas where sea turtles have been sighted. Helicopter activity projections are 7,000-9,000 trips over the life of a proposed action (**Table 4-2**) or 175-225 trips annually. Noise from service-vessel traffic and helicopter overflights may elicit a startle reaction from sea turtles; there is the possibility of short-term disruption of activity patterns. Sounds from approaching aircraft are detected in the air far longer than in water. For example, an approaching Bell 214ST helicopter became audible in the air more than four minutes before passing overhead, while it was detected underwater for only 38 seconds at 3-m depth and for 11 seconds at 18-m depth (Richardson et al., 1995). There are no systematic studies published concerning the reactions of sea turtles to aircraft overflights, and anecdotal reports are scarce. It is assumed that aircraft noise could be heard by a sea turtle at or near the surface and could cause it to alter its activity (Advanced Research Projects Agency, 1995). In the wild, most sea turtles spend at least 3-6 percent of their time at the surface. Despite the brevity of their respiratory phases, sea turtles sometimes spend as much as 19-26 percent of their time at the surface, engaged in surface basking, feeding, orientation, and mating (Lutcavage et al., 1997). Sea turtles located in shallower waters have shorter surface intervals, whereas turtles occurring in deeper waters have longer surface intervals. It is not known whether turtles exposed to recurring vessel disturbance would be stressed or otherwise affected in a negative but inconspicuous way. Migratory corridors used by sea turtles may be impacted by increased vessel and aircraft disturbance. Increased vessel traffic would increase the probability of collisions between vessels and turtles, potentially resulting in injury or death to some animals.

A total of 11-13 exploratory wells and 19-27 development wells are projected to be drilled as a result of a proposed action (**Table 4-2**). Two production structures are projected as a result of a proposed action (**Table 4-2**). These structures could generate sounds at intensities and frequencies that could be heard by turtles. There is some evidence suggesting that turtles may be receptive to low-frequency sounds, which is at the level where most industrial noise energy is concentrated. Potential effects on turtles include disturbance (subtle changes in behavior, interruption of activity), masking of other sounds (e.g., surf, predators, and vessels), and stress (physiological).

Sea turtles can become entangled in or ingest debris produced by exploration and production activities resulting from a proposed action. Turtles that mistake plastic for jellyfish may be more vulnerable to gastrointestinal blockage, resulting in their starvation. Turtles entangled in debris may drown or may be impaired in their ability to swim, dive, forage or mate. The probability of plastic ingestion/entanglement is unknown.

Summary and Conclusion

Routine activities resulting from a proposed action have the potential to harm individual sea turtles. These animals could be impacted by the degradation of water quality resulting from operational discharges; noise generated by helicopter and vessel traffic, platforms, and drillships; brightly-lit platforms;; vessel collisions; and jetsam and flotsam generated by service vessels and OCS facilities. Lethal effects are most likely to be from chance collisions with OCS service vessels, ingestion of debris, or entanglement in flotsam. Most OCS activities are expected to have sublethal effects. Contaminants in waste discharges and drilling muds might indirectly affect sea turtles through food-chain biomagnification; there is uncertainty concerning the possible effects. Chronic sublethal effects (e.g., stress) resulting in persistent physiological or behavioral changes and/or avoidance of impacted areas could cause declines in survival or fecundity, and result in population declines, however, such declines are not expected. The routine activities of a proposed action are unlikely to have significant adverse effects on the size and recovery of any sea turtle species or population in the GOM.

4.2.1.7. Impacts on the Alabama, Choctawhatchee, St. Andrew, and Perdido Key Beach Mice, and Florida Salt Marsh Vole

The Alabama, Choctawhatchee, St. Andrew, and Perdido Key beach mice are designated as protected species under the Endangered Species Act of 1973 (**Chapter 1.3.**, Regulatory Framework). The mice occupy restricted habitat behind coastal foredunes of Florida and Alabama (Ehrhart, 1978; USDOI, FWS, 1987). Portions of the beach mouse habitat have been designated as critical.

Proposed Action Analysis

The major impact-producing factors associated with a proposed action that may affect beach mice include beach trash and debris, efforts undertaken for the removal of marine debris or for beach restoration, offshore and coastal oil spills, and spill-response activities. The potential impacts from spills on beach mice and spill-response activities are discussed in **Chapter 4.4.7.**

Beach mice may mistakenly consume trash and debris. Mice may become entangled in the debris. A proposed action in the EPA is expected to contribute negligible marine debris or disruption to beach mice areas. Efforts undertaken for the removal of marine debris or for beach restoration, such as sand replenishment, may temporarily scare away beach mice, destroy their food resources such as sea oats, or collapse the tops of their burrows.

Trash and debris from a proposed action could reach the salt marsh area where the vole lives, based on drifter studies in the GOM (Lugo-Fernandez et al., 2001). Major routine impact-producing factors and potential effects on the salt marsh vole are similar to those discussed above for beach mice.

Summary and Conclusion

An impact from a proposed action on the Alabama, Choctawhatchee, St. Andrew and Perdido Key beach mice, and Florida salt marsh vole is possible but unlikely. Impact may result from consumption of beach trash and debris. Efforts undertaken for the removal of marine debris or for beach restoration, such as sand replenishment, may temporarily scare away beach mice, destroy their food resources, or collapse the tops of their burrows.

4.2.1.8. Impacts on Coastal and Marine Birds

This section discusses the possible effects of a proposed action in the EPA on coastal and marine birds of the GOM and its contiguous waters and wetlands. Major, potential impact-producing factors for marine birds in the offshore environment include OCS-related helicopter and service-vessel traffic and noise, air emissions, degradation of water quality, habitat degradation, and discarded trash and debris from service-vessels and OCS structures. Any effects are especially grave for intensively managed populations. For example, endangered and threatened species may be harmed by any impact on viable reproductive population size or disturbance of a few key habitat factors.

Proposed Action Analysis

Noise

The transportation or exchange of supplies, materials, and personnel between coastal infrastructure and offshore oil and gas structures is accomplished with helicopters, aircraft, and boats and a variety of service vessels. It is projected that 7,000-9,000 helicopter flights related to a proposed action in the EPA would occur over the life of a proposed action; this is an average rate of 175-225 annual helicopter trips. During the peak year (year 11), 300-400 trips are projected. Service vessels would use selected nearshore and coastal (inland) navigation waterways, or corridors, and adhere to protocol set forth by the USCG for reduced vessel speeds within these inland areas. It is projected that 8,000-9,000 service-vessel trips related to a proposed action in the EPA would occur in the life of a proposed action; this is an average rate of 200-225 service-vessels trips annually. During the peak year (year 11), 300-500 trips are projected.

Major concerns related to helicopter and service-vessel traffic are intense aversion, panic, and head injury following a bird's collision with helicopters or vessels. Birds may also collide with ground structures after being frightened by a near-miss with a helicopter or vessel. Disturbances from OCS-related helicopter or service-vessel traffic to coastal birds can result from the mechanical noise or physical presence (or wake) of the vehicle. The degree of disturbance exhibited by groups of coastal birds to the presence of air or vessel traffic is highly variable, depending upon the bird species in question, type of vehicle, altitude or distance of the vehicle, the frequency of occurrence of the disturbance, and the season. Helicopter and service-vessel traffic related to OCS activities could sporadically disturb feeding, resting, or nesting behavior. Disturbance can also lead to a permanent desertion of active nests or of critical or preferred habitat, which could contribute to the relocation of a species or group to less favorable areas or to a decline of species through reproductive failure resulting from nest abandonment. When birds are flushed prior to or during migration, the energy cost could be great enough that they might not reach their destination on schedule or they may be more susceptible to diseases (Anderson, 1995). Waterfowl are more overtly responsive to noise than other birds and seem particularly responsive to aircraft, possibly because aerial predators frequently harass them (Bowles, 1995). The FAA and corporate helicopter policy advise helicopters to maintain a minimum altitude of 700 ft while in transit offshore and 500 ft while working between platforms. When flying over land, the specified minimum altitude is 1,000 ft over unpopulated areas or across coastlines and 2,000 ft over populated areas and biologically sensitive areas such as wildlife refuges and national parks. Many undisturbed coastal areas and refuges provide preferred and/or critical habitat for feeding, resting (or staging), and nesting birds. The effect of low-flying aircraft within the vicinity of aggregations of birds on the ground or on the water typically results in mass disturbance and abandonment of the immediate area. However, pilots traditionally have taken great pride in not disturbing birds. Compliance to the specified minimum altitude requirements greatly reduces effects of aircraft disturbance on coastal and marine birds. Routine presence of aircraft at sufficiently high altitudes results in acclimation of birds to routine noise. As a result of inclement weather, about 10 percent of helicopter trips would occur at altitudes somewhat below the minimums listed above. Although these incidents are seconds in duration and sporadic in frequency, they can disrupt coastal bird behavior and, at worst, possibly result in habitat or nest abandonment. Birds in flight over water typically avoid helicopters. Low-flying aircraft may temporarily disrupt feeding or flight paths. Routine presence and low speeds of service vessels within inland and coastal waterways would diminish the effects of disturbance from service vessels on nearshore and inland populations of coastal and marine birds. Birds can lose eggs and young when predators attack nests after parents are flushed into flight by service-vessel noise. Bald eagle nests would be sensitive to overhead noise because they are above the forest canopy, and piping plover nests are on dunes open to the sky. Similarly, bald eagles and brown pelicans feed over open water and piping plover feed on open beaches.

Air Quality Degradation

Contamination of wildlife by air emissions can occur in three ways: inhalation, absorption, and ingestion. Inhalation is the most common mode of contamination for birds (Newman, 1980). The major effects of air pollution include direct mortality, debilitating injury, disease, physiological stress, anemia, hypocalcemica, bioaccumulation of air pollutants with associated decrease in resistance to debilitating factors, and population declines (Newman, 1979). Direct effects can be either acute, such as sudden mortality from hydrogen sulfide, or chronic, such as fluorosis from fluoride emissions. The magnitude of effect, acute or chronic, is a function of the pollutant, its ambient concentration, pathway of exposure, duration of exposure, and the age, sex, reproductive condition, nutritional status, and health of the animal at the time of exposure (Newman, 1980). For metals in air emissions, chemical composition as well as size of particulate compounds has been shown to influence the toxicity levels in animals. Particulate size affects retention time and clearance from and deposition in the respiratory tract (Newman, 1981).

Levels of sulfur oxide (mainly sulfur dioxide, SO_2) emissions from hydrocarbon combustion from OCS-related activities are of concern in relation to birds. Research specific to birds has elucidated both acute and chronic effects from SO_2 inhalation (Fedde and Kuhlmann, 1979; Okuyama et al., 1979). Due to their lack of tracheal submucosal glands, birds appear to have more tolerance for inhaled SO_2 than most mammals (Llacuna et al., 1993; Okuyama et al., 1979). This suggestion stems from laboratory investigations where the test subject was the domestic chicken. Acute exposure of birds to 100 ppm SO_2 produced no alteration in heart rate, blood pressure, lung tidal volume, respiratory frequency, arterial blood gases, or blood pH.

Exposure to 100 ppm or less of SO_2 did not affect respiratory mucous secretion. Exposure to 1,000 ppm SO_2 caused mucus to increase and drip from the mouths of birds, but lungs appeared normal. Exposure to 5,000 ppm resulted in gross pathological changes in airways and lungs, and then death (Fedde and Kuhlmann, 1979). Chronic (two week) exposure of birds to three concentrations of SO_2 for 16 hr/day for various total periods showed a statistical change in 10 cellular characteristics and resulted in cellular changes characteristic of persistent bronchitis in 69 percent of the tests done (Okuyama et al., 1979).

The indirect effects of air emissions on wildlife include food web contamination and habitat degradation, as well as adverse synergistic effects of air emissions combined with natural and other manmade stresses. Air emissions can cause shifts in trophic structure that alter habitat structure and change local food supplies (Newman, 1980).

Air pollutants may cause a change in the distribution of certain bird species (e.g., Newman, 1977; Llacuna et al., 1993). Migratory bird species would avoid potentially suitable habitat in areas of heavy air pollution in favor of cleaner areas if available (Newman, 1979). The abundance and distribution of passerine birds, both active and sedentary, and migratory species, as well as nonpasserine and nonmigratory varieties, are also greatly affected by natural factors such as weather and food supply. Therefore, any reduction in the numbers of birds within a given locale does not have a diagnostic certainty pointing to air emissions (Newman, 1980).

Chapter 4.2.1.1. provides an analysis of the effects of a proposed action on air quality. Emissions of pollutants into the atmosphere from the activities associated with a proposed action would have minimum effects on offshore and onshore air quality because of the prevailing atmospheric conditions, emission heights and rates, and pollutant concentrations. Estimated increases in onshore annual average concentrations of NO_x, SO_x, and PM_{10} would be less than 0.29, 0.03, and 0.01 micrograms/m^3, respectively, per modeled steady state concentrations. These concentrations are far below concentrations that could harm coastal and marine birds, including the three listed species (piping plover, bald eagle, and brown pelican).

Water Quality Degradation

Chapter 4.2.1.2. provides an analysis of the effects of a proposed action on water quality. Expected degradation of coastal and estuarine water quality resulting from of OCS-related discharges may affect coastal birds directly by means of acute or chronic toxic effects from ingestion or contact, or indirectly through the contamination of food sources. Operational discharges or runoff in the offshore environment could also affect seabirds (e.g., laughing gulls) that remain and feed in the vicinity of offshore OCS structures and platforms. These impacts could also be both direct and indirect.

Maintenance dredging operations remove several million cubic feet of material, resulting in localized impacts (primarily increased turbidity and resuspended contaminants) during the duration of the operations. Water clarity would decrease over time within navigation channels used for vessel operations and within pipeline canals due to continuous sediment influx from bank erosion, natural widening, and reintroduction of dredged material back into surrounding waters. Turbidity in water may block visual predation on fish by brown pelicans and bald eagles. For a proposed action, the projected, primary service bases are Venice and Fourchon, Louisiana, and Mobile, Alabama; and secondary service bases are Cameron, Intracoastal City, Houma, and Morgan City, Louisiana, and Pascagoula, Mississippi. A proposed action would result in very small incremental contribution to the need for channel maintenance. Coastal and marine birds that feed exclusively within these locations would likely experience chronic, nonfatal physiological stress. Some coastal and marine birds would experience a decrease in viability and reproductive success that would be indistinguishable from natural population variations.

Habitat Degradation

The greatest negative impact to coastal and marine birds is loss or degradation of preferred or critical habitat. The extent of bird displacement resulting from habitat loss is highly variable between different species, based upon specific habitat requirements and availability of similar habitat in the area. Habitat loss interferes especially with the listed birds (brown pelican, piping plover, and bald eagle), which for now require trends of increases in populations rather than stasis and equilibrium. Habitat requirements for most bird species are incompletely known. The analysis of the potential impacts on sensitive coastal environments (**Chapter 4.2.1.3.**) concludes that a proposed action is not expected to adversely alter barrier beach configurations significantly beyond existing, ongoing impacts in much localized areas downdrift of artificially jettied and maintained channels. Impacts of navigation canals are the most significant OCS-related and proposed-action-related impacts to wetlands.

Coastal and marine birds are susceptible to entanglement in floating, submerged, and beached marine debris; specifically in plastics discarded from both offshore sources and land-derived litter and waste disposal (Heneman and the Center for Environmental Education, 1988). Studies in Florida reported that 80 percent of brown pelicans showed signs of injury from entanglement with fishing gear (Clapp and Buckley, 1984). In addition, seabirds ingest plastic particles and other marine debris more frequently than do any other taxa (Ryan, 1990). Interaction with plastic materials may lead to permanent injuries and death. Ingested debris may have three basic effects on seabirds: irritation and blockage of the digestive tract, impairment of foraging efficiency, and release of toxic chemicals (Ryan, 1990; Sileo et al., 1990a). Effects of plastic ingestion may last a lifetime and may include physical deterioration due to malnutrition; plastics often cause a distention of the stomach, thus preventing its contraction and simulating a sense of satiation (Ryan, 1988). Some birds also feed plastic debris to their young, which could reduce survival rates. The chemical toxicity of some plastics can be high, posing a hazard in addition to obstruction and impaction of the gut (Fry et al., 1987). Sileo et al. (1990b) found that the prevalence of ingested plastic found within the gut of examined birds varied greatly among species. Species that seldom regurgitate indigestible stomach contents are most prone to the aforementioned adverse effects (Ryan, 1990). Within the GOM, these include the phalaropes, petrels, storm petrels, and shearwaters. The piping plover, bald eagle, and the brown pelican would share vulnerability to debris with birds in general. It is expected that coastal and marine birds would seldom become entangled in or ingest OCS-related trash and debris as a result of MMS prohibitions on the disposal of equipment, containers, and other materials into offshore waters by lessees (30 CFR 250.40). In addition, MARPOL, Annex V, Public Law 100-220 (101 Statute 1458), which prohibits the disposal of any plastics, garbage, and other solid wastes at sea or in coastal waters, went into effect January 1, 1989, and is enforced by the USCG.

Summary and Conclusion

The majority of effects resulting from a proposed action in the EPA on endangered/threatened and nonendangered/nonthreatened coastal and marine birds are expected to be sublethal: behavioral effects, nonfatal exposure to or intake of OCS-related contaminants or discarded debris, temporary disturbances, and displacement of localized groups from impacted habitats. Chronic sublethal stress, however, is often undetectable in birds. As a result of stress, individuals may weaken, facilitating infection and disease; then migratory species may not have the strength to reach their destination. No significant habitat impacts are expected to occur directly from routine activities resulting from a proposed action. Secondary impacts to coastal habitats would occur over the long-term and may ultimately displace species from traditional sites to alternative sites.

Bald eagle, piping plover, and brown pelican use habitat that is open to the sky, thus impacted by helicopter noise. They would also be susceptible to disturbance by discarded debris. Turbidity may hide pelagic fishes from predation by brown pelican.

4.2.1.9. Impacts on Endangered and Threatened Fish

4.2.1.9.1. Gulf Sturgeon

Effects on Gulf sturgeon from routine activities associated with a proposed action could result from degradation of estuarine and marine water quality, pipeline installation, and drilling and produced water discharges. Potential impacts from accidental oil spills on Gulf sturgeon are discussed in **Chapter 4.4.9.1.**

Proposed Action Analysis

Drilling mud discharges may contain chemicals that are toxic to Gulf sturgeon at concentrations four of five orders of magnitude higher than concentrations found a few meters from the discharge point. Offshore discharges of drilling muds are expected to dilute to background levels within 1,000 m of the discharge point.

Produced-water discharges may contain components potentially detrimental to Gulf sturgeon. Moderate heavy-metal and hydrocarbon contamination of sediments and the water column are expected to occur out to several hundred meters downcurrent from the discharge point (CSA, 1997b); however, offshore discharges of produced water are expected to disperse and dilute to background levels within 1,000 m of the discharge point.

All of the proposed 50-800 km of pipelines would be laid in deep water. Regulations do not require burial of pipelines in >60 m water depth; therefore, little resuspension of sediments would result. Gulf sturgeons are expected to avoid lay-barge equipment and resuspended sediments. No impacts on Gulf sturgeon are expected from installation of the projected pipelines.

Minor degradation of estuarine water quality is expected in the immediate vicinity of shorebases and other OCS-related facilities as a result of routine effluent discharges and runoff. Only a small amount of the routine dredging done in coastal areas would be directly or indirectly due to a proposed action.

Platform removal may kill some Gulf sturgeon, but the fish is not typically drawn to underwater structures.

Summary and Conclusion

Potential impacts on Gulf sturgeon may occur from resuspended sediments and OCS-related discharges, as well from nonpoint runoff from estuarine OCS-related facilities. The low toxicity of this pollution and the unlikely, simultaneous occurrence of individual Gulf sturgeon and of contamination is expected to result in little impact of a proposed action on Gulf sturgeon. Routine activities resulting from a proposed action in the EPA are expected to have little potential effects on Gulf sturgeon.

4.2.1.9.2. Smalltooth Sawfish

Effects on smalltooth sawfish from routine activities associated with a proposed action could potentially result from jetsam and flotsam resulting from exploration and development activities and associated vessel traffic, pipeline installation, drilling and produced-water discharges, and structure-removal operations. Potential impacts from accidental oil spills on smalltooth sawfish are discussed in **Chapter 4.4.9.2.**

Proposed Action Analysis

Fishing and habitat alteration and degradation in the past century have reduced the U.S. population of the smalltooth sawfish (USDOC, NMFS, 2000). At present, the smalltooth sawfish is primarily found in southern Florida in the Everglades and Florida Keys. Historically, this species was common in neritic and coastal waters of Texas and Louisiana. Many records of the smalltooth sawfish were documented in the 1950's and 1960's from the northwestern Gulf in Texas, Louisiana, Mississippi, and Alabama. Since 1971, however, there have been only three published or museum reports of the species captured in the region, all from Texas (1978, 1979, and 1984). Additionally, reports of captures have dropped dramatically. Louisiana, an area of historical localized abundance, has experienced marked declines in sawfish landings. The lack of smalltooth sawfish records since 1984 from the area west of peninsular Florida is a clear indication of their rarity in the northwestern Gulf.

Drilling mud discharges may contain chemicals that would be toxic to smalltooth sawfish. Offshore discharges of drilling muds are expected to dilute to background levels within 1,000 m of the discharge point. Produced-water discharges may contain components potentially detrimental to smalltooth sawfish. Moderate heavy-metal and hydrocarbon contamination of sediments and the water column are expected to occur out to several hundred meters downcurrent from the discharge point (CSA, 1997b); however, offshore discharges of produced water are expected to disperse and dilute to background levels within 1,000 m of the discharge point.

All of the proposed 50-800 km of pipelines would be laid in deep water. Smalltooth sawfish typically inhabit infralittoral waters (<100 m in depth) and would not be impacted by any proposed pipelines in deep water as a result of a proposed action.

Minor degradation of estuarine water quality is expected in the immediate vicinity of shore bases and other OCS-related facilities as a result of routine effluent discharges and runoff, and a small amount of the routine dredging may occur in coastal areas due to a proposed action. However, the shore bases projected to be used in support of a proposed action and the potential dredging activities are located in areas where smalltooth sawfish are no longer likely to occur.

Summary and Conclusion

Potential impacts to smalltooth sawfish may occur from jetsam and flotsam, suspended sediments, OCS-related discharges, and nonpoint runoff from estuarine, OCS-related facilities. However, because the current population of smalltooth sawfish is primarily found in southern Florida in the Everglades and Florida Keys, impacts to these rare animals from routine activities associated with a proposed action are expected to be miniscule.

4.2.1.10. Impacts on Fish Resources and Essential Fish Habitat

Effects on fish resources and EFH from activities associated with a proposed action could result from coastal environmental degradation, marine environmental degradation, petroleum spills, subsurface blowouts, pipeline trenching, and offshore discharges of drilling muds and produced waters. Potential effects from routine activities resulting from a proposed action on fish resources and EFH are described below. Potential effects on the two habitats of particular concern for GOM fish resources (Weeks Bay National Estuarine Research Reserve in Alabama and Grand Bay in Mississippi and Alabama) are included under the analyses for wetlands (**Chapter 4.2.1.3.2.**). Potential effects from accidental events (blowouts and spills) on fish resources and EFH are described in **Chapter 4.4.10.** Potential effects on commercial fishing from a proposed action are described in **Chapter 4.2.1.11.**

Healthy fish resources and fishery stocks depend on EFH waters and substrate necessary to fish for spawning, breeding, feeding, and growth to maturity. Because of the wide variation of habitat requirements for all life history stages (as described in **Chapter 3.2.8.**, Fisheries) for managed fish species, the EFH for the GOM includes all coastal and marine waters and substrates from the shoreline to the seaward limit of the EEZ. Collectively, the adverse impacts on coastal EFH and marine EFH are called, respectively, coastal and marine environmental degradation in this analysis.

Few fish species within the proposed lease sale area are estuary dependent, although indirect associations of fish species with those that are estuary dependent can be assumed (Darnell and Soniat, 1979; Darnell, 1988), particularly if artificial reef species are considered. Coastal environmental degradation resulting from a proposed action, although indirect, has the potential to adversely affect EFH and fish resources. The environmental deterioration and effects on EFH and fish resources result from the loss of GOM wetlands and coastal estuaries as nursery habitat and from the functional impairment of existing habitat through decreased water quality (Chambers, 1992; Stroud, 1992).

Wetlands and estuaries within Louisiana, Mississippi, and Alabama may be affected by activities resulting from a proposed action (**Chapters 4.2.1.3.2. and 4.4.3.2.**). These activities include expansion of onshore facilities in wetland areas, vessel usage of navigation channels and access canals, maintenance of navigation channels, inshore disposal of OCS-generated petroleum-field wastes, and spills from both coastal and offshore OCS-support activities.

Coastal water quality (**Chapters 4.2.1.2.1. and 4.4.2.1.**) may be adversely affected by saltwater intrusion and sediment disturbances from channel maintenance dredging, onshore pipeline emplacements, and canal widening. Trash, discharges, runoff, and spills may be released from onshore facilities and vessel traffic and cause degradation of coastal water quality. Besides coastal sources, offshore spills and trash occurring in association with OCS operations and reaching coastal waters may impact water quality conditions.

Since all of the fish species within a proposed lease sale area are dependent on offshore water, marine environmental degradation resulting from a proposed action has the potential to adversely affect EFH and fish resources. In general, offshore EFH includes both high- and low-relief live bottoms (pinnacles) and both natural (topographic features) and artificial reefs. There are no natural banks or pinnacles in the proposed lease sale area (in the traditional sense as found on the continental shelf). A proposed action could impact soft-bottom communities, hard-bottom communities (although rare in deep-water) organisms colonizing scattered anthropogenic debris and artificial reefs. Impact-producing factors that could affect EFH include infrastructure emplacement, anchoring, infrastructure removal, operational offshore waste discharges, blowouts, and to a limited extent, laying of pipelines. The impacts could include immediate mortality of live-bottom organisms or the alteration of sediments to the point that recolonization of the affected areas may be delayed or impossible.

The attraction of pelagic highly migratory fish species to artificial structures in deepwater areas of the GOM is an evolving issue. The existing information on fish attracting devices (FAD) indicates that several commercially and recreationally important species would be or are already being attracted to GOM offshore structures. The main species are yellowfin tuna (*Thunnus albacares*), skipjack (*Katsuwonus pelamis*), and bigeye tuna (*Thunnus obesus*). There are a number of possible ramifications that may include primary ecological effects including: (1) changes in distribution patterns (particularly due to aggregation and concentration), (b) changes in movement and migration patterns; (c) changes in spawning and larval survival/recruitment (due to a and b above). A number of possible secondary, indirect effects of FAD's include (1) increased catchability and fishing mortality due to aggregation around structures, and (2) changes in population age structure due to increased or changed age-specific mortality due to fishing. At this point in time, it is not known to what extent deepwater structures are acting as FAD's. A study performed by USGS/BRD to assess existing literature and synthesize information from a special FAD's workshop has recently been completed. Discussion of these results and directions for potential future studies are ongoing. The present literature does not include substantive data for the GOM; however, the results of this USGS/BRD project is leading to new studies that will directly address GOM highly migratory species and their attraction to deepwater platforms.

Impact-producing factors from routine offshore activities that could result in marine water quality degradation include platform and pipeline installation, platform removal, and the discharge of operational wastes (**Chapter 4.2.1.2.2.**). Offshore accidents including blowouts and spills from platforms, service vessels, and pipelines could also occur and potentially alter offshore water quality (**Chapter 4.4.2.2.**). Coastal operations could indirectly affect marine water quality; offshore water quality can be impacted through migration of contaminated coastal waters (**Chapter 4.2.1.2.1.**).

Chronic, low-level pollution is a persistent and recurring event resulting in frequent but nonfatal physiological irritation to those resources that lie within the range of impact and that are likely to be adversely affected by the pollution. The geographic range of the pollutant effect depends on the mobility of the resource, the characteristics of the pollutant, and the tolerance of the resource to the pollutant in question (in this case hydrocarbons).

Drilling muds contain materials, such as lead and cadmium, that in high concentrations are toxic to fishery resources; however, the discharge plume disperses rapidly, is very near background levels at a distance of 1,000 m, and is usually undetectable at distances greater than 3,000 m (Kennicutt, 1995) (**Chapter 4.1.1.4.1.**, Drilling Muds and Cuttings). Since 1993, USEPA has required concentrations of mercury and cadmium to be less than or equal to 1 ppm and 3 ppm, respectively, in the stock barite used to make drilling muds. There has recently been increased media focus on mercury uptake in fish and other marine species. An MMS-funded study titled *Gulf of Mexico Offshore Operations Monitoring Experiment* (Kennicutt, 1995) analyzed sediments at three sites in the GOM. Results of this study indicated that mercury levels were slightly elevated in sediments or organisms at one platform site (High Island Block A-389). The average concentration of mercury at High Island Block A-389 was twice as high as the other two platforms. The highest average concentration (0.41 µg/g) was found within 50 m of the platform, but decreased to 0.12 µg/g at 100 m. Although these concentrations were the highest found, they were low relative to the probable effects level (0.7) believed to cause biological effects. This platform used the practice of shunting drilling muds and cuttings to within 10 m of the seafloor to avoid dispersal and prevent impact to the nearby East Flower Garden Bank. Shunting will not occur in the proposed action area.

In this same study, metal concentrations were measured in tissues for 37 marine species. Fish tissue concentrations were generally low; for example, the average concentration was 0.45 µg/g for all flounder species, 0.39 µg/g for all hake species, and 0.24 µg/g for all snapper species. Shrimp had statistically higher tissue concentrations (0.36 µg/g) near platforms than far from platforms (0.19 µg/g). These values are well below the Federal guidelines set by FDA to protect human health, which is 1 ppm. Additional discussion of mercury in drilling muds can be found in **Chapter 4.1.1.4.1.**

In addition to toxic trace elements and hydrocarbons in produced waters, there are additional components and properties, such as hypersalinity and organic acids, that have a potential to adversely affect fishery resources. Produced waters that are discharged offshore are diluted and dispersed to very near background levels at a distance of 1,000 m and are undetectable at a distance of 3,000 m from the discharge point (Harper, 1986; Rabalais et al., 1991; Kennicutt, 1995).

Proposed Action Analysis

The effects of a proposed action on coastal wetlands and coastal water quality, with the exception of accidental events, are analyzed in detail in **Chapters 4.2.1.3.2. and 4.2.1.2.1.**, respectively. Collectively, the adverse impacts from these effects are called coastal environmental degradation in this EIS. The effects of a proposed action on marine water quality are analyzed in detail in **Chapter 4.2.1.2.2.** Collectively, the adverse impacts from these effects are called marine environmental degradation in this EIS. The direct and/or indirect effects from coastal and marine environmental degradation on fish resources and EFH are summarized and considered below.

Coastal Environmental Degradation

A proposed action is projected to increase traffic in navigation channels to and from service bases from Louisiana to Alabama. This may result in some erosion of wetlands along the channels, particularly in Louisiana. Little erosion along the navigation channels in Mississippi and Alabama is expected because the channels are in upland areas and the banks are developed. Additional information regarding erosion along navigation channels is provided in the wetland analysis (**Chapter 4.2.1.3.2.**).

No new pipeline landfalls are projected in support of a proposed action. A total of four new pipelines are projected but these are projected to connect to existing or proposed pipelines that extend into deep water.

Localized, minor degradation of coastal water quality is expected in waterbodies in the immediate vicinity of coastal shore bases, commercial waste-disposal facilities, and oil refineries or gas processing plants as a result of routine effluent discharges and runoff. A proposed action in a proposed action area is projected to contribute a small percentage of the OCS-Program-related use of these facilities.

Maintenance dredging of waterways and channels would result in decreased water clarity and some resuspension of contaminants. This could preclude, in rare instances, uses of those waters directly affected by the dredging operations for up to several months. The periods between projected dredging operations, ranging from 1-2 years, should generally allow for the recovery of affected areas. Only a very small amount of the routine dredging done in coastal areas would be directly or indirectly due to a proposed action.

It is expected that coastal environmental degradation from a proposed action would have little effect on fish resources or EFH. Wetlands that could be impacted for some period of time or converted to open water are discussed in the wetlands analysis (Chapter 4.2.1.3.2.). Recovery of fish resources or EFH can occur from more than 99 percent, but not all, of the potential coastal environmental degradation. Fish populations, if left undisturbed, would regenerate in one generation and most EFH can recuperate quickly, but the loss of wetlands as EFH could be permanent. At the expected level of effect, the resultant influence on fish resources or EFH from a proposed action would be negligible and indistinguishable from natural population variations.

Marine Environmental Degradation

For any activities associated with a proposed action, USEPA's Region 4 would regulate discharge requirements through their NPDES permits. Contaminant levels in the EPA are generally low, reflecting the lack of pollution sources and high-energy environment of much of the region. The primary water quality impact from any increased turbidity would be localized decreased water clarity. Bottom disturbance from emplacement operations associated with a proposed action would produce localized, temporary increases in suspended sediment loading, resulting in decreased water clarity and little reintroduction of pollutants.

The major sources of discharges associated with a proposed action to marine waters are the temporary discharge of drilling muds and cuttings and the long-term discharge of produced-water effluent. Both of these discharges contain various contaminants of concern (e.g., trace metals and petroleum-based organic) that may have environmental consequences on marine water quality and aquatic life. Drilling mud discharges contain chemicals toxic to marine fishes; however, this is only at concentrations four or five orders of magnitude higher than the concentrations found a few meters from the discharge point. Offshore discharges of drilling muds are expected to dilute to background levels within 1,000 m of the discharge point.

Produced-water discharges contain components and properties potentially detrimental to fish resources. Moderate petroleum and metal contamination of sediments and the water column are expected to occur out to several hundred meters downcurrent from the discharge point (CSA, 1997a). However, these results would be expected to be far less at the greater water depths of a proposed action (1,600-3,000 m). Offshore discharges of produced water are expected to disperse and dilute to background levels within 1,000 m of the discharge point.

The projected total number of platform installations resulting from a proposed action is only two structures for all water depths. Ten years after a platform is installed, the structure would be acting as a climax community artificial reef. Essentially 100 percent of the platform-associated species present would represent new biomass and not recruits from nearby live bottoms due to the extreme distances and water depths separating them. All structures associated with a proposed action are expected to be removed 36 years after the lease sale. Structure removal results in at least some loss of artificial-reef habitat. It is expected that structure removals would have a negligible effect on fish resources because of their low numbers and the fact that the principal managed fishery resource associated with the structures (highly migratory species) are not dependent on specific structures for survival. Tropical species associated with the upper structure that would be removed or relocated would probably perish due to their introduction to a pelagic environment that would not provide food resources or habitat critical for their survival.

The projected length of pipeline installations for a proposed action is 50-800 km. With connection to existing pipelines in deep water, there would be no trenching for pipeline burial, which has the potential to adversely affect fish resources. Without burial, the resultant influence on fish resources would be negligible and indistinguishable from other natural population variations. Exposed pipeline in deep water would also act as hard substrate and have a positive impact on many deep-water fish species.

It is expected that marine environmental degradation from a proposed action would have little effect on fish resources or EFH. The impact of marine environmental degradation is expected to cause an undetectable decrease in fish populations. Recovery of fish resources or EFH can occur from 100 percent of the potential marine environmental degradation. Fish populations, if left undisturbed, would regenerate in one generation. The USEPA NPDES permits would regulate offshore discharges and subsequent changes to marine water quality. At the expected level of effect, the resultant influence on fish resources or EFH would be negligible and indistinguishable from natural population variations.

Summary and Conclusion

It is expected that coastal and marine environmental degradation from a proposed action would have little effect on fish resources or EFH. The impact of coastal and marine environmental degradation is expected to cause an undetectable decrease in fish resources or in EFH. Recovery of fish resources and EFH can occur from more than 99 percent, but not all, of the expected coastal and marine environmental degradation. Fish populations, if left undisturbed, would regenerate in one generation, but any loss of wetlands as EFH would be permanent.

The USEPA NPDES permits would regulate offshore discharges and subsequent changes to marine water quality. At the expected level of impact, the resultant influence on fish resources and EFH would be negligible and indistinguishable from natural population variations.

Activities such as OCS discharge of drilling muds and produced water would cause negligible impacts and would not deleteriously affect fish resources or EFH. At the expected level of impact, the resultant influence on fish resources would cause less than a 1 percent change in fish populations or EFH. As a result, there would be little disturbance to fish resources or EFH.

A proposed action is expected to result in less than a 1 percent decrease in fish resources and/or standing stocks or in EFH. It would require one generation for fish resources to recover from 99 percent of the impacts. Recovery from the loss of wetlands habitat would probably not occur.

4.2.1.11. Impacts on Commercial Fishing

Effects on commercial fishing from activities associated with a proposed action could result from installation of production platforms, underwater OCS obstructions, production platform removals, seismic surveys, subsurface blowouts, and petroleum spills. Potential effects from routine activities resulting from a proposed action in a proposed action area on fish resources and EFH are described in **Chapter 4.2.1.10.** Potential effects from accidental events (spills and blowouts) on fish and EFH are described in **Chapter 4.4.10.** Potential effects on commercial fishing from routine activities resulting from a proposed action are described below.

Healthy fishery stocks depend on EFH waters and substrate necessary to fish for spawning, breeding, feeding, and growth to maturity. Due to the wide variation of habitat requirements for all life history stages (as described in **Chapter 3.2.8.**, Fisheries) for managed species in the CPA, the EFH for the GOM includes all coastal and marine waters and substrates from the shoreline to the seaward limit of the EEZ. Collectively, the adverse impacts on coastal EFH and marine EFH are called, respectively, coastal and marine environmental degradation in this analysis.

Few fish species within a proposed action area are estuary dependent, although indirect associations of fish species with those that are estuary dependent can be assumed (Darnell and Soniat, 1979; Darnell, 1988), particularly if artificial reef species are considered. Coastal environmental degradation resulting from a proposed action, although indirect, has the potential to adversely affect EFH and commercial fisheries. Environmental deterioration and effects on EFH and commercial fisheries result from the loss of GOM wetlands and coastal estuaries as nursery habitat and from the functional impairment of existing habitat through decreased water quality (Chambers, 1992; Stroud, 1992).

Wetlands and estuaries within Louisiana, Mississippi, and Alabama may be affected by activities resulting from a proposed action (**Chapters 4.2.1.3.2. and 4.4.3.2.**). These activities include construction or expansion of onshore facilities in wetland areas, vessel usage of navigation channels and access canals, maintenance of navigation channels, inshore disposal of OCS-generated petroleum-field wastes, and spills from both coastal and offshore OCS-support activities.

Coastal water quality (**Chapters 4.2.1.2.1. and 4.4.2.1.**) may be adversely affected by saltwater intrusion and sediment disturbances from channel maintenance dredging, onshore pipeline emplacements, and canal widening. Trash, discharges, runoff, and spills may be released from onshore facilities and vessel traffic and cause degradation of coastal water quality. Besides coastal sources, offshore spills and trash occurring in association with OCS operations and reaching coastal waters may impact water quality conditions.

Since all of the fish species harvested within a proposed action area are dependent on offshore water, marine environmental degradation resulting from a proposed action has the potential to adversely affect EFH and fish resources. In general, offshore EFH includes both high- and low-relief live bottoms (pinnacles) and both natural (topographic features) and artificial reefs; however, there are no natural banks or pinnacles in a proposed action area (in the traditional sense as found in the photic zone on the continental shelf). A proposed action could impact soft-bottom communities, hard-bottom communities (those that could exist in deep water), and organisms colonizing scattered anthropogenic debris and artificial reefs; however, there are no commercially important bottom species in the proposed lease sale area. Impact-producing factors that could affect EFH include infrastructure emplacement, anchoring, infrastructure removal, operational offshore waste discharges, blowouts, and pipeline trenching.

Impact-producing factors from routine offshore activities that could result in degradation of marine water quality include platform and pipeline installation, platform removal, and the discharge of operational wastes (**Chapter 4.2.1.2.2.**). Offshore accidents including blowouts and spills from platforms, service vessels, and pipelines could also occur and potentially alter marine water quality (**Chapter 4.4.2.2.**). Coastal operations could indirectly affect marine water quality; offshore water quality can be impacted through migration of contaminated coastal waters (**Chapter 4.4.2.1.**).

The area occupied by structures, anchor cables, and safety zones (for vessels larger than 100 feet) associated with a proposed action would be unavailable to commercial fishermen and could cause space-use conflicts. Exploratory drilling rigs would spend approximately 30-150 days onsite and would cause short-lived interference to commercial fishing. A floating production system in deeper water requires as much as 5 ha of space. The use of FPSO's is not projected for a proposed action, and the USCG has not yet determined what size of a navigational safety zone would be required for an FPSO during normal or offloading operations.

Underwater OCS obstructions, such as pipelines, can cause gear conflicts that result in losses of trawls and catch, business downtime, and vessel damage. Water depths in a proposed action area are generally deeper than any commercial trawling activities (>1,600 m). Virtually all commercial trawl fishing in the GOM is performed in water depths less than 200 m (Louisiana Dept. of Wildlife and Fisheries, 1992). Longline fishing is performed in water depths greater than 100 m and usually beyond 300 m; however, all longline fishing is prohibited in two areas in the vicinity of DeSoto Canyon. One of these areas includes an area north of 28 degrees latitude (described in **Chapter 3.3.1.**, Commercial Fishing) that encompasses 160 potential lease blocks from the total of 256 in a proposed action area. Although GOM fishermen are experiencing some economic loss from gear conflicts, the economic loss for a fiscal year has historically been less than 0.1 percent of the value of that same fiscal year's commercial fisheries landings. In addition, most financial losses from gear conflicts are covered by the Fishermen's Contingency Fund (FCF).

Lessees are required to remove all structures and underwater obstructions from their leases in the Federal OCS within one year of the lease relinquishment or termination of production (**Chapter 4.1.1.11.**, Decommissioning and Removal Operations).

Chronic, low-level pollution is a persistent and recurring event, resulting in frequent but nonfatal physiological irritation to those resources that lie within the range of impact and that are likely to be adversely affected by the pollution. The geographic range of the pollutant effect depends on the mobility of the resource, the characteristics of the pollutant, and the tolerance of the resource to the pollutant in question (in this case hydrocarbons).

Drilling muds contain materials, such as lead and cadmium, that in high concentrations are toxic to fishery resources; however, the plume disperses rapidly, is very near background levels at a distance of 1,000 m, and is usually undetectable at distances greater than 3,000 m (Kennicutt, 1995) (**Chapter 4.1.1.4.1.**, Drilling Muds and Cuttings). Since 1993, USEPA has required concentrations of mercury and cadmium to be less than or equal to 1 ppm and 3 ppm, respectively, in the stock barite used to make drilling muds. Trace amounts of mercury that are naturally occurring in the major drilling mud component barite has been raised as an issue by the media. Mercury in drilling mud is described in more detail in **Chapters 3.1.2., 4.1.1.4.1., and 4.2.1.10.** Although mercury that is found in the tissues of some large size predatory fish is a concern, there is no current evidence that contributions from drilling discharges play any major role.

In addition to toxic trace elements and hydrocarbons in produced waters, there are additional components and properties, such as hypersalinity and organic acids, that have a potential to adversely affect commercial fishery resources. Produced waters that are discharged offshore are diluted and dispersed to very near background levels at a distance of 1,000 m and are undetectable at a distance of 3,000 m from the discharge point (Harper, 1986; Rabalais et al., 1991; Kennicutt, 1995).

Proposed Action Analysis

Installation of offshore structures may cause space-use conflicts with commercial fishing activities. Only two production structure installations are projected for a proposed action. Using the 500-m navigational safety zone figure (although to date only seven operators throughout the GOM have established an official safety zone and six other operators have initiated the process for obtaining the USCG safety zone around production platforms), the possible area excluded from commercial trawl fishing or longlining would be approximately 95 ha, depending on the size of the facility itself. Technically, the safety zone exclusion would not apply to vessels smaller than 100 ft. The maximum excluded area of 190 ha (2 structures @ up to 95 ha each including safety zones) represents only a very small fraction (0.0003%) of the total area of a proposed action. There is no use of FPSO's projected for a proposed action. All structures associated with a proposed action are projected to be removed by the year 2037.

Two large areas in the DeSoto Canyon Area have been designated by NOAA Fisheries as swordfish nursery areas and are closed to longline fishing activities. The boundaries of the closed areas are described in **Chapter 3.3.1.**, Commercial Fishing, and are shown on **Figure 3-9**. The longline closure areas are located largely in the EPA. One of these includes an area north of 28 degrees latitude that encompasses 160 potential lease blocks from the total of 256 in a proposed action area. A small portion of the northern closed area includes 174 blocks in the CPA in the Mississippi Canyon, Main Pass, Viosca Knoll, and Mobile lease areas. The closed areas cover nearly 845,000 km^2 and would displace commercial longlining, which may increase activity in the CPA and possibly the WPA. Longline fishing could occur in the 96 blocks of a proposed action south of 28 degrees latitude, but some portion of these blocks bordering the closed area would also be avoided due to the extreme length of longline sets and time required for their retrieval.

Underwater OCS obstructions such as pipelines could cause fishing gear loss and additional user conflicts but none of a proposed action area occurs in water depths shallower than 1,600 m. Gear loss and user conflicts are mitigated by the FCF. Direct payments for claims in FY 1997 totaled $238,404 and total payments for FY 1998 were $311,290. The amount available for GOM FCF claims in FY 1999 was $1,212,969. The majority of claims are resolved within six months of filing. The economic loss from gear loss and user conflicts has historically been less than 0.1 percent of the same year's value of GOM commercial fisheries landings. It is expected that installed pipelines in the proposed lease sale area should never conflict with bottom trawl or other fishing activities other than during temporary exclusion from the area of a pipelaying barge, and they are expected to have a negligible effect on commercial fishing.

Structure emplacements can act as FAD's and can result in aggregation of highly migratory fish species. A number of commercially important highly migratory species, such as tunas and marlins, are known to congregate and be caught around FAD's. Structure removals result in loss of artificial-reef habitat. It is expected that structure removals would have a negligible effect on commercial fishing because of the inconsequential number of removals (maximum of 2) and the consideration that removals kill only those fish proximate to the removal site.

Seismic surveys would occur in a proposed action area. Usually, fishermen are precluded from a very small area for several days. This should not impact the annual landings or value of landings for commercial fisheries in the GOM. The GOM species can be found in many adjacent locations and GOM commercial fishermen do not fish in one locale. Gear conflicts between seismic surveys and commercial fishing are also mitigated (see above) by the FCF. All seismic survey locations and schedules are published in the USCG *Local Notice to Mariners,* a free publication available to all fishermen. Seismic surveys would have a negligible effect on commercial fishing.

Summary and Conclusion

Activities such as seismic surveys would cause negligible impacts and would not deleteriously affect commercial fishing activities. Operations such as production platform emplacement, and underwater OCS impediments, would cause slightly greater impacts on commercial fishing. Some positive impacts to commercial fishing resulting from fish aggregating around deepwater structures may be possible. At the expected level of impact, the resultant influence on commercial fishing would be indistinguishable from variations due to natural causes. As a result, there would be very little impact to commercial fishing. A proposed action is expected to result in less than a 1 percent change in activities, in pounds landed, or in the value of landings. It would require less than six months for fishing activity to recover from any impacts.

4.2.1.12. Impacts on Recreational Fishing

This section discusses the possible effects of a proposed action on recreational fishing. Impact-producing factors associated with a proposed lease sale that could directly impact recreational fishing in the offshore environment include the presence of offshore structures, pipeline installation activities, and spills. Potential effects from accidental events including spills on recreational fishing are described in **Chapter 4.4.11.**

Recreational fishing could be indirectly impacted by adverse effects of a proposed action on fish stocks or EFH. The analyses of the potential impacts of a proposed action on fish resources and EFH (**Chapter 4.2.1.10.**) and on commercial fisheries (**Chapter 4.2.1.11.**), especially in regard to fish populations, also applies to recreational fishing.

As indicated in **Chapter 3.3.2.**, marine recreational fishing along Florida's west coast, and coastal Alabama, Mississippi, and Louisiana is very popular with both residents and tourists, and is economically important to coastal states. The latest information from the NMFS Marine Recreational Fisheries Statistics Survey (USDOC, NMFS, 2002) indicates there were almost 2 million resident participants in GOM saltwater fishing from Louisiana to Florida and a similar number of out-of-state (tourist) fishermen. Of these resident and tourist fishermen from Louisiana to Florida, an estimated 1.9 million offshore fishing trips occurred in Federal waters (>10 mi off Florida's west coast and >3 mi off Alabama, Louisiana, and Mississippi) during 2001 (USDOC, NMFS, 2002). The greatest number of fish caught and landed from this offshore zone included dolphins, grunts, jacks, porgies, groupers, snappers, and mackerels. Likewise, a significant amount of effort is expended by a specialized group of big game or billfish fishermen seeking primarily tuna, marlin, and wahoo focused in deep offshore waters from south of the Mississippi Delta to the DeSoto Canyon off northwest Florida.

Figure 1-1 depicts the proposed lease sale area in relation to the coastline from Louisiana to western Florida. Because of the great distances to all of the identified lease tracts offered for consideration in a proposed action, only fishermen departing from northwest Florida to coastal Alabama are likely to be impacted by a proposed action. Almost all offshore recreational fishing is currently confined within 100 mi of shore and most of a proposed action area lies about 100 mi from the Mississippi, Alabama, and Florida shores. The Louisiana Mississippi River delta coastline lies 70 mi from the proposed lease sale area, but no major recreational fishing ports are located in the area. Very few fishing trips go beyond the 200-m contour line, the DeSoto Canyon area, or 100 mi from shore.

Proposed Action Analysis

Although it is evident from available information that offshore recreational fishing is a popular, productive, and economically significant activity in the offshore waters of the northeastern GOM, no definitive information exists on the level and precise location of recreational fishing in the 256 tracts included in the proposed lease sale area. Beyond the 900-m bathymetric contour, very little recreational fishing is believed to occur because of the water depth, the distance from shore, and the lack of known natural features or artificial reefs, all of which make recreational fishing impractical, very costly, and unproductive. The proposed lease sale area is 138 nmi from Panama City, Florida; 100 nmi from Pensacola, Florida; and 123 nmi from Biloxi, Mississippi.

The type of development activities most likely to affect fish and recreational fishing within a proposed lease sale area most frequented by offshore fishermen is the introduction of high-profile structures, specifically drilling rigs and platforms. Rigs and platforms function as very large *de facto* artificial reefs. They attract and concentrate sport fish and stimulate the growth of marine life, which, in turn, attract fishermen and divers (Bull et al., 1997). Many studies (Ditton and Auyong, 1984; Roberts and Thompson, 1983; Ditton and Graefe, 1978; Dugas et al., 1979) have demonstrated that, when GOM petroleum structures are accessible to marine recreational fishermen and scuba divers, the structures are a major attraction throughout their entire lifetime for marine recreational fishing and are a positive influence on tourism and coastal economics. The introduction of two production facilities as a result of a proposed action could attract recreational fishermen to pursue game fish attracted to these deepwater structures. It is unlikely that recreational divers would venture as far as any structures in the proposed lease sale area for diving or spearfishing. Even if production facilities applied for and established 500-m safety zones, this would not exclude any recreational fishing vessel less than 100 ft in length. Fishing prospects are likely to improve by those choosing to fish in the immediate vicinity of rigs and platforms.

Oil and gas development and production resulting from this proposal would require the installation of pipelines to gather and transport petroleum products to onshore processing and refining facilities. No interaction between offshore pipelines and recreational fishing is likely after construction is complete due to the extreme water depths and no attempted fishing on the bottom. Short-term, space-use conflict could occur during the time that any pipeline is being installed.

Summary and Conclusion

The leasing, exploration, development, production, and transportation of oil and gas in the proposed lease sale area could attract limited additional recreational fishing activity to petroleum structures installed on productive leases. Each structure placed in the GOM to produce oil or gas would function as a *de facto* artificial reef, attract sport fish, and improve fishing prospects in the immediate vicinity of platforms. This impact would last for the life of the structure, until the structures are removed from the location and the marine environment. A proposed action would have a beneficial effect on offshore and deep-sea recreational fishing within developed leases accessible to fishermen. The 100-mi travel distance would be substantial but not insurmountable. These effects would last until the production structures are removed from the marine environment. Short-term space-use conflict could occur during the time that any pipeline is being installed.

4.2.1.13. Impacts on Recreational Resources

This section discusses the possible effects of a proposed action on GOM recreational beaches. Millions of annual visitors attracted to these resources are responsible for thousands of local jobs and billions of dollars in regional economic activity. Major recreational beaches are defined as those frequently visited sandy areas along the shoreline that are exposed to the GOM and that support a multiplicity of recreational activities, most of which is focused at the land and water interface. Included are Gulf Islands National Seashore, State parks and recreational areas, county and local parks, urban beaches, private resort areas, and State and private environmental preservation and conservation areas. The general locations of these beaches are indicated on MMS Visual 2—Multiple Use (USDOI, MMS, 2001c).

The primary impact-producing factors to the enjoyment and use of recreational beaches are trash and debris, and oil spills. Additional factors such as the physical presence of platforms and drilling rigs can affect the aesthetics of beach appreciation, and noise from OCS-related aircraft can adversely affect a beach-related recreation experience. All these factors, either individually or collectively, may adversely affect the number and value of recreational beach visits. The potential impacts from oil spills and other accidental events on recreational resources are discussed in **Chapter 4.4.**

The value of recreation and tourism in the GOM coastal zone from Texas through Florida has been estimated in the tens of billions of dollars annually (USDOI, MMS, 2001e; pages III-101 and III-102). A significant portion of these expenditures is made in coastal counties, where major shoreline beaches are primary recreational attractions. Over one million people visit the mainland unit and barrier island beaches of the Gulf Island National Seashore in Mississippi and Florida annually, demonstrating the popularity of destination beach parks throughout the Gulf Coast region east of the Mississippi River. Trash and debris from OCS operations can wash ashore on GOM recreational beaches. Litter on recreational beaches from OCS operations could adversely affect the ambience of the beach environment, detract from the enjoyment of beach activities, and increase administrative costs on maintained beaches. Some trash items, such as glass, pieces of steel, and drums with chemical residues, can also be a health threat to users of recreational beaches. Current industry waste management practices; training and awareness programs focused on the beach litter problem; and the OCS industry's continuing efforts to minimize, track, and control offshore wastes are expected to minimize potential for accidental loss of solid wastes from OCS oil and gas operations.

Since the proposed lease sale area is so far from shore (70 mi from Louisiana, 98 mi from Mississippi, 93 mi from Alabama, and 100 mi from Florida), platforms and drilling rigs would not be visible from shore. However, noise associated with vessels and aircraft traveling between coastal service bases and offshore operation sites can adversely affect the natural ambience of coastal beaches. Although this may affect the quality of recreational experiences, it is unlikely to reduce the number of recreational visits to coastal beaches in the GOM.

Proposed Action Analysis

A proposed action is projected to result in the drilling of 30-40 exploration and development wells and the installation of 2 platforms. Marine debris would be lost from time to time from these operations. Waste management practices and training programs are expected to minimize the level of accidental loss of solid wastes from activities resulting from a proposed action. Since Louisiana is closest to the proposed lease sale area, it would be the most likely state to be affected by any waterborne trash. Beached litter and debris from a proposed action are likely to be imperceptible to beach users or administrators; a lease sale and its subsequent activity constitutes only a small percentage of the total OCS Program. Between 8,000 and 9,000 service-vessel trips are estimated to occur over the life of a proposed action or about 200-225 trips annually. The estimated number of helicopter trips is 7,000-9,000, which is approximately 175-225 trips annually. Vessels and helicopters are expected to use service bases in or around the ports of Venice and Fourchon, Louisiana, and Mobile, Alabama. Vessels are assumed to use established nearshore traffic lanes and helicopters are assumed to comply with aerial clearance restrictions at least 90 percent of the time. This additional helicopter and vessel traffic would add little noise pollution as long as it is disbursed over a range of times and places.

Summary and Conclusion

Operations resulting from a proposed action would generate additional marine debris. The impact on Gulf Coast recreational beaches is expected to be minimal. The incremental increase in helicopter and vessel traffic is expected to add little additional noise that may annoy beach users. A proposed action is expected to result in nearshore operations that may adversely affect the enjoyment of some Gulf Coast beach uses; however, these would have little effect on the number of beach users.

4.2.1.14. Impacts on Archaeological Resources

This section discusses potential impacts from a proposed action. Major impact-producing factors that could affect both prehistoric and historic archaeological resources are direct physical contact from drilling rig and platform emplacement; pipeline installation and trenching; anchoring; dredging activity; oil spills; and ferromagnetic debris. Chapters of this EIS that provide supportive material for the archaeological resources analysis include **Chapters 3.3.4.** (Archaeological Resources), **4.1.1.** (Offshore Impact-Producing Factors and Scenario), **4.1.2.1.** (Coastal Infrastructure), and **4.3.1**. (Oil Spills).

Blocks with a high probability for the occurrence of prehistoric, prehistoric and historic, or historic archaeological resources are found in the EPA. Blocks with a high probability for prehistoric archaeological resources are found landward of a line that roughly follows the 60-m bathymetric contour. The areas of the northern GOM that are considered to have a high probability for historic period shipwrecks were redefined as a result of an MMS-funded study (Garrison et al., 1989). The study expanded the shipwreck database in the GOM from 1,500 to more than 4,000 wrecks. Statistical analysis of shipwreck location data identified two specific types of high-probability areas—the first within 10 km of the shoreline, and the second proximal to historic ports, barrier islands, and other loss traps. High-probability search polygons associated with individual shipwrecks were created to afford protection to wrecks located outside of the two aforementioned high-probability areas (see (cf.) Visual 3—Offshore Regulatory Features).

An Archaeological Resources Stipulation was included in all GOM lease sales from 1974 through 1994. The stipulation was incorporated into operational regulations effective November 21, 1994. The language of the stipulation was incorporated into the operational regulations under 30 CFR 250.194 with few changes, and all protective measures offered in the stipulation have been adopted by the regulation.

NTL 2002–G01, issued in December 2001 with an effective date of March 15, 2002, outlines MMS's archaeological survey and report requirements. Survey linespacing at 50 m is required for historic shipwreck surveys in water depths of 200 m or less. Survey linespacing of 300 m is required for prehistoric site surveys and for shipwreck surveys in water depths greater than 200 m.

Several OCS-related, impact-producing factors may cause adverse impacts to archaeological resources. Offshore development could result in a drilling rig, platform, pipeline, dredging activity, or anchors impacting a prehistoric archaeological site or an historic shipwreck. Physical contact with a prehistoric site would cause a disturbance of the site stratigraphy and artifact provenance that would adversely affect the integrity of the site and its research potential. Direct physical contact with a shipwreck site could destroy fragile ship remains, such as the hull and wooden or ceramic artifacts, and could disturb the site context. The result would be the loss of archaeological data on ship construction, cargo, and the social organization of the vessel's crew, and the concomitant loss of information on maritime culture for the time period from which the ship dates.

The emplacement of drilling rigs and production platforms has the potential to cause physical impact to prehistoric and/or historic archaeological resources. Pile driving associated with platform emplacement may also cause sediment liquefaction an unknown distance from the piling, disrupting stratigraphy in the area of liquefaction.

Pipeline installation has the potential to cause a physical impact to prehistoric and/or historic archaeological resources.

Anchoring associated with platform emplacement may also physically impact prehistoric and/or historic archaeological resources.

The OCS operations may also generate tons of ferromagnetic structures and debris, which would tend to mask magnetic signatures of significant historic archaeological resources. The task of locating historic resources via an archaeological survey is, therefore, made more difficult as a result of leasing activity.

The dredging of new channels, as well as maintenance dredging of existing channels, has the potential to cause a physical impact to both prehistoric sites and historic shipwrecks (Espey, Huston, & Associates, 1990). There are many navigation channels that provide OCS accesses to onshore facilities.

4.2.1.14.1. Historic

Proposed Action Analysis

The specific locations of archaeological sites in the proposed lease sale area cannot be identified without first conducting a remote-sensing survey of the seabed and near-surface sediments. The MMS, by virtue of new operational regulations under 30 CFR 250.194, requires that an archaeological survey be conducted prior to development of leases within the high-probability zones for historic and prehistoric archaeological resources. A proposed action includes the potential drilling of 11-13 exploration wells and 19-27 development wells over the 40-year life of a proposed action. Approximately 8,000-9,000 service-vessel trips (**Table 4-2**) are estimated for a proposed action; this is a rate of 200-225 service-vessel trips annually.

Of the 256 blocks in the proposed lease sale area, 10 blocks fall within the GOM Region's high-probability area for historic resources. These 10 lease blocks are deepwater blocks and must be surveyed at a minimum 300-m linespacing.

Ferromagnetic debris associated with exploration and production activities has the potential to mask the magnetic signatures of historic shipwrecks.

Onshore historic properties include sites, structures, and objects such as historic buildings, forts, lighthouses, homesteads, cemeteries, and battlefields. Sites already listed on the National Register of Historic Places and those considered eligible for the Register have already been evaluated as being able to make a unique or significant contribution to science. At present, unidentified historic sites may contain unique historic information and would have to be assessed after discovery to determine the importance of the data. However, no new onshore infrastructure is projected as a result of a proposed action.

Deepening and/or widening of navigation channels through maintenance dredging could have the potential to impact historic shipwrecks. The initial maintenance dredging of ports and navigation channels could impact an historic shipwreck if an archaeological survey was not performed. The potential areas of such impact include shore-base ports and their associated navigation channels. Projected primary service bases are the port areas of Venice and Fourchon, Louisiana, and Mobile, Alabama. This includes smaller ports in the area of the larger ports listed. Secondary service bases are Cameron, Intracoastal City, Houma, and Morgan City, Louisiana, and Pascagoula, Mississippi. The current system of navigation channels is believed to be generally adequate to accommodate traffic generated by a proposed action. The navigation channel at Pass Fourchon, Louisiana, is expected to be deepened to accommodate and recruit new business, which includes OCS-related business. All projected service bases and associated navigation channels represent high probability areas for the occurrence of historic period shipwrecks (Garrison, 1989). These areas and activities fall within the jurisdiction of the COE. It is assumed that before maintenance dredging to deepen and/or widen ports and navigation channels would occur the COE would require coordination with appropriate State and Federal agencies and conduct requisite remote-sensing archaeological surveys.

Summary and Conclusion

The greatest potential impact to an archaeological resource as a result of a proposed action would result from a contact between an OCS offshore activity (drilling rig emplacement, platform installation, pipeline installation, or dredging) and a historic shipwreck. The archaeological survey and archaeological clearance of sites required prior to an operator beginning oil and gas activities on a lease are estimated to be highly effective at identifying possible historic shipwreck sites. Since the site survey and clearance provide a substantial reduction in the potential for a damaging interaction between an impact-producing factor and a historic shipwreck, there is a very small possibility of an OCS activity impacting a historic site.

Ten of the blocks offered in the proposed lease sale area fall within the MMS GOM Region's high-probability area for the occurrence of historic shipwrecks and would require a survey at a minimum 300-m linespacing.

Most other activities associated with a proposed action are not expected to impact historic archaeological resources. Ferromagnetic debris has the potential to mask the magnetic signatures of historic shipwrecks. It is expected that onshore archaeological resources would be protected through the review and approval processes of the various Federal, State, and local agencies involved in permitting onshore activities. Deepening and/or widening activities associated with maintenance dredging of navigation channels may result in impacts to historic shipwrecks.

Oil and gas activities associated with a proposed action could impact a shipwreck because of incomplete knowledge on the location of shipwrecks in the GOM. Although this occurrence is not probable, such an event would result in the disturbance or destruction of important historic archaeological information. Other factors associated with a proposed action are not expected to affect historic archaeological resources.

4.2.1.14.2. Prehistoric

Prehistoric archaeological resources include sites, structures, and objects such as shell middens, earth middens, campsites, kill sites, tool manufacturing areas, ceremonial complexes, and earthworks. Offshore development as a result of a proposed action could result in an interaction between a drilling rig, platform, pipeline, anchors, or dredging operations and an inundated prehistoric site. Water depths in the proposed lease sale area range from approximately 1,600 to 3,000 m. New pipelines projected as a result of a proposed action would be in <500 m of water. Based on the current acceptable seaward extant of the prehistoric archaeological high probability area for this part of the GOM the extreme water depth precludes the existence of any prehistoric archaeological resources within the proposed lease sale area and projected pipeline corridors.

Proposed Action Analysis

At present, unidentified onshore prehistoric sites would have to be assessed after discovery to determine the uniqueness or significance of the information that they contain. Sites already listed in the National Register of Historic Places and those considered eligible for the Register have already been evaluated as having the potential for making a unique or significant contribution to science. Of the unidentified coastal prehistoric sites that could be impacted by onshore development, some may contain unique information. However, no new onshore infrastructure is projected as a result of a proposed action.

The projected deepening of the Pass Fourchon navigation channel could impact a prehistoric site. Protection of archaeological resources in this case is expected to be accomplished by the required coordination by COE with appropriate State and Federal project review and permitting agencies.

Summary and Conclusion

Since no new onshore infrastructure is projected as a result of a proposed action and no prehistoric sites are located within the proposed lease sale area, a proposed action is not expected to result in impacts to prehistoric archaeological sites.

4.2.1.15. Impacts on Human Resources and Land Use

This proposed action analysis considers the effects of OCS-related, impact-producing activities from a proposed EPA lease sale in relation to the continuing baseline of non-OCS-related factors. Non-OCS factors include fluctuations in workforce, net migration, relative income, oil and gas activity from State waters, wetland loss, and tropical storms. Unexpected events that may influence oil and gas activity within the analysis area but cannot be predicted are not considered in this analysis.

4.2.1.15.1. Land Use and Coastal Infrastructure

Proposed Action Analysis

Chapters 3.3.5.1.2. and 3.3.5.8. discuss land use and OCS-related oil and gas infrastructure associated with the analysis area. The existing oil and gas infrastructure is expected to be sufficient to handle activities associated with a proposed action. The OCS activities from past and future OCS lease sales would continue to occur, and related impacts would continue even in the absence of a proposed action.

Summary and Conclusion

A proposed action in the EPA of its own accord would not require additional coastal infrastructure or alter the current land use of the analysis area.

4.2.1.15.2. Demographics

In this section, MMS projects how and where future demographic changes would occur and whether they correlate with a proposed EPA lease sale. The addition of any new human activity, such as oil and gas development resulting from a proposed action, can affect local communities in a variety of ways. Typically, these effects are in the form of people and money, which can translate into changes in the local social and economic institutions and land use.

Proposed Action Analysis

Population

Population projections related to activities resulting from a proposed action are expressed as total population numbers and as a percentage of the population levels that would be expected if a proposed action did not occur (**Tables 4-22 and 4-23**). **Chapter 3.3.5.4.1.** discusses baseline population projections for the analysis area. Because the baseline projections assume the continuation of existing social, economic, and technological trends, they also include population changes associated with the continuation of current patterns in OCS Program activities. Population impacts from a proposed action mirror the assumptions for employment impacts described in **Chapter 4.2.1.15.3.**, Economic Factors, below. Projected population changes reflect the number of people dependent on income from OCS-related employment for their livelihood, which is based on the ratio of population to employment in the analysis area over the life of a proposed lease sale.

Population associated with a proposed action in the EPA is estimated at 3,950-27,100 persons during the peak years of impact (years 5 and 6) for the low- and the high-case scenarios, respectively. It is during those years of peak population that a substantial amount of platform and pipeline installations are projected in association with a proposed action in the EPA. Platform fabrication and installation, and pipeline installation activities are labor intensive and tend to occur concurrently, therefore, leading to employment and population impacts.

Population impacts from a proposed action in the EPA are expected to be minimal, i.e., less than 1 percent of total population for any coastal subarea. The mix of males to females is expected to remain unchanged. The increase in employment is expected to be met primarily with the existing population and available labor force, with the exception of some in-migration (some of which may be foreign) projected to move into focal areas, such as Port Fourchon, due to the labor supply/demand imbalance for some onshore oil and gas infrastructure industries in these areas (**Chapter 4.1.2.1.**, Coastal Infrastructure).

Age

If a proposed EPA lease sale is held, the age distribution of the analysis area is expected to remain virtually unchanged. Given both the low levels of population growth and industrial expansion associated with a proposed action, the age distribution pattern discussed in **Chapter 3.3.5.4.2.** is expected to continue through the year 2042. Activities relating to a proposed action in the EPA are not expected to affect the analysis area's median age.

Race and Ethnic Composition

The racial distribution of the analysis area is expected to remain virtually unchanged if a proposed action in the EPA is held. Given the low levels of employment and population growth and the industrial expansion projected for a proposed action, the racial distribution pattern described in **Chapter 3.3.5.4.3.** is expected to continue through the year 2042.

Education

Activities relating to a proposed EPA lease sale are not expected to significantly affect the analysis area's educational levels. Given the low levels of employment and population growth and the industrial expansion projected for a proposed action, the analysis area's education status, described in **Chapter 3.3.5.4.4.**, is expected to continue through the year 2042. Activities relating to a proposed action in the EPA are not expected to affect the analysis area's educational attainment.

Summary and Conclusion

Activities relating to a proposed EPA lease sale are expected to minimally affect the analysis area's land use, infrastructure, and demography. These impacts are projected to mirror employment effects that are estimated to be negligible to any one subarea. Baseline patterns and distributions of these factors, as described in **Chapter 3.3.5.**, Human Resources and Land Use, are expected to maintain. Changes in land use throughout the analysis area are expected to be contained and minimal. The OCS-related infrastructure is in place and would not change as a result of a proposed action. Current baseline estimates of population growth for the analysis area show a continuation of growth, but at a slower rate.

4.2.1.15.3. Economic Factors

The importance of the oil and gas industry to the coastal communities of the GOM is significant, particularly in south Louisiana, eastern Texas, and coastal Alabama. Dramatic changes in the level of OCS oil and gas activity over recent years have resulted in parallel fluctuations in population, labor, and employment in the analysis area. The economic analysis for a proposed lease sale in the EPA focuses on the potential direct, indirect, and induced impacts of the OCS oil and gas industry on the population and employment of the counties and parishes in the analysis region defined in **Chapter 3.3.5.1.**, Socioeconomic Analysis Area. To improve regional economic impact assessments and to make them more consistent with each other, MMS developed a new methodology for estimating changes to employment and other economic factors. The methodology developed to quantify these impacts on population and employment takes into account changes in OCS-related employment, along with population impacts resulting from these employment changes within each individual subarea.

The GOM region model has two steps.

(1) Because there are no publicly available models that estimate the expenditures resulting from offshore oil and gas activities, the model first estimates expenditures for 10 scenario activities projected to result from a proposed action in the EPA. These activities include exploratory drilling, development drilling, production operations and maintenance, platform fabrication and installation, pipeline construction, pipeline operations and maintenance, gas processing and storage construction, gas processing and storage operations and maintenance, workovers, and platform removal and abandonment. The model then assigns these expenditures to industrial sectors in the 10 subareas defined in **Chapter 3.3.5.1.**, **Figure 3-10**.

(2) The second step in the model uses multipliers from the commercial input-output model IMPLAN (using 1999 data, the latest available data) to translate these expenditures into direct, indirect, and induced employment and other economic factors. Direct employment results from the first round of industry spending. It is the employment that results from the initial dollars spent by the oil and gas industry on the 10 scenario activities (listed above). Indirect employment results as the initial spending reverberates through the economy. First, the suppliers of the goods and services for the 10 activities spend the initial direct dollars from the industry. Then, these dollars are re-spent by other suppliers until the initial dollars have trickled throughout the economy. Households spending the resulting labor income creates induced employment.

Both the level (the amount spent) and the sectoral (the industry in which it is spent) allocation of expenditures can vary considerably by the phase of OCS activity and by the water depth of the OCS activities. For example, an exploratory well in 0-60 m of water is expected to be drilled using a jack-up rig and to cost about $4 million; whereas, an exploratory well in 800 m or greater water depth is expected to be drilled using a drillship and to cost in excess of $10 million to complete. All activities associated with a proposed action in the EPA are in water depths of 800 m or greater. In addition, spending on materials such as steel would be much higher for platform fabrication and installation than for operations and maintenance once production begins. Therefore, the model estimates and allocates expenditures for the 10 scenario activities. Because local economies vary, a separate set of IMPLAN multipliers is used for each coastal subarea to which expenditures are assigned. Each set of multipliers is based on the actual historical patterns of economic transactions in the area. Model results for employment are presented in the number of jobs per year, where one job is defined as a year of employment. This does not necessarily mean only one person occupies the position through out the year. One job may be equal to two part-time positions occupied over the year or one person occupying a position for 6 months, while another person occupies it for the other 6 months.

The projections in this section are not statements of what would happen but of what might happen, given the assumptions and methodologies used. The projections are business-as-usual trend forecasts, given known technology, technological and demographic trends, and current laws and regulations. Because energy markets are complex, models are simplified representations of energy production and consumption, regulations, and producer and consumer behavior. Projections are highly dependent on the data, methodologies, model structures, and assumptions used in their development. Energy projections are subject to much uncertainty. Many of the events that shape energy markets are random and cannot be anticipated, including severe weather, political disruptions, strikes, and technological breakthroughs. In addition, future developments in technologies, demographics, and resources cannot be foreseen with any degree of certainty. Given this, MMS has endeavored to make these projections as objective, reliable, and useful as possible (USDOE, EIA, 2001b).

Proposed Action Analysis

Total employment projections for activities resulting from a proposed action are expressed as absolute numbers and as a percentage of the employment levels expected if no development occurs (**Tables 4-24 and 4-25**). The baseline projections of population and employment used in this analysis are described in **Chapters 3.3.5.4. and 3.3.5.5.** (**Tables 3-17 through 3-32**). Because these baseline projections assume the continuation of existing social, economic, and technological trends, they also include employment resulting from the continuation of current patterns in OCS Program activities. Population impacts, described in **Chapter 4.2.1.15.2.**, Demographics, (**Tables 4-29 and 4-30**), mirror those assumptions associated with employment. Projected population changes reflect the number of people dependent on income from oil- and gas-related employment for their livelihood. This figure is based on the ratio of population to employment in the impact region over the life of a proposed lease sale.

Based on model results (**Table 4-24**), direct employment associated with a proposed EPA lease sale is estimated at 1,300-9,000 jobs during peak impact years 5 and 6 for the low- and high-case scenarios, respectively. Indirect employment is projected at 450-3,200 jobs, while induced employment is calculated to be 540-3,500 jobs, for the low- and high-case scenarios, respectively. Therefore, total employment resulting from a proposed lease sale in the EPA is not expected to exceed 2,300-15,700 jobs in any given year over a proposed action's 40-year lifetime. Employment associated with a proposed EPA lease sale is projected to peak in years 5 and 6, which are the projected peak years for platform and pipeline installation activities in support of a proposed action. Platform fabrication and installation, and pipeline installation activities are labor intensive and tend to occur concurrently.

Although most of the employment (on an absolute basis) related to a proposed action is expected to occur in coastal Subarea TX-2 (this is due to offshore oil and gas corporate offices headquartered in Houston and the abundant offshore oil and gas infrastructure in this coastal subarea), employment is not expected to exceed 1 percent of the total employment in any given coastal subarea of Texas, Louisiana, Mississippi, or Alabama (**Table 4-25**). On a percentage basis, coastal Subareas LA-1, LA-2, LA-3, and MA-1 (this is due to the vast offshore oil and gas infrastructure in the coastal subareas) are projected to have the greatest employment impact at 0.3 percent each. Considering Florida's current opposition to oil and gas development in offshore waters and the scarcity, if not absence, of onshore supporting service bases, MMS anticipates that very few OCS-related activities would be staged from Florida. Model results concur there would be little to no economic stimulus to the Florida analysis region as a result of a proposed action in the EPA.

Summary and Conclusion

Should a proposed EPA lease sale occur, there would be only minor economic changes in the Texas, Louisiana, Mississippi, and Alabama coastal subareas. A proposed action is expected to generate less than a 1 percent increase in employment in any of these subareas. This demand would be met primarily with the existing population and available labor force. There would be very little to no economic stimulus in the Florida subareas.

4.2.1.15.4. Environmental Justice

The analysis of environmental justice concerns is divided into those related to routine operations (below) and those related to oil spills (**Chapter 4.4.14.4.**). Concerns related to routine operations center on increases in onshore activity (such as employment, migration, commuter traffic, and truck traffic) and on additions to the infrastructure supporting this activity (such as fabrication yards, supply ports, and onshore disposal sites for offshore waste). **Chapter 3.3.5.8.** describes the widespread presence of an extensive OCS support system and associated labor force, as well as economic factors related to OCS activities.

Proposed Action Analysis

Environmental justice issues involve questions of disproportionate and negative effects on minority and low-income populations. A proposed action is expected to increase slightly employment opportunities in a wide range of businesses along the Gulf Coast. These conditions preclude a prediction of where much of this employment would occur or who would be hired. **Figures 3-14 and 3-15** provide distributions of census tracts of high concentrations of minority groups and low-income households. As stated in **Chapter 3.3.5.4.**, Demographics, pockets of concentrations of these populations are scattered throughout the GOM coastal counties and parishes. Many of these populations are in large urban areas where the complexity and dynamism of the economy and labor force preclude a measurable effect. Low-income populations are almost exclusively minority and urban. Because the distribution of low-income and minority populations does not parallel the distribution of industry activity, effects of a proposed action are not expected to be disproportionate.

The widespread economic effects of a proposed action on minority and low-income populations are not expected to be negative. Ongoing MMS research includes gathering information on race and employment. Offshore workers in the production sector are almost entirely male and white (Rosenberg, personal communication, 2001). Other sectors, such as the fabrication industry and support industries (e.g., trucking), employ minority workers and provide jobs across a wide range of pay levels and educational/skill requirements (Austin et al., 2002a and b; Donato et al., 1998). A study of oil industry trends between 1980 and 1990 found that downsizing was concentrated in the production sector; therefore, it affected white male employment more than that of women or minorities (Singelmann, in preparation). Evidence also suggests that a healthy offshore petroleum industry also indirectly benefits low-income and minority populations. One MMS study in Louisiana found income inequality decreased during the oil boom and increased with the decline (Tolbert, 2001). Another MMS-funded study found that reemployment rates for poorly educated black and white women laid off in the closing of an OCS-related plant in one rural town were much higher than reemployment rates related to similar closings elsewhere because Louisiana's oil industry had created a complex local economy (Tobin, 2001). While a proposed action would provide little additional employment, it would have the effect of maintaining current activity levels, which is expected to be beneficial to low-income and minority populations.

Environmental justice often concerns the possible siting of infrastructure in places that would have disproportionate and negative effects on minority and low-income populations. Since a proposed action would help to maintain ongoing levels of activity rather than expand them, no one proposed lease sale would generate significant new infrastructure demand. For this reason, this EIS considers infrastructure projections only for the cumulative analysis (**Chapter 4.4.14.4.**). The cumulative analysis concludes that, as with the analysis of employment effects of a proposed action, infrastructure effects are expected to be widely and thinly distributed. Since the siting of new infrastructure would reflect the distribution of the petroleum industry and not that of minority and low-income populations, OCS activity is not expected to disproportionately effect these populations. Lafourche Parish is identified as a location of concentrated effects. Each OCS-related facility constructed onshore must first receive approval by the relevant Federal, State, county or parish, and community involved. MMS assumes that new construction would be approved only if consistent with appropriate land-use plans, zoning regulations, and other State/regional/local regulatory mechanisms.

Because of Louisiana's extensive oil-related support system (**Chapter 3.3.5.8.**, OCS-Related Coastal Infrastructure), that State is likely to experience more employment effects related to a proposed action than are the other coastal states. This is confirmed in the economic factors section (**Chapter 4.2.1.15.3.**). Lafourche Parish, Louisiana, is likely to experience a large concentration and is the only parish where additional OCS-related activities and employment are sufficiently concentrated enough to increase stress to its infrastructure. However, effects of a proposed action are not expected to be significant in the long term.

The concentrated socioeconomic impacts in Lafourche Parish are not expected to have disproportionate effects on minority and low-income populations for several reasons. The parish is not predominately minority or low income (**Figures 3-14 and 3-15**). The Houma, a Native American tribe recognized by the State of Louisiana, has been identified by MMS as a possible environmental justice concern. The MMS is currently funding a study focused on Lafourche Parish and the Houma. Available information indicates that the Houma are not expected to be disproportionately affected because they are not residentially segregated but, rather, live interspersed among the non-minority population (Fischer, 1970).

Two local infrastructure issues described in **Chapter 3.3.5.2.**, How OCS Development Has Affected the Analysis Area, could possibly have related environmental justice concerns: traffic on LA 1 and the Port Fourchon expansion. Neither, however, are expected to disproportionately affect minority or low-income populations. Increased traffic may have health risks (e.g., increased accident rates). However, as described in **Chapter 3.3.5.1.**, Socioeconomic Analysis Area, human settlement patterns in the area (on high ground along LA 1 and Bayou Lafourche) mean that rich and low-income alike would be affected by any increased traffic. Port Fourchon is relatively new and is surrounded by mostly uninhabited land. Existing residential areas close to the port are also new and not considered low-income areas. Any expansion of infrastructure at Port Fourchon is not expected to disproportionately affect minority or low-income populations. Lafourche Parish is an area of relatively low unemployment because of the concentration of petroleum-related industry in the area (Hughes, 2002). While the minority and low-income populations of Lafourche Parish would share with the rest of the parish population any negative impacts related to a proposed action, most effects related to a proposed action would be economic and positive.

Summary and Conclusion

Because of the existing extensive and widespread support system for OCS-related industry and associated labor force, the effects of a proposed action are expected to be widely distributed and little felt. In general, who would be hired and where new infrastructure might be located is impossible to predict. Impacts related to a proposed action are expected to be economic and have a limited but positive effect on low-income and minority populations. Given the existing distribution of the industry and the limited concentrations of minority and low-income peoples, a proposed action is not expected to have a disproportionate effect on these populations.

Lafourche Parish would experience the most concentrated effects of a proposed action; however, because the Parish is not heavily low-income or minority, because the Houma are not residentially segregated, and because the effects of road traffic and port expansion would not occur in areas of low-income or minority concentration, these groups would not be differentially affected. In general, the effects in Lafourche Parish are expected to be mostly economic and positive. A proposed action would help to maintain ongoing levels of activity rather than expand them.

4.2.2. Alternative B – No Action

Description of the Alternative

Alternative B is equivalent to cancellation of a lease sale scheduled for a specific period in the proposed *Outer Continental Shelf Oil and Gas Leasing Program: 2002-2007.* By canceling a proposed lease sale, the opportunity is postponed or foregone for development of the estimated 0.065-0.085 BBO and 0.265-0.340 Tcf of gas. Any potential environmental impacts resulting from a proposed sale (**Chapter 4.2.1.**, Alternative A – The Proposed Actions) would not occur or would be postponed.

Effects of the Alternative

Under Alternative B, the U.S. Dept. of the Interior cancels a planned Eastern GOM lease sale. Therefore, the oil expected from a lease sale would remain undiscovered and undeveloped. The environmental effects of Alternative A (proposed action) also would not occur. Other sources of energy would need to substitute for the lost production. Principal substitutes would be additional imports, conservation, additional domestic production, and switching to other fuels. These alternatives, except conservation, have significant negative environmental impacts of their own.

This section briefly discusses the most likely alternative sources, the quantities expected to be needed, and the environmental impacts associated with the alternatives. The discussion is based on material from the following MMS publications: *Final Outer Continental Shelf Oil and Gas Leasing Program: 2002-2007, Decision Document* (USDOI, MMS, 2002a); *Outer Continental Shelf Oil and Gas Leasing Program: 2002-2007, Final Environmental Impact Statement* (USDOI, MMS, 2002b); and *Energy Alternatives and the Environment* (USDOI, MMS, 2001d). These sources are incorporated into this document by reference.

Most Important Substitutes for Production Lost through No Lease Sale

Energy Alternatives and the Environment discusses a long list of potential alternatives to natural gas and oil. However, most substitutes for the natural gas and oil from the lease sale would come from four sources:

- additional imports;
- conservation;
- additional domestic production; and
- fuel switching.

Additional domestic production and imports would augment supply, while conservation and switching to alternative fuels shift demand downward. The table below shows the percentage and range of quantities expected to be needed to substitute for the lost natural gas and oil production. The quantities for conservation and fuel switching are in equivalent energy units.

Substitutes for Natural Gas and Oil Lost Because of No Lease Sale

Source	Percent of Lost Oil Production	Range of Oil Quantity (MMbbl)	Percent of Lost Gas Production	Range of Gas Quantity (Bcf)
Imports	86-88%	56-75	16%	42-54
Conservation	6-7%	5	16-17%	45-54
Additional Domestic Production	3%	2-3	26-28%	69-95
Fuel Switching	4-5%	3	40-42%	111-136
Total Production Lost through No Sale	100%	65-85	100%	265-340

Notes: Bcf – billion cubic feet.
MMbbl – million barrels.

Environmental Impacts from the Most Important Substitutes

Additional Imports: Significant environmental impacts from an increase in oil imports include the following:

- generation of greenhouse gases and air pollutants from both transport and dockside activities (emissions of NO_x, SO_x, and VOC's have an impact on acid rain, tropospheric ozone formation, and stratospheric ozone depletion);
- degradation of water quality from oil spills related to accidental discharges or tanker casualties;
- oil-spill contact with flora, fauna, or recreational and scenic land and water areas; and
- increasing public concern about tanker spills.

Imported oil may also impose negative environmental impacts in producing countries and in countries along trade routes. Additional imports of natural gas would require construction of new pipelines from the most likely sources—Canada and Mexico. Pipeline construction can disrupt wildlife habitat, lead to increased erosion, and add to the siltation of streams and rivers.

Conservation: Conservation is composed of two major components:

- substituting energy-saving technology, often embodied in new capital equipment, for energy resources (e.g., adding to home insulation); and
- consuming less of an energy-using service (e.g., turning down the thermostat in an office during the winter).

Consuming less of an energy service is positive from an environmental perspective. Substituting energy-saving technology would tend to result in positive net gains to the environment. The amount of gain would depend on the extent of negative impacts from capital equipment fabrication.

Additional Domestic Production: Onshore oil and gas production has notable negative impacts on surface water, groundwater, and wildlife. It can also cause negative impacts on soils, air pollution, vegetation, noise, and odor. Offshore oil and gas production imposes the risk of oil spills affecting water quality, localized degradation of air quality, potential impacts on coastal wetlands dependent wildlife, and shoreline erosion from additional supply boat traffic. Offshore activities may also have negative impacts on social, cultural, and economic measures such as recreation.

Fuel Switching: The most likely substitutes for natural gas are oil, which would further increase imports, and coal for use in electricity generation. Coal mining causes severe damage to land and wildlife habitat. It also is a major contributor to water quality deterioration through acid drainage and siltation. Alternative transportation fuels may constitute part of the oil substitution mix. The mix depends on future technical and economic advances. No single alternative fuel appears to have an advantage at this time. Every fuel alternative imposes its own negative environmental effects.

Other Substitutes

Government could also impose other substitutes for natural gas and oil. The most likely sectors to target would be transportation, electricity generation, or various chemical processes. *Energy Alternatives and the Environment* discusses many of the alternatives at a level of detail impossible here.

Summary and Conclusion

Canceling a lease sale would eliminate the effects described for Alternative A (**Chapter 4.2.1.**). Other sources of energy would substitute for the lost production. Principal substitutes would be additional imports, conservation, additional domestic production, and switching to other fuels. These alternatives, except conservation, have significant negative environmental impacts of their own.

4.3. Impact-Producing Factors and Scenario – Accidental Events

The NEPA requires Federal agencies to consider potential environmental impacts (direct, indirect, and cumulative) of proposed actions as part of agency planning and decisionmaking. The NEPA analyses address many issues relating to potential impacts, including issues that may have a very low probability of occurrence, but which the public considers important or for which the environmental consequences could be significant.

The past several decades of data show that accidental spills ≥1,000 bbl associated with oil and gas exploration and development are low probability events in Federal OCS waters of the GOM.

This section describes accidental events associated with a proposed action, the Gulfwide OCS Program, and non-OCS activities that could potentially affect the biological, physical, and socioeconomic resources of the GOM. These include oil spills, blowouts, vessel collisions, and spills of chemicals or drilling fluids.

4.3.1. Oil Spills

4.3.1.1. Background

This section provides information and data for the following: (1) spills that have occurred from OCS operations and non-OCS operations; (2) estimated rates of oil spill occurrences, based on analysis of past spills; (3) projections of oil spills from OCS future operations and from other potential sources in the GOM area; (4) known OCS oil characteristics; (5) MMS spill prevention and spill preparedness and response plan requirements; and (6) industry capabilities to respond to spill incidents.

OCS spills are spills to U.S. waters from operations occurring due to oil and gas extraction activities that are a result of an OCS lease sale. They include spills that occur at offshore oil or gas development sites; spills that occur along routes used to transport oil and gas, services, and products back and forth from coastal support bases to offshore development sites; and spills that occur at onshore or coastal