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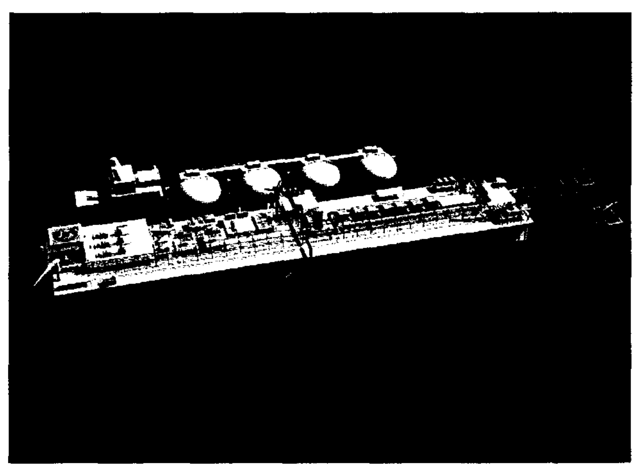
Section 3
Affected Environment

USCG-2004-16860-31



3. Affected Environment

3.1 Water Quality

3.1.1 Definition of the Resource

For the purposes of this document, water quality is the ability of a waterbody to maintain the ecosystems it supports or influences. In the case of coastal and marine environments, the water quality is influenced by river drainage (including sediments), and wet (e.g., precipitation) and dry (e.g., dust) atmospheric deposition. The natural aquatic processes of mixing and circulation can either improve the water quality through flushing, or contribute to the decline in water quality. Besides these natural inputs, human activities can affect water quality through dredging, runoff, burning, dumping, discharging, air emissions, and oil or chemical spills.

Evaluation of water quality is done by direct measurement of factors that are considered important to the health of an ecosystem. The primary factors influencing coastal and marine environments are temperature, salinity, dissolved oxygen (DO), nutrients, pH, contaminants, and turbidity or the load of suspended matter. Trace constituents such as metals and organic compounds also affect water quality. Altering the ecosystem through changes in any of these water quality parameters would affect the biological resources and associated habitat and could result in the population reduction of specific species, support of undesirable or exotic species, and possibly mass mortality. Such effects can either be localized or widespread.

The region under consideration is divided into coastal and marine waters. Coastal waters include the bays and estuaries along southwestern Louisiana shores in the vicinity of Cameron, Louisiana and marked inland navigation fairways. Marine waters, as defined in this document, include offshore outer continental shelf waters in the vicinity of the proposed Port site (WC-213) and the Alternate Site (WC-183).

3.1.2 Coastal Waters

While the proposed Terminal would not be in coastal waters, the support vessels would be based at an existing facility in Cameron, Louisiana. Proposed Port support operations would include activities that would traverse coastal and intracoastal waters. The following discussion is presented due to the proposed support vessels operating in proximity to an estuary. Estuaries represent a transition zone between the fresh water of rivers and the higher salinity waters offshore. These bodies of water are influenced by fresh water and sediment influx from rivers, and the tidal actions of the oceans. The primary variables that influence coastal water quality are water temperature, total dissolved solids (salinity), suspended solids (turbidity), and nutrients. An estuary's salinity and temperature structure are determined by hydrodynamic mechanisms including tides, nearshore circulation, freshwater discharge from rivers, evaporation, and local precipitation.

Estuaries provide habitat for plants, animals, and humans. Wetlands, such as emergent marshes, mangrove swamps, and seagrass beds surround the Gulf Coast estuaries, providing food and shelter for shorebirds, migratory waterfowl, fish, invertebrates (e.g., shrimp, crab, and oysters), reptiles, and mammals. Estuarine-dependent species constitute more than 75 percent of the commercial fishery harvests from the GOM (NOAA 1990).

Estuarine ecosystems are affected by humans, primarily via upstream withdrawals of water for agricultural, industrial, and domestic purposes; contamination by industrial and sewage discharges and agricultural runoff carrying pesticides and herbicides; and habitat alterations (e.g., construction and dredge and fill operations). Drainage from more than 40 percent of the contiguous United States enters the GOM, primarily from the Mississippi River approximately 370 km (230 mi) east of the Proposed Port. Texas, Louisiana, and Alabama, ranked first, second, and fourth in the Nation, respectively, for greatest discharges of toxic chemicals in 1995 (USEPA 1999). The GOM region ranks highest of all coastal regions in the United States in the number of wastewater treatment plants (1,300), number of industrial point sources (2,000), percent of land use devoted to agriculture (31 percent), and application of fertilizer to agricultural lands (62,000 tons of phosphorus and 758,000 tons of nitrogen) (NOAA 1990).

In 1999, USEPA assessed the ecological condition of GOM estuaries. The assessment describes the general ecology and summarizes the "health" of all Gulf estuarine systems. The Vermilion/Atchafalaya/Cote Blanche estuarine system (a large estuarine system that opens into the GOM) was considered to be in only fair to moderate condition in the early 1990s due primarily to wetland loss, sediment contaminants, high turbidity, excessive concentrations of nutrients, and a high level of degraded benthos (USEPA 1999). With more than 1,821 square kilometers (km^2) (703 square miles [mi^2]), the waters of this estuarine system average 2.0 m (6.6 ft) deep with a salinity of 1 practical salinity unit (psu); 100 percent of the estuarine complex has high nutrient concentrations and 23 percent is covered with contaminated sediments (USEPA 1999).

3.1.3 Marine Waters

The proposed Terminal and pipelines would be in the marine waters of the nearshore GOM. While the various parameters measured to evaluate water quality vary in marine waters, one parameter—pH—does not. The buffering capacity of the marine environment is controlled by carbonate and bicarbonate, which maintain a pH of 8.2 (MMS 2002a). Factors such as currents and severe weather events also affect water quality, but in a manner often more difficult to measure. The following description details the physical environment of the marine waters in the vicinity of the proposed Port, including the shallower waters lying over the continental shelf as well as those deeper waters farther offshore.

3.1.3.1 Continental Shelf West of the Mississippi River

The proposed Terminal would be located 61 km (38 mi) south of the Louisiana coast in GOM waters that are approximately 16.8 m (55 ft) deep (see Figure 3-1). The five proposed pipelines have a total cumulative length of approximately 105.7 km (65.7 mi) and would be designed to connect the Terminal to the existing natural gas pipeline infrastructure. The proposed pipelines would be buried in the continental shelf sea floor in waters ranging in depth from 12.19 to 18.29 m (40 to 60 ft).

The proposed Terminal would be located in the continental shelf waters west of the Mississippi River. The continental shelf is the seaward extension of the continental plate. A gentle incline or gradient (< 1:1,000), low relief (< 20 m [65 ft]), or widths of about 100 km (62 mi), and water depths of 130 m (427 ft) on average, worldwide, distinguish the continental shelf (Kennett 1982, Eisma 1988). The width of the continental shelf in the GOM is highly variable, ranging from less than 20 km (12 mi) to more than 200 km (124 mi). The depth at which the shelf break (the change in gradient that marks the transition between the continental shelf and continental slope provinces) occurs in the GOM from 10 to 200 m (33 to 656 ft) of water depth (Roberts et al. 1999). In the area of interest, the shelf break occurs at approximately 120 m (394 ft).

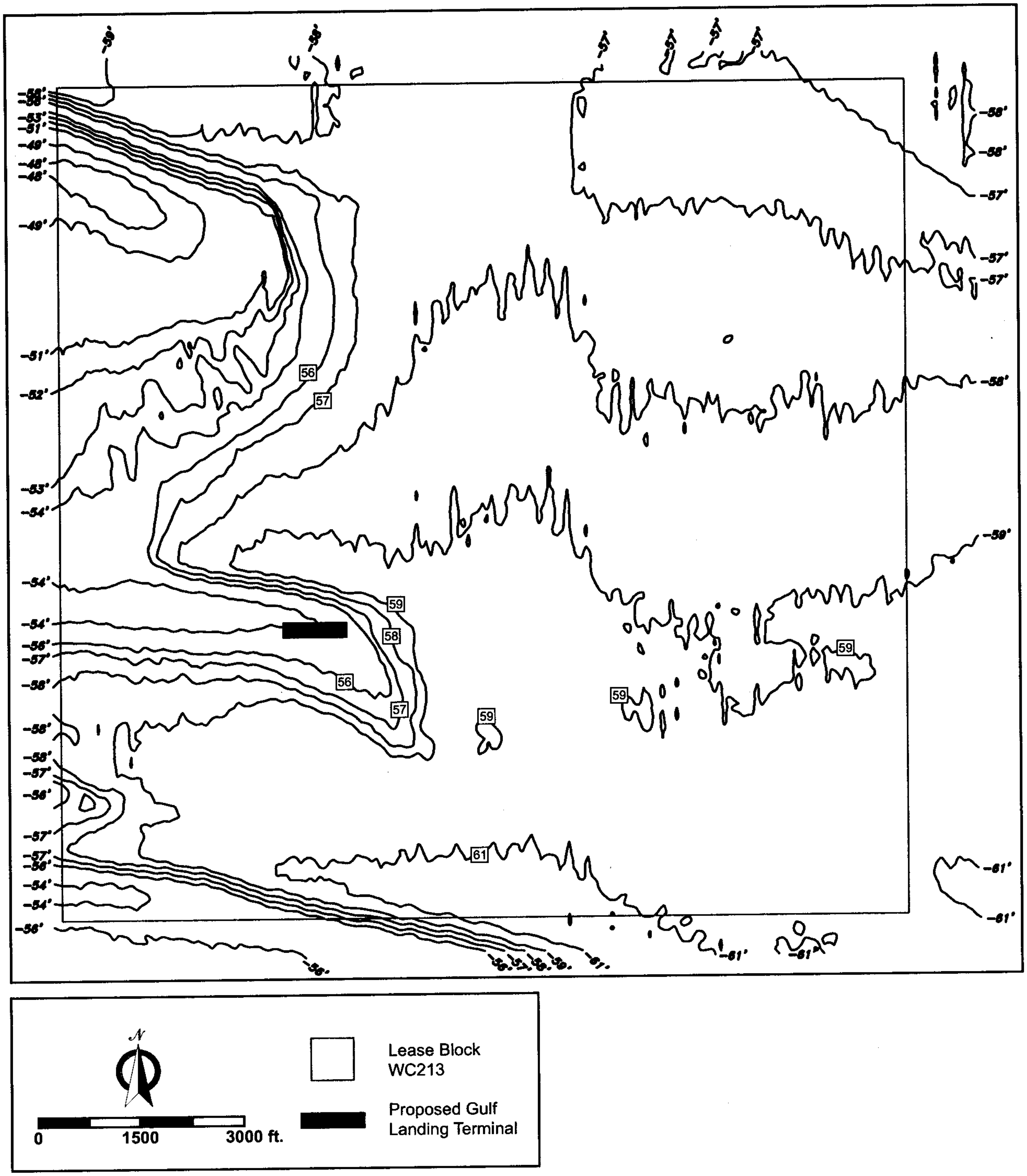


Figure 3-1. Bathymetry of West Cameron Block 213

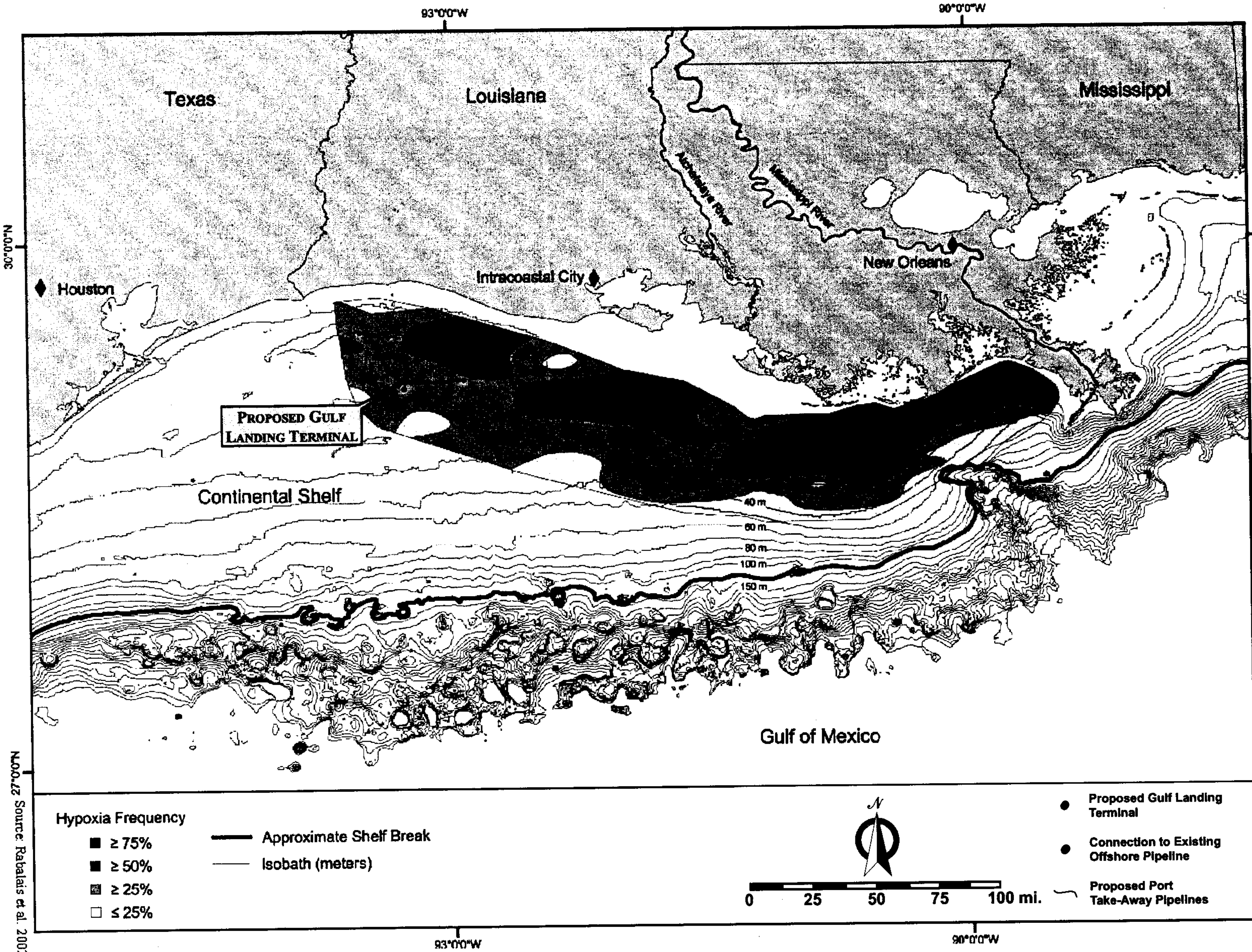
Fresh water, sediments, and pollutants flow onto the continental shelf of western Louisiana from the Mississippi and Atchafalaya Rivers (Murray 1997). These rivers add a tremendous volume of fresh water to the GOM, draining more than 40 percent of the contiguous United States; the Mississippi River system has the seventh largest riverine discharge in the world (Meade 1995). While the average river discharge from the Mississippi River exceeds the output of all other rivers along the Texas-Louisiana coast by a factor of 10, during low-flow periods the Mississippi River can have a flow less than all the other rivers combined (Nowlin et al. 1998a). Urban and agricultural discharge into the northern GOM contribute high concentrations of nutrients, pesticides, and fecal coliform bacteria; waste and runoff from 75 percent of U.S. farms and 80 percent of U.S. cropland are discharged into the GOM via the Mississippi River system (MMS 1998).

Late spring and early summer bring calm waters to the GOM and an environmental phenomenon termed the "dead zone" for the lack of fish, shrimp, and crab found in this extensive area during the summer harvesting season (Rabalais 2002). The dead zone, a zone of hypoxia, is presented in Figure 3-2. It is defined as an area with an oxygen concentration of less than 2 mg/L. The dead zone on the Louisiana-Texas shelf is one of the largest areas of low oxygen in the world's coastal waters (Murray 1997). This hypoxic area, was estimated at 22,000 km^2 (8,495 mi^2) in summer 2002. The hypoxic area stretches from the Mississippi River Delta westward along the Texas continental shelf to Freeport, Texas. Bottom waters in the vicinity of the proposed Terminal site have been hypoxic during the midsummer for at least 50 percent of the period from 1985 through 2001 (Rabalais et al. 2002).

Two sets of circumstances cause the hypoxic zone: the lack of wind to churn the water and excess amounts of nitrogen in the water. During summer months, the less dense fresh water from the Mississippi River system spreads over the continental shelf, resulting in a stratified water column. When stratification occurs, the lower saltwater layer becomes cut off from the resupply of oxygen from the fresh surface waters. While surface oxygen concentrations are at or near saturation, hypoxia is observed in bottom waters of the continental shelf during the summer months (see Figure 3-2). The oxygen-depleted bottom waters occur seasonally and are affected by the timing of the Mississippi River and Atchafalaya River discharges that carry nutrients to the surface waters. Mineral nutrients, especially dissolved inorganic nitrogen, encourage the growth of algae. Some of the algae die; others are consumed by aquatic organisms that generate large amounts of fecal matter. This abundance of organic waste sinks to the saltier depths where it decomposes, using what remains of the available oxygen and creating a hypoxic zone. This condition persists until autumn winds return to stir the waters of the GOM (NCAT 1999).

In months with little freshwater input from the Mississippi River system, fall through winter, salinities along the coast range from 29 to 32 psu (MMS 1998). During the spring and summer when the volume of fresh water discharged from the Mississippi River and other rivers is high, a strong salinity gradient forms, resulting in salinities typically less than 20 psu in continental shelf waters (MMS 1998). Sea surface temperature has been measured by NOAA Buoy No. 42035 for a period of 8.5 years. The buoy is in 15 m (49 ft) of water and is about 120 km (74.6 mi) west of the proposed Terminal location. At this location, the mean annual sea floor temperature ranges from 12.3 °C to 30.2 °C (54.1 °F to 86.4 °F). The sea surface has a mean annual range of 8.6 °C to 36.0 °C (47.5 °F to 96.8 °F) (GL 2003a).

A turbid surface layer of suspended particles is associated with the freshwater river plume. The naturally occurring nepheloid layer, composed of suspended clay material from the underlying sediment, is always present on the continental shelf (MMS 2002a). This near-bottom layer of turbid water has greatly elevated levels of suspended material (greater than 1 ppm). This layer can range from less than 1 meter to several meters thick. The nepheloid layer is separated from the overlying water by a sharp discontinuity in suspended particulate matter. Nepheloid layers might contribute to the transport of materials, including



Source: Rabalais et al. 2002

Figure 3-2. Midsummer Distribution of Bottom-Water Hypoxia off Louisiana and the Frequency (%) of Hypoxic Occurence from 1985–2001

contaminants, from nearshore to offshore areas (MMS 2002a). In addition to suspended matter, the Mississippi River discharge supplies nutrients such as nitrate, phosphate, and silicate to the shelf.

The Louisiana-Texas Shelf Physical Oceanography Program (LATEX) is a six-year oceanographic research initiative that has as its principal objective the identification of key dynamical processes governing the circulation, transport, and cross-shelf mixing of the waters on the Texas-Louisiana shelf. Sponsored by MMS of the Department of the Interior, LATEX is one of the largest shelf physical oceanography research project ever undertaken. Seawater compositon data for surface (0–5 m) (0–16 ft), mid-depth (greater than 5–10 m [16–33 ft]), and near-bottom (greater than 10 m [33 ft]) were collected from two locations, LATEX Sites 18 and 20. LATEX Site 18 (28.96° N, 91.98° W) has a depth of 20 m (65 ft) and is about 110 km (68 mi) east from the proposed Terminal. LATEX Site 20 (29.26° N, 94.06° W) has a depth of 15 m (49 ft) and is approximately 90 km (56 mi) west from the proposed Terminal. The data are presented in Table 3-1.

Table 3-1. Mean Seawater Composition at Three Depths at LATEX Sites 18 and 20

LATEX Site No.	Depth	Dissolved Oxygen (ml/L)	Ammonium (µmol/L)	Suspended Solids (mg/L)	Salinity (psu)	Conductivity
18	surface	5.120	0.572	2.850	30.192	4.57
18	mid-depth	4.771	0.93	1.97	32.4545	4.71
18	near-bottom	3.37	1.7233	3.0933	33.6966	4.81
20	surface	5.149375	0.72	1.843	29.9597937	4.47
20	mid-depth	4.735882	0.71235294	no samples collected	31.0339	4.65
20	near-bottom	3.9275	1.53166666	2.24625	32.4410083	4.81

Source: GL 2003a

Notes: ml/L – milliliters per liter
mg/L – milligrams per liter
µmol/L –micromole per liter
psu – practical salinity unit

Continental shelf waters off the coast of Louisiana are contaminated with trace organic pollutants including polynuclear aromatic hydrocarbons (PAHs), herbicides, chlorinated pesticides, and polychlorinated biphenyls (PCBs); and trace inorganic (metals) pollutants, largely from riverine discharge. Higher concentrations of pollutants have generally been found in marine organisms from the Mississippi Delta rather than in offshore biota (Kennicutt et al. 1988). The highest levels of hydrocarbons occur at point sources near the coast or natural seeps; areas off northern Texas, Louisiana, and Alabama show detectable levels of petroleum hydrocarbons, likely from natural seepage (Kennicutt et al. 1988). Mercury was detected in 70 of 516 water samples taken between 1994 and 2000 from Louisiana surface waters and the GOM; the concentration rarely exceeded 0.1 parts per billion (ppb) (LDEQ 2000). Nearshore average concentrations for a limited number of samples in the Mississippi River plume for cadmium (0.02 ppb), copper (0.5 ppb), and nickel (0.5 ppm) were higher than offshore concentrations, as expected (MMS 2001). The metals (arsenic, barium, cadmium, copper, iron, lead, mercury, manganese, nickel, and zinc) concentrations in the GOM waters were below 10 ppm. Total dissolved solids in the GOM were 7,000 ppm (GL 2003a).

3.1.4 Deepwater

Limited information is available on the deepwater environment. Gulf water at depths greater than 1,400 m (4,593 ft) is relatively homogeneous with respect to temperature, salinity, and oxygen (Nowlin 1972; Pequegnat 1983; Gallaway et al. 1988). Of importance, however, is the flushing time of the GOM. Oxygen in the deepwater Gulf originates in surface waters and must be mixed into the deep water by some mechanism. If the replenishment of the water occurs over a long period of time, the addition of hydrocarbons from natural seeps as well as oil and gas activities could lead to low oxygen and potentially hypoxic conditions in the deep water of the GOM. The time scales and mechanism for maintaining the high oxygen levels in the deepwater Gulf are unknown.

Limited analyses of trace metals and hydrocarbons for the water column and sediments exist (Trefry 1981; Gallaway et al. 1988). Hydrocarbon seeps are extensive throughout the continental slope and contribute hydrocarbons to the surface sediments and water column, especially in the central GOM (Sassen et al. 1993a, 1993b). MacDonald et al. (1993) observed 63 individual seeps using remote sensing and submarine observations. Estimates of the total volume of seeping oil vary widely from 21,848,739 gal per year (29,000 barrels [bbl] per year) (MacDonald 1998) to 16.38 gal per year (520,000 bbl per year) (Mitchell et al. 1999). In addition to hydrocarbon seeps, other fluids leak from the underlying sediments into the bottom water along the continental slope. These fluids have been identified from three sources: (1) sea water trapped during the settling of sediments, (2) dissolution of underlying salt diapirs (salt domes), and (3) deep-seated formation waters (Fu and Aharon 1998; Aharon et al. 2001). The first two fluids are the source of authigenic (formed *in situ*) carbonate deposits, while the third is rich in barium and is the source of barite deposits such as chimneys.

3.1.4.1 Waves and Circulation

Circulation patterns of the GOM are presented in Figure 3-3. The Loop Current is the dominant circulation feature in the GOM, enters through the Yucatán Channel and exits through the Florida Straits as the Florida Current. This clockwise (anticyclonically) flowing current forms a large loop before its waters exit the GOM. The position of the Gulf Stream is temporally variable; the Loop Current might turn suddenly to the east, while at other times it penetrates northwestward to the Louisiana-Florida continental shelf (Paluszkiewicz et al. 1983). Its northward penetration into the GOM occurs on a nearly annual cycle, but the amplitude might vary (Maul and Vukovich 1993).

Closed rings of clockwise-rotating water, called eddies, separate periodically from the Loop Current. The average diameter of warm-core eddies is about 200 km (124 mi) but rings as large as 400 km (248.5 mi) in diameter have been observed (Elliot 1982). Typically, these warm-core rings slowly move westward into the western GOM or west-southwest into the southwestern GOM. They generally move at speeds of 5 centimeters per second (cm/s) (0.16 ft/s) and dissipate or "die" as they collide with the continental shelf in the western GOM (Wiseman and Sturges 1999). These large oceanographic features transport great quantities of heat, salt, and water into the western GOM as they move. Their temperature is usually so much greater than the surrounding water that they can easily be detected by differences in sea surface temperature, except in late spring through early fall when the surface temperatures in the GOM are nearly uniform (Elliot 1982; Biggs 1992). Warm-core rings can sustain their physical properties for long periods of time (1 year or longer) and are shed from the Loop Current at a highly variable rate of approximately one eddy every 6 to 17 months, with an average period of 10 to 11 months (Maul and Vukovich 1993). As the warm-core rings or eddies move into the western GOM and interact with the continental margin (the transition to the ocean base), secondary smaller-scale, cold-core rings might be generated. Occasionally, a warm-core ring will move into the northeastern GOM, but this pathway is rare; a warm-core ring was documented in this area of the GOM from May through July of 1998 (Müller-Karger 2000).

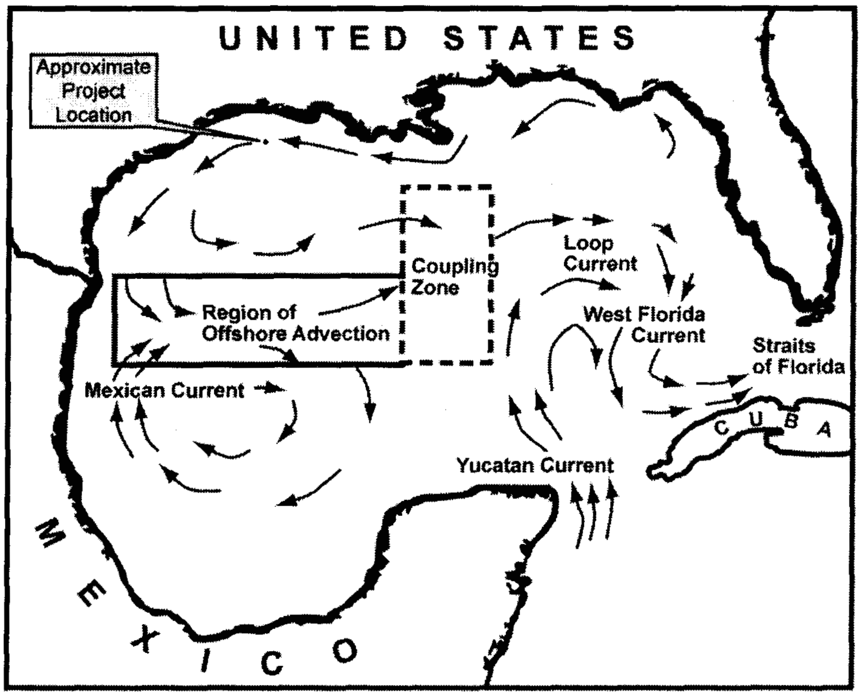


Figure 3-3. Circulation of the Gulf of Mexico

The net result is that at almost any given time, the GOM is populated with numerous eddies that interact with one another and with the margins.

Circulation in continental shelf waters is more complicated than in deeper waters, as shallower waters are more affected by wind and waves. In the proposed Terminal vicinity, surface circulation is primarily wind-driven and shows a strong correlation between wind stress and longshore currents. This relationship results in the Louisiana shelf water flowing primarily in a west-to-southwestern direction for much of the year. Surface flow reversal occurs during midsummer when weak southerly and southwesterly winds blow along the Louisiana coast (Cochrane and Kelly 1986).

The LATEX study refined the understanding of the circulation on the shelf of the northwestern GOM by revealing that mean currents were downcoast over the inner shelf and upcoast over the outer shelf (Nowlin et al. 1998a). The results of the LATEX study indicated that currents over the inner shelf reflect a downcoast flow during non-summer months (September through May) and an upcoast flow during summer months. Over the outer shelf, there is no systematic, general pattern to the annual signal although near surface flow during the summer was generally upcoast. Currents over the inner shelf are largely forced by wind stress (GL 2003a). Current velocities on the Louisiana continental shelf also vary seasonally and are often influenced by weather events, such as the passage of atmospheric fronts. Current measurements from two sites (LATEX Sites 18 and 21) are representative of currents near the proposed Terminal locations. Table 3-2 lists the mean and maximum current velocities for the two sites. These high-velocity rotary currents or gyres exist in the upper layers of the water column throughout the continental shelf waters of Texas and Louisiana (MMS 2001).

Severe wind conditions including gales, squalls, and hurricanes occur in the region of the proposed Terminal. The most severe wind conditions occur during winter storms and hurricanes. Such wind events can result in extreme waves and currents with a velocity of 100 to 150 cm/s (3.2 to 4.9 ft/s) over the continental shelf. Cold fronts and the subsequent wave conditions affect near-surface water temperatures, although water at depths greater than about 100 m (328 ft) remains unaffected by surface boundary heat flux. The predominate wind directions at the proposed Terminal are from the east and south (more than 70 percent of the time). The wind direction is between south and southeast 40 percent of the time. The remaining 30 percent of the time, the wind direction is scattered between south and northeast.

Table 3-2. Mean and Maximum Current Velocities in the Vicinity of the Proposed Terminal Location from 1992 through 1994

Location and Depth Below Surface	Summer (July through August)		Nonsummer (September through June)	
	Mean Velocity (ft/s)	Maximum Velocity (ft/s)	Mean Velocity (ft/s)	Maximum Velocity (ft/s)
East (LATEX Site 18, 28.963° N, 91.983° W)				
26 feet	0.35	1.57	0.19	1.67
62 feet	0.07	0.75	0.06	1.13
West (LATEX Site 21, 28.837° N, 94.08° W)				
46 feet	0.17	1.15	0.23	1.33
72 feet	0.14	0.95	0.12	0.97

Source: Nowlin et al. 1998b

3.2 Biological Resources

3.2.1 Definition of the Resource

Biological resources include those species and habitats that occur within the region of influence (ROI). The ROI for biological assessment of the proposed Port includes the area that could be directly or indirectly affected by construction or operation of the proposed Terminal and the five proposed take-away pipelines, approximately 61 km (38 mi) south of the Louisiana coast within WC-213 (Figure 2-1). The ROI for the proposed Port also includes support-vehicle operating areas. Support vehicles such as tugs, supply vessels, and helicopters would operate from existing facilities in Cameron, Louisiana. Support-vessel operating areas would be defined by existing channel and navigation requirements. Helicopter flight paths would be managed by all applicable and appropriate FAA and flight safety guidelines.

The parameters used to define the ROI for the proposed Port are also used to define the ROI for the alternative terminal site location within WC-183 (Figure 2-9). The alternative terminal would be approximately 13 km (8 mi) north of the preferred site and approximately 48 km (30 mi) south of the Louisiana coast.

Biological resources evaluated for this assessment include protected and sensitive habitats, wetlands, marine mammals, sea turtles, migratory birds, and fisheries resources. Fisheries resources include fish, ichthyoplankton (fish eggs and larvae), EFH, and federally managed commercial and recreational fisheries. Water depth at the proposed Terminal location WC-213 is approximately 16.8 m (55 ft). Water depth at the alternative Terminal location in WC-183 is approximately 16.5 m (54 ft). Because of the proximity and similar physical conditions of the proposed Terminal and the alternative Terminal sites, the biological resources associated with the two sites would be similar.

Determining which habitats and species occur in an area affected by a proposed action was accomplished through literature reviews and coordination with appropriate Federal and state regulatory agency representatives, resource managers, and other knowledgeable experts. The various Federal laws that protect these resources are described below.

The locations and temporary distributions and abundances of marine organisms are often influenced by a combination of environmental, biotic, and anthropogenic factors. Environmental factors include those that are chemical, climatological, or physical (i.e., related to characteristics of a location) in nature. Biotic factors include the distribution and abundance of prey, inter- and intraspecific competition, reproduction, natural mortality, catastrophic events (e.g., die-offs), and predation. Anthropogenic factors include noise, hunting pressure, pollution and oil spills, habitat loss and degradation, shipping traffic, recreational and commercial fishing, oil and gas development and production, and seismic exploration. The interplay of these various factors and the effects of various oceanographic characteristics (e.g., bottom depth and topographic relief) ultimately affect the location and temporary distribution of prey species. This, in turn, is the major influence on diversity, abundance, and distribution of marine mammals, sea turtles, migratory birds, and fisheries resources.

Under the Marine Mammal Protection Act (MMPA) of 1972 (16 U.S.C. 1361 et seq.), the Secretary of Commerce is responsible for the protection of all cetaceans (whales, porpoises, and dolphins) and pinnipeds (seals and sea lions) except walruses, and has delegated authority for implementing the MMPA to NOAA Fisheries. The Secretary of the Interior is responsible for walruses, polar bears, sea otters, manatees, and dugongs and has delegated the responsibility of conservation and protection of these marine mammals to the USFWS. These responsibilities include providing overview and advice to regulatory agencies on all Federal actions that might affect these species.

The MMPA prohibits the "take" of marine mammals, with certain exceptions, in waters under U.S. jurisdiction and by U.S. citizens on the high seas. Under Section 3 of the MMPA, "take" of marine mammals is defined as "harass, hunt, capture, or kill or attempt to harass, hunt, capture, or kill any marine mammal" and "harassment" is defined as any act of pursuit, torment, or annoyance that has the potential to injure marine mammal stock in the wild; or has the potential to disturb a marine mammal or marine mammal stock in the wild by disrupting behavioral patterns, including migration, breathing, nursing, breeding, feeding, or sheltering. In cases where U.S. citizens are engaged in activities, other than fishing, that result in "unavoidable" incidental take of marine mammals, the Secretary of Commerce can issue a "small take authorization." The authorization can be issued after notice and opportunity for public comment if the Secretary of Commerce finds negligible impacts. The MMPA requires consultations with NOAA Fisheries if impacts on marine mammals are unavoidable. Informal consultation with NOAA Fisheries was initiated by the USCG and MARAD on May 6, 2004. However, the Applicant, Gulf Landing LLC, would have the responsibility under the MMPA to acquire a small take authorization, if deemed necessary. Section 2.0 and portions of Sections 3.2 and 4.2 of this EIS serve as the BA for the Proposed Action, and present information relevant to the resources afforded protection under the MMPA. All correspondence related to the MMPA is provided in Appendix C.

The ESA of 1973 (16 U.S.C. 1531-1534) establishes protection and conservation of threatened and endangered species and the ecosystems upon which they depend. The ESA is administered by the USFWS and NOAA Fisheries. Under the ESA, an "endangered" species is defined as any species in danger of extinction throughout all or a significant portion of its range. A "threatened" species is defined as any species likely to become an endangered species in the foreseeable future. Section 7 of the ESA requires that all Federal agencies consult with the USFWS or NOAA Fisheries, as applicable, before initiating any action that could affect a listed (threatened or endangered) species. Informal consultation with the both NOAA Fisheries and the USFWS was initiated by the USCG and MARAD on May 6, 2004.

Under the ESA, the USCG and MARAD have the responsibility of determining whether or not the Proposed Action would adversely affect federally listed threatened or endangered species or their designated critical habitats. If it is determined that it would adversely affect threatened or endangered species or their designated critical habitats, the nature and extent of the impacts must be determined, and measures must be recommended to reduce the potential impacts to acceptable levels. A BA is used in the interagency consultation as a basis for determining whether the adverse effects are likely to result in jeopardy to any listed species or their habitats. Section 2.0 and portions of Sections 3.2 and 4.2, of this EIS serve as the BA for the Proposed Action, and present information relevant to the resources afforded protection under the ESA.

If it is determined that the project is likely to jeopardize any listed species or habitats, the USFWS or NOAA Fisheries would issue a BO about the potential for jeopardy. They may also issue an incidental take statement as an exception to the prohibitions in Section 9 of the ESA. If, however, the USCG and MARAD determine that no federally listed or proposed threatened or endangered species or their designated critical habitat would be affected by the proposed Port, and the USFWS and NOAA Fisheries concur, then no further action is necessary under the ESA. All correspondence with the USFWS and NOAA Fisheries with respect to the ESA is presented in Appendix C.

Under the MSA (16 U.S.C. 1802), Congress mandated the identification of habitats essential to managed species and measures to conserve and enhance this habitat. NOAA Fisheries and the eight regional Fishery Management Councils (Councils), under the authority of the Secretary of Commerce, are mandated to describe and identify EFH in each fishery management plan; minimize, to the extent practicable, the adverse effects of fishing on EFH; and identify other actions to encourage the conservation and enhancement of EFH. The MSA requires cooperation among NOAA Fisheries, the Councils, fishing participants, and Federal and state agencies to protect, conserve, and enhance EFH. The statute includes a mandate that Federal agencies must consult with the Secretary of Commerce on all activities, or proposed activities, authorized, funded, or undertaken by the agency, that might adversely affect EFH. NOAA Fisheries recommends consolidated EFH consultations with interagency coordination procedures required by other statutes such as NEPA or the ESA (50 CFR 600.920(e)(1)) to reduce duplication and improve efficiency. The mandatory contents of an EFH Assessment are detailed in 50 CFR 600.920(e)(3). Therefore, Sections 3.2.6, 4.2.4, and 5.1.2 of this EIS serve as an EFH Assessment for the Proposed Action (WC-213). USCG and MARAD initiated EFH consultation with NOAA Fisheries on May 6, 2004. Correspondence with NOAA Fisheries with respect to the EFH is presented in Appendix D.

The Migratory Bird Treaty Act (MBTA) of 1918 (16 U.S.C. 703-712) affirms, or implements, the U.S. commitment to four international conventions (with Canada, Japan, Mexico, and Russia) for the protection of a shared migratory bird resource. The MBTA protects species or families of birds that live, reproduce, or migrate within or across international borders at some point in their life cycle.

3.2.2 Existing Conditions

Support vessels (i.e., tugs to assist the LNGCs and supply vessels) would traverse 61 km (38 mi) of coastal waters, from existing facilities in Cameron, Louisiana. Cameron is a major port of call for the offshore oil and gas industry and the area also supports two menhaden processing plants (Nipper et al. 2004). The potential for accidents (further described in Section 4.10) and other indirect effects that could result from operation of the proposed Port might have ramifications for nearshore coastal waters throughout the GOM. Thus, there is a need to characterize the coastal environments of the GOM. The following description of protected and coastal biological resources of the central GOM has been developed with these considerations in mind.

3.2.2.1 Coastal

Protected Habitats. Protected habitats are biologically sensitive marine habitats that are managed by Federal, state, or local agencies. Protected habitats in the GOM include National Marine Sanctuaries (NMSs), Federal Fishery Management Zones (FFMZs), National Wildlife Refuges (NWRs), National Estuarine Research Reserves (NERRs), coral reefs, and critical habitat. These habitats are offered varying degrees of protection from agencies such as NOAA Ocean Services, NOAA Fisheries, the DOI, the USFWS, the National Park Service (NPS), the USCG, and state agencies.

The protected habitats in the coastal area of the ROI include

- Sabine NWR
- Shell Keys NWR
- Marsh Island State Wildlife Refuge
- Rockefeller State Wildlife Refuge
- Piping Plover Critical Habitat

Sabine NWR was established in 1937 (USFWS undated). This refuge occupies 124,511 acres (ac) of marsh between Calcasieu and Sabine Lakes in Cameron Parish, Louisiana. The refuge is comprised of 39,844 ac of open water and 84,667 ac of grassland/herbaceous/marshes. Wildlife that occupies the refuge includes ducks, geese, alligators, muskrats, nutria, raptors, wading birds, shorebirds, blue crab, and shrimp. The refuge also supports olivaceous cormorant, snowy egret, and common egret rookeries (USFWS undated).

Shell Keys NWR is one of the oldest refuges in the National Wildlife Refuge System. It is described as a small group of unsurveyed islets located in the GOM (Wildernet 2003). It is about 5.6 km (3.5 mi) south of Marsh Island in Vermilion Parish, Louisiana. Species known to nest at the refuge include royal tern, sandwich tern, black skimmer, and laughing gull. Recent hurricanes and storms have eroded the island to the extent that no nesting has occurred since 1992. The refuge is also used as a loafing area by white pelican, brown pelican, and various other species of terns and gulls (Wildernet 2003).

Marsh Island State Wildlife Refuge is between Vermilion Bay and the GOM in Vermilion Parish, Louisiana (LDWF 2004a). The refuge comprises approximately 70,000 ac. This reflects a decrease of 6,664 ac that have been lost to erosion since the park was originally deeded. The refuge is comprised primarily of brackish marsh; it is virtually treeless and very flat. Marsh Island State Wildlife Refuge is managed for migrant and resident birds and serves as an important wintering grounds for "lesser" snow geese (white and blue phases) (Nipper et al. 2004). It is also used by shrimp as a nursery ground. Marsh Island is very popular for recreational fishing, birding, crabbing, and shrimping (LDWF 2004a).

Rockefeller State Wildlife Refuge is in eastern Cameron Parish and western Vermilion Parish, Louisiana. This refuge has lost approximately 10,000 of its original 86,000 ac to beach erosion. The refuge borders the GOM for 42.6 km (26.5 mi) and extends inland toward the Grand Chenier ridge, a stranded beach ridge (described below) (LDWF 2004b). Rockefeller State Wildlife Refuge is one of the most biologically diverse wildlife areas in the Nation (LDWF 2004b). It is located at the terminus of the vast Mississippi Flyway. Ducks, geese, coots, shorebirds, and wading birds either migrate through or overwinter in the refuge's coastal marshes. Additionally, neotropical migrant passerines use the shrubs and trees on levees and other "upland" areas of the refuge as a rest stop on their trans-Gulf journeys to and from Central and South America (LDWF 2004b).

Critical habitat is designated under the ESA as "a specific geographic area that is essential for the conservation of a threatened or endangered species and that may require special management or protection." Critical habitat can include an area that is not currently occupied by a species, but is needed for the recovery of that species. Critical habitat has been designated for wintering piping plovers at various locations along the Louisiana Gulf Coast, including Cameron Parish, Louisiana (Unit LA-1) (66 FR 132 pp. 36038-36079). Unit LA-1 of piping plover critical habitat is comprised of 6,548 ac of land in Cameron and Vermilion Parishes. In the ROI, this unit of piping plover critical habitat includes the shore of the GOM, extending from the east side of Sabine Pass (Texas/Louisiana border) following the shoreline east for 25.7 km (16.0 mi) to the west end of Constance Beach. It also extends from the east end of the town of Holly Beach following the shoreline for approximately 97 km (60.3 mi) east to the eastern boundary line of Rockefeller State Wildlife Refuge. The critical habitat includes land from the seaward boundary of mean low low water (MLLW) to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. The shoreline in this unit is both state and privately owned.

Coastal Barrier Beaches and Associated Dunes. The GOM shoreline stretches about 1,500 km (919 mi) from the Mexican border to Florida (MMS 2002a). The coastline is characterized by coastal barrier landforms (i.e., barrier islands, major bars, sand spits), which are composed of sand and other unconsolidated coarse sediments (MMS 2001). The sediments have been transported to their present location by rivers, waves, currents, storm surges, and winds. Coastal landforms are transitory in nature and are constantly being sculpted and modified by the same forces that led to their original deposition.

Barrier landforms can be described as either "transgressive" or "regressive" sequences (MMS 2001). When the shoreline is moving landward and marine deposits rest on top of terrestrial deposits, the landform is considered transgressive. When terrestrial sediments are being deposited on top of marine sediments and the shoreline is being extended out into the sea, the landform is considered regressive.

The central and western GOM consists of islands, spits, and beaches that extend in an irregular arch from Baldwin County, Alabama, westward to the U.S./Mexico border in Cameron County, Texas (MMS 2001). These barrier landforms (e.g., barrier islands, major bars, sand spits) can be divided into four major classifications based on location: (1) the Mississippi Sound Landform Complex, (2) Mississippi Deltaic Landform Complex, (3) Chenier Plain Landform Complex, and (4) Texas Barrier Island Landform Complex.

The Mississippi Sound barrier islands are shoals and sandbars that have resulted from westward sand migration resulting in shoal and sand bar growth (MMS 2001). Barrier islands along the Mississippi River Deltaic Plain are a result of a series of overlapping river deltas that have extended onto the continental shelf. The Chenier Plain consists of sand beaches and extensive coastal mud flats that have resulted from fine particle deposition from both the Mississippi and the Atchafalaya Rivers. Mud and fine particles are carried westward by the prevailing coastal current. The Texas Barrier Island Landform Complex is made of transgressive beaches, formed from thin accumulations of sand, shell, and caliche nodules. These beaches are migrating landward over tidal marshes. They have poorly developed dunes and are characterized by numerous washover channels.

There are coastal barrier features along the eastern portion of the coast of Cameron Parish, Louisiana, afforded protection under the Coastal Barrier Resources Act (CBRA) (16 U.S.C. 3501 *et seq* (FEMA undated).

Wetlands. Wetland habitats associated with the coastal GOM include mangroves; fresh, brackish, and salt marshes; mud flats; forested wetlands of hardwoods; and cypress-tupelo swamps. They might cover vast expanses of the coastline or occupy only narrow bands along the shore. Wetlands provide unique habitats that are critical to the adjacent terrestrial and continental shelf ecosystems. A vast number of invertebrate, fish, reptile, bird, and mammal species inhabit wetland areas. Two-thirds of the high-value fish caught in the GOM spend at least some portion of their life cycle in nearshore seagrass beds or salt marshes (MMS 2001).

Wetlands in the central and western GOM are characterized according to freshwater input and whether they are enclosed, semi-enclosed, or open. The wetlands in the GOM are classified as estuaries, lagoons, sounds, and coastal wetlands. Bays are semi-enclosed embayments with little freshwater input. Estuaries are embayments with substantial freshwater input from rivers and streams, and consequently lower and more variable salinities, and represent mixing zones where continental freshwater runoff mixes with higher salinity ocean water. Lagoons are long narrow bodies of water, with higher salinity, that occur where nearshore water is prevented from entering the open sea by nearshore barrier islands. Salinities in lagoons can exceed open-ocean salinities (e.g., Laguna Madre). Sounds are defined as large embayments of open-ocean water that have been cut off from the open sea by barrier islands farther from shore. Salinities in sounds rarely exceed open-ocean waters. Coastal wetlands are areas where the salt marsh or wetland community fronts directly on the open sea with very little protection from barrier islands and very little beach. Coastal wetlands are characterized by high organic productivity, high detritus production, and extensive nutrient recycling (MMS 2001).

Cameron, Louisiana, is situated on Calcasieu Pass, which connects Calcasieu Lake to the GOM (Nipper et al. 2004). Calcasieu Lake is on the Chenier Coastal Plain just east of the Texas-Louisiana border. The lake receives freshwater input from the Calcasieu River. The Calcasieu Lake basin is characterized by marshes which might be fresh, intermediate, brackish, or saline. The basin supports a variety of marine and wetland habitats but is dominated by marshlands. Common living resources include shrimp, Gulf menhaden, nutria, muskrat, and waterfowl (Nipper et al. 2004).

Seagrass Beds. Seagrass beds occur in shallow water on sand bottoms with relatively low wave energy. Seagrass beds support a tremendously complex ecosystem and are extremely productive. They provide nursery grounds for vast numbers of commercially and recreationally important fisheries species, including shrimp, black drum, snapper, grouper, spotted sea trout, southern flounder.

There are more than 7,413,000 ac of seagrass bed in the coastal waters of the entire GOM. Most of the seagrass beds in the U.S. coastal waters are located west of the Florida shelf (MMS 2001). There are approximately 74,000 ac of seagrass beds in the coastal waters of Mississippi and Alabama, growing along the inner edges of the barrier islands of Mississippi Sound and along the shorelines of prominent bays. The nearshore waters of Texas contain approximately 37,000 ac of seagrass beds, most of which are in the Laguna Madre and the Copano-Aransas Bay complex (MMS 2001).

3.2.2.2 Offshore

Protected Habitats. Coral reefs are offered additional protection under EO 13089, *Coral Reef Protection,* which directs Federal agencies to determine whether their proposed actions could affect coral reefs; to use their programs and authorities to protect and enhance the conditions of such ecosystems; and, to the extent permitted by law, to ensure that any actions they authorize, fund, or carry out will not degrade the conditions of such ecosystems. There are no coral reefs in the ROI. Therefore, the USCG and MARAD have eliminated coral reefs from further consideration.

The National Marine Sanctuary Program was created by Title III of the MPRSA of 1972 which was renamed The National Marine Sanctuaries Act (NMSA) in 1992 (16 U.S.C. 1431 et seq.). The NMSA authorizes the Secretary of Commerce to designate NMSs based on statutory criteria and stipulated factors. Most NMSs prohibit drilling, dredging, discharging pollutants, and other activities considered to have an adverse effect on wildlife. The only NMSs in the GOM are Flower Garden Banks NMS and the Florida Keys NMS, neither of which is located in the ROI. The proposed Gulf Landing Terminal and Alternate Site locations are over 121 km (75 mi) from the Flower Garden Banks NMS and over 805 km (500 mi) from the Florida Keys NMS. Therefore, the USCG and MARAD have eliminated both NMSs from further consideration.

Benthic Community. Offshore areas in the vicinity of the proposed Terminal and the proposed pipeline routes consist of muddy bottom areas that are largely devoid of benthic vegetation. Marine communities in the ROI consist of soft-bottom associations. The major benthic habitat of the northern GOM consists of a soft muddy bottom, dominated by polychaetes (bristleworms). Infaunal communities on the GOM continental shelf are generally dominated by polychaete worms, followed by crustaceans and mollusks. Epifaunal communities, typically associated with hard bottom, include crustaceans, echinoderms, mollusks, hydroids, sponges, and soft and hard corals. Shrimp and demersal fish are also closely associated with the benthic community. The distributions of these animals are typically influenced by sediment composition or grain size, but also by temperature, salinity, and distance from shore (MMS 2002a). Illumination, food availability, currents, tides, and wave shock also play a role in the distribution of benthic fauna.

Sargassum. One type of vegetation present in the pelagic waters of the GOM is the floating brown alga *Sargassum (Sargasssum fluitans* and *s. natans).* The *Sargassum* community comprises a unique and diverse association of organisms (MMS 2002a). Animals associated with *Sargassum* include hydroids, copepods, fish (54 species), crab, gastropods, polychaetes, bryozoans, anemones, and sea-spiders. Shrimp and crab comprise the bulk of the invertebrates and are a major source of food for associated fish. *Sargassum* acts as a vehicle for dispersal of some of its inhabitants and might be important in the life histories of many species of fish. It provides them with a substrate, protection against predation, and concentration of food in the open GOM (GMFMC 1998). Large predators associated with the *Sargassum* complex include amberjacks (*Seriola dumerili*), dolphin (*Coryphaena hippurus*), and almaco jacks (*S. rivoliana*).

Pinnacle Trends. Pinnacle trends are thousands of carbonate mounds ranging in size from less than a few feet to nearly 3,000 feet (less than a meter to nearly a kilometer) in diameter, which appear to be biogenic features formed during the last deglaciation (MMS 2002b). Pinnacle trends have been mapped and primarily occur in two parallel bands along isobaths. Exclusion zones are required around topographic highs such as pinnacle trends on the OCS, because rises of 6 to 8 ft stimulate increased biological productivity. Gulf Landing LLC has completed a survey that indicates no topographic highs are in the proposed Terminal vicinity and pipeline corridors. There are no pinnacle trends in the vicinity of the proposed Terminal or pipeline corridors. The nearest area of pinnacle trends is along the shelf edge between the Mississippi River Delta and De Soto Canyon (MMS 2002a), which is more than 161 km (100 mi) from the proposed Terminal. Therefore, the USCG and MARAD have eliminated pinnacle trends from further consideration.

Chemosynthetic Communities. Chemosynthetic (seep) communities are located in deep water (290 m to greater than 3,000 m [951 ft to 9,843 ft]) in the GOM, where chemical conditions are favorable and constant. These communities include vestimentiferan tubeworms, seep mussels, vesicomyid and lucinid clams, and specialized polychaete worms, which use a chemosynthetic process to oxidize hydrogen sulfide or methane to produce basic organic compounds (MMS 2002a). There are no seep communities in the in the vicinity of the proposed Terminal or pipeline corridors. The nearest chemosynthetic community is more than 161 km (100 mi) from proposed Terminal. Therefore, the USCG and MARAD have eliminated chemosynthetic communities from further consideration.

Hard Bottoms. Hard bottom areas are highly productive, and generally characterized by high diversity of epibiota on rock or firm substrate (MMS 2002a). There are no hard bottom areas reported in the vicinity of the proposed Terminal or pipeline corridors. The nearest hard bottom area is more than 80 km (50 mi) from the proposed Terminal. Therefore, the USCG and MARAD have eliminated hard bottoms from further consideration.

3.2.3 Marine Mammals

There are 29 species of marine mammals within the GOM. These species and their frequency of occurrence, habitat, and general distribution in the GOM are presented in Table F-1 in Appendix F. There are 28 species of the Order Cetacea (whales and dolphins), 7 species from the Suborder Mysticeti (i.e., baleen whales) and 21 species from the Suborder Odontoceti (i.e., toothed whales including dolphins) and 1 species of the West Indian manatee (Order Sirenia, Family Trichechidae) (*Trichecus manatus*) (MMS 2001).

3.2.3.1 Nonthreatened and Nonendangered Marine Mammal Species

During the GulfCet I and II surveys, 20 and 19 species, of cetaceans, respectively, were sighted (MMS 1996). The most abundant species in both surveys was the pantropical spotted dolphin. Other species that were abundant in both surveys include the spinner dolphin, Clymene dolphin, bottlenose dolphin, striped dolphin, melon-headed whale, Atlantic spotted dolphin, and Risso's dolphin. The distribution of cetaceans throughout the GOM appears to be affected by water depth or geographic region. The GulfCet II survey concluded that most cetaceans were associated with cyclonic eddies. This association is believed to be in response to a concentration of prey species (MMS and USGS 2000). Cyclonic eddies are low-salinity, nutrient-rich water with enhanced primary productivity. The only species typically occurring outside the major influences of eddies, on the continental shelf or shelf break, were bottlenose dolphins, Atlantic spotted dolphins, and possibly Bryde's whales. Two discrete populations of bottlenose dolphins are believed to exist, one in nearshore waters and the other along the outer edge of the continental shelf (MMS 2001). The distribution of bottlenose dolphins appears to be related to zooplankton biomass (Baumgartner et al. 2001).

The species of nonlisted marine mammals most likely to occur in the ROI, based on habitat and occurrence (Table F-1, Appendix F), are the Atlantic spotted dolphin and the bottlenose dolphin.

3.2.3.2 Threatened and Endangered Marine Mammal Species

Six of the whale species that occur in the GOM and the West Indian manatee are listed as endangered. The endangered whale species are the sperm whale (*Physeter macrocephalus*), sei whale (*Balaenoptera borealis*), blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), northern right whale (*Eubalaena glacialis*), and humpback whale (*Megaptera novaeangliae*).

Sperm Whale. Sperm whales are the largest member of the suborder Odontoceti or toothed whales. The International Whale Commission (IWC) recognizes four populations of sperm whales worldwide: North Pacific, North Atlantic, northern Indian Ocean, and southern hemisphere (NMFS 2002a). GOM sperm whales are assessed as a unit stock by NOAA Fisheries. In the northwestern Atlantic, sperm whales are distributed in the U.S. EEZ over the continental shelf edge, the continental slope, and into the midocean regions. Their distribution is associated with the Gulf Stream and social structure. Generally, sperm whales group by gender and age, with the females and juveniles based in tropical and subtropical waters, and males in the higher latitudes feeding in polar regions and returning to tropical waters to breed. The seasonal distribution of sperm whales in the eastern United States is from the waters off Cape Hatteras in the winter, shifting to the waters off Delaware and Virginia, and north to the southern portion of Georges Bank in the spring. The distribution expands in the summer to include the areas east and north of Georges Bank, and into the Northeast Channel region, as well as the continental shelf (inshore of the 100-m isobath) south of New England. In the fall, sperm whales shift to the continental shelf edge from the mid-Atlantic Bight to south of New England (Waring et al. 2003).

Predatory behavior of sperm whales might include ambushing prey, attracting squid with bioluminescent mouths, and stunning prey with ultrasonic sounds. This predatory behavior makes sperm whales vulnerable to drowning caused by deep sea cables wrapped around their jaws (NMFS 2002a).

The sperm whale is the only large cetacean common to the GOM (NMFS 2002a; MMS 2001). Sperm whales are found in the waters of the GOM throughout the year, but are most common during the summer months. Consistent sightings, strandings, and catches indicate that there might be a distinct stock of sperm whales in the GOM. The last assessment of the GOM stock of sperm whales occurred in 1995. This population was estimated to be 411 individuals based on a 1991–1994 average abundance estimate of 530 sperm whales (NOAA Fisheries 2003a). GulfCet II was a program conducted in 1996 and 1997 that used aerial surveys and shipboard visual and acoustic surveys to document cetacean, sea turtle, and seabird populations. This program was an extension of GulfCet I, which was a 3-year, extensive survey of cetaceans in the offshore waters (100–2,000 m deep [328 ft–6,560 ft]) of the north central and western GOM. An annual abundance of 530 sperm whales was estimated from GulfCet II survey data.

The GulfCet II survey indicated that sperm whales were sighted throughout the GOM; however, sightings were most commonly aggregated along the 1,000-m (3,280-ft) isobath. The presence of female and juvenile sperm whales south of the Mississippi River Delta was associated with cyclonic eddies. This association suggests that the whales are trying to stay near variable areas of low-salinity, nutrient-rich water with enhanced primary and secondary productivity. Therefore, distribution is related to the distribution of prey (MMS and USGS 2000). Currently no critical habitat is designated for sperm whales in the GOM, but the area south of the Mississippi Delta might be essential habitat for sperm whales.

While they can be encountered almost anywhere on the high seas, sperm whales show a preference for continental margins, sea mounts, and areas of upwelling where food is abundant (NMFS 2002a). Because they generally occur in waters greater than 180 m (590 ft) deep, it is unlikely that sperm whales would occur in the ROI. Furthermore, the number of LNGCs associated with the Proposed Action (about 135 per year) represents an insignificant increase in the amount of vessel traffic approaching and exiting the GOM, and is not expected to cause a significant increase in the frequency of sperm whale collisions. Therefore, the USCG and MARAD have eliminated sperm whales from further consideration.

Sei Whale. The IWC recognizes two stocks of sei whales in the northwestern Atlantic Ocean, a Nova ***Sei Whale.*** The IWC recognizes two stocks of sei whales in the northwestern Atlantic Ocean, a Nova Scotia stock and a Labrador Sea stock. The stock that occurs in the waters of the U.S. EEZ is the Nova Scotia stock. This stock is concentrated in the northern waters during feeding season. In the spring and summer, the stock extends south to the Gulf of Maine and Georges Bank. The sei whale is generally distributed offshore and occasionally follows prey species inshore (Waring et al. 2003). Sightings of the sei whale in the GOM are rare. In the BO for the MMS GOM OCS Multi-Lease Sale, NOAA Fisheries concluded that there is no resident stock of this species in the GOM (NMFS 2002a). Therefore, the USCG and MARAD have eliminated sei whales from further consideration.

Blue Whale. The western North Atlantic stock of the blue whale is distributed from Arctic to temperate waters. Blue whales are most commonly sighted off eastern Canada and the Gulf of St. Lawrence. They are found in the Gulf of St. Lawrence in the spring, summer, and fall, and off southern Newfoundland in the winter. The U.S. EEZ might represent the southern part of the blue whale's feeding range. This is based on four sightings, all in August (Waring et al. 2003). The southern limit of the species is unknown. However, the U.S. Navy tracked one blue whale acoustically for 1,400 NM from waters northeast of Bermuda to the southwest and west of Bermuda. The presence of blue whales in the GOM is limited to two strandings on the Texas coast and two unconfirmed sightings (MMS 2001). In the BO for the MMS GOM OCS Multi-Lease Sale, NOAA Fisheries concluded that there is not a resident stock of this species in the GOM (NMFS 2002a). It is unlikely that blue whales would occur in the ROI. Therefore, the USCG and MARAD have eliminated blue whales from further consideration.

Fin Whale. The IWC indicates there is one stock of fin whales along the eastern United States. Fin whales are common in the waters of the U.S. EEZ, from the U.S./Canada border south to Cape Hatteras, North Carolina. New England waters represent a major feeding ground for the fin whale. Fin whales migrate south in the fall from the Labrador and Newfoundland region, past Bermuda, to the West Indies (NMFS 2002b). It is likely that fin whales in the U.S. EEZ undergo migrations to Canadian waters, open-ocean areas, and even subtropical or tropical regions (Waring et al. 2003). However, these might not be the distinct annual migrations made by other mysticete species. In the BO for the MMS GOM OCS Multi-Lease Sale, NOAA Fisheries concluded that there is not a resident stock of this species in the GOM (NMFS 2002a). It is unlikely that fin whales would occur in the ROI. Therefore, the USCG and MARAD have eliminated fin whales from further consideration.

Northern Right Whale. The distribution of the western northern right whale population ranges from wintering and calving grounds in coastal waters of the southeastern United States, to summer feeding and nursery grounds in New England waters, northward to the Bay of Fundy and the Scotian Shelf (Waring et al. 2003). Early records of the northern right whale in the GOM represent either geographic anomalies or a more extensive historic range beyond the sole known calving and wintering ground in the waters of the southeastern United States. The first confirmed right whale sighting in the GOM in 20 years occurred off the coast of the Florida Panhandle more than 322 km (200 mi) from the ROI (AP 2004). In the BO for the MMS GOM OCS Multi-Lease Sale, NOAA Fisheries concluded that there is not a resident stock of this species in the GOM (NMFS 2002a). It is unlikely that northern right whales would occur in the ROI. Therefore, the USCG and MARAD have eliminated northern right whales from further consideration.

Humpback Whale. Humpback whales in the western North Atlantic are distributed along the east coast of the United States (including the Gulf of Maine), the Gulf of St. Lawrence, Newfoundland/Labrador, western Greenland, Iceland, and northern Norway. These areas constitute feeding areas in the spring, summer, and fall for six discrete subpopulations of humpback whales. In 1995, the IWC acknowledged that whales from the Gulf of Maine could be treated as a separate stock for the purposes of management. This designation is based on the strong fidelity of whales to the region, and the attendant assumption that if subpopulations were wiped out, repopulation by immigration from adjacent areas would not occur on any reasonable management timescale. Whales from all six feeding areas calve and mate primarily in the West Indies in the winter. Other documented mating and calving areas include the Cape Verde Islands, Puerto Rico, and the coast of Venezuela. Humpback whale sightings and strandings have increased in recent years in the mid-Atlantic and southeastern United States, including the Delaware and Chesapeake Bays, and Virginia and North Carolina. Evidence suggests that mid-Atlantic areas represent both migratory pathways and winter feeding grounds for juveniles (Waring et al. 2003; NMFS 2002b). In the BO for the MMS GOM OCS Multi-Lease Sale, NOAA Fisheries concluded that there is not a resident stock of this species in the GOM (NMFS 2002a). It is unlikely that humpback whales would occur in the ROI. Therefore, the USCG and MARAD have eliminated humpback whales from further consideration.

West Indian Manatee. West Indian manatees (*Trichechus manatus*) occasionally enter Lakes Pontchartrain and Maurepas, as well as associated coastal waters and streams, during the summer months (i.e., June through September). Manatees have been reported in the Amite, Blind, Tchefuncte, and Tickfaw Rivers, as well as in canals within the adjacent coastal marshes of Louisiana. They have also been occasionally observed elsewhere along the Louisiana Gulf Coast. The manatee has declined in numbers due to collisions with boats and barges, entrapment in flood control structures, poaching, habitat loss, and pollution. Cold weather and outbreaks of red tide might also adversely affect these animals (Firmin 2003). Occurrence of the West Indian manatee in the northern GOM is considered rare (Würsig et al. 2000). It is unlikely that West Indian manatees would occur in the ROI. Therefore, the USCG and MARAD have eliminated West Indian manatees from further consideration.

3.2.4 Sea Turtles

3.2.4.1 Threatened and Endangered Species

All five species of sea turtles that inhabit the GOM are threatened or endangered and could occur in the ROI (MMS 2001). These species are the loggerhead sea turtle (Caretta caretta), Kemp's ridley sea turtle (Lepidochelys kempi), leatherback sea turtle (Dermochelys coriacea), hawksbill sea turtle (Eretmochelys imbricata), and the green sea turtle (Chelonia mydas). The loggerhead sea turtle is the most common sea turtle in the GOM, while the hawksbill sea turtle is the least common. The USFWS and NOAA Fisheries share the responsibility for sea turtle recovery under the authority of the ESA. Table 3-3 lists the sea turtles that occur in the GOM.

Sea turtle life history stages include eggs, hatchling, juvenile, and adult. In general, sea turtles nest along the entire northern GOM coastline; however, specific nesting distributions by species are described below. Hatchling sea turtles move offshore in a swimming frenzy immediately after hatching. Post-frenzy, hatchling sea turtles move to areas of convergence or to Sargassum mats and undergo passive oceanic migrations (Wyneken 2001). Juvenile sea turtles actively recruit to nearshore nursery habitat and move into adult foraging habitat when approaching sexual maturity. At the onset of nesting, adults move between foraging habitats and nesting beaches. Mating habitat depends on species and might occur off nesting beaches or remotely. Females reside near nesting beaches during nesting season (MMS 2002b).

Table 3-3. Sea Turtles That Occur in the GOM

Species	Status[1]	Typical Adult Habitat	Juvenile/ Hatchlings Potentially Present?	Nesting
Loggerhead sea turtle *(Caretta caretta)*	T	estuarine, coastal, and shelf waters	Yes	Some nesting along northern Gulf Coast; main U.S. nesting beaches are in southeastern Florida
Kemp's ridley sea turtle *(Lepidochelys kempi)*	E	shallow coastal waters, seagrass beds	Yes	Nests mainly at Rancho Nuevo, Mexico; minor nesting on Padre and Mustang Islands, Texas
Leatherback sea turtle *(Dermochelys coriacea)*	E	slope, shelf, and coastal waters; considered the most "pelagic" of the sea	Yes	Some nesting in northern Gulf, especially Florida Panhandle; nearest major nesting turtle concentrations are in Caribbean and southeastern Florida
Hawksbill sea turtle *(Eretmochelys imbricata)*	E	coral reefs, hard bottom areas in coastal waters; adults not often sighted in northern GOM	Yes	Nesting in continental U.S. is limited to southeastern Florida and Florida Keys
Green sea turtle *(Chelonia mydas)*	T, E[2]	shallow coastal waters, seagrass beds	Yes	Isolated and infrequent nesting in northern Gulf

Source: MMS 2002a

Notes: [1] E – endangered, T – threatened under the Endangered Species Act of 1973.

[2] Green sea turtles are listed as threatened except for Florida, where breeding populations are listed as endangered.

There are no designated critical habitats or migratory routes for sea turtles in the northern GOM. However, NOAA Fisheries recognizes many coastal areas as preferred habitat (i.e., important habitats for the species within a specific geographic area) for sea turtles. For example, nearshore or inshore areas are preferred habitat for green sea turtles; while bays, especially in Louisiana and Texas, are preferred habitat for Kemp's ridley sea turtles (MMS 2002b). *Sargassum* mats are also recognized as preferred habitat for hatchlings (MMS 2001). Highest sea turtle abundance in the western GOM occurs in depths from 0 to 18 m (0 to 60 ft). However, sea turtles are more abundant in the eastern GOM than in the western GOM (McDaniel et al. 2000).

Loggerhead Sea Turtle. The loggerhead is the most abundant sea turtle in the GOM. This species has been federally listed as threatened since 1978. It is a cosmopolitan species that inhabits temperate and tropical waters, including estuaries and continental shelves of both hemispheres (NMFS and USFWS 1991a; NMFS 2002a). Five populations of loggerhead sea turtles exist worldwide in the Atlantic Ocean, Pacific Ocean, Indian Ocean, Caribbean Sea, and Mediterranean Sea. In the western Atlantic Ocean, the five major nesting aggregations are (1) a northern nesting aggregation from North Carolina to northeast Florida about 20° N latitude; (2) a south Florida nesting aggregation from 29° N latitude on the east coast to Sarasota on the west coast; (3) a Florida Panhandle nesting aggregation at Eglin Air Force Base and the beaches near Panama City, Florida; (4) a Yucatán nesting aggregation on the eastern Yucatán Peninsula, Mexico; and (5) a Dry Tortugas nesting aggregation on the islands of the Dry Tortugas, near Key West, Florida (NMFS 2002b).

One of the best methods to assess the population size of loggerhead sea turtles is the use of index data on nesting females. These data indicate that between 1989 and 1998, the number of nests laid along the U.S. Atlantic and GOM coasts ranged from 53,000 to 92,000, annually. The average was nearly 73,000. On average, 90.7 percent of the nests were from the south Florida nesting aggregation, 8.5 percent from the northern nesting aggregation, and 0.8 percent from the Florida panhandle nesting aggregation (NMFS 2002a).

In the southeastern United States, female loggerhead sea turtles mate from late April through early September (NMFS and USFWS 1991a). Individual females might nest several times within one season, but usually nest at intervals of every 2 to 3 years. For their first 7 to 12 years, loggerhead sea turtles inhabit the pelagic waters near the North Atlantic Gyre and are called pelagic immatures. When loggerhead sea turtles reach 40–60 cm (16–24 in) straight-line carapace length, they begin to recruit to coastal inshore and nearshore waters of the continental shelf throughout the U.S. Atlantic and GOM, and are referred to as benthic immatures. Benthic immatures have been found in waters from Cape Cod, Massachusetts, to southern Texas. They forage off the northeastern United States and migrate south in the fall as temperatures drop. Most recent estimates indicate that the benthic immature stage ranges from ages 14–32 and the turtles mature around ages 20–38 (NMFS 2002a).

Prey species for omnivorous juveniles include crab, mollusks, jellyfish, and vegetation at or near the surface (NMFS 2002a). Coastal subadults and adults feed on benthic invertebrates, including mollusks and decapod crustaceans.

Loggerhead sea turtles were sighted during both the GulfCet I and GulfCet II surveys (MMS 1996). Results from the GulfCet II survey indicate that the number of loggerhead sea turtle sightings in the northeastern GOM was 20 times higher on the continental shelf versus the continental slope. The majority of the loggerhead sea turtle sightings occurred in winter, around depths of 100 m (328 ft). However, there were sightings over waters as deep as 1,000 m (3,280 ft). Oceanic waters might be used by loggerhead sea turtles to travel between foraging sites (MMS and USGS 2000).

Kemp's Ridley Sea Turtle. The Kemp's ridley sea turtle primarily inhabits coastal waters in the GOM and northwestern Atlantic Ocean (NMFS and USFWS 1992a). This species has been federally listed as endangered since 1978, and is considered the most endangered sea turtle in the world. Nesting is primarily limited to beaches at Rancho Nuevo, a stretch of beach in southern Tamaulipas, Mexico. Nesting occurs from April into July. On average, individual females nest every other year (ranging from every year to every 4 years), with an average of 2.5 nests per female per season. Average clutch size is 100 eggs per nest (NMFS 2002a).

Nesting data indicate a severe decline of Kemp's ridley sea turtles from the more than 40,000 females when the nesting aggregation in Rancho Nuevo was first discovered. In the 1970s, the number of females ranged from 2,000 to 5,000. The number of nests increased from a low of 702 nests in 1985 to 1,930 nests in 1995 and 6,277 nests in 2000 (NMFS 2002a).

Prey species for the Kemp's ridley sea turtle include nearshore crab, mollusks, fish, shrimp, and shrimp fishery discards (NMFS 2002a). After hatching, pelagic Kemp's ridley sea turtles feed on *Sargassum* or other epipelagic GOM species.

Kemp's ridley sea turtles have been sighted within 15 km (9.3 mi) off shore and in depths less than 18 m (59 ft) (MMS 2002a). Kemp's ridley sea turtles were sighted during both GulfCet I and GulfCet II surveys (MMS 1996). Three Kemp's ridley sea turtles were sighted in shelf waters of the eastern GOM during the GulfCet II survey (MMS and USGS 2000). The abundance estimate resulting from these three sightings was 12 individuals. Nearshore waters of the GOM are believed to provide important developmental habitat for juvenile Kemp's ridley sea turtles. The primary subadult habitat is along the northern GOM coast from Cedar Key, Florida, to Port Aransas, Texas (NMFS 2002a).

Leatherback Sea Turtle. The leatherback sea turtle has been federally listed as an endangered species since June 2, 1970. It is primarily a pelagic species and is distributed in temperate and tropical waters worldwide (NMFS and USFWS 1992b). The leatherback is the largest, deepest diving, most migratory, widest ranging, and most pelagic sea turtle (USFWS 2002a). Nesting grounds are found circumglobally. Leatherbacks undergo extensive migrations from feeding grounds to nesting beaches. Once they nest, they move offshore and use both coastal and pelagic waters (NMFS 2002a).

Historically, the most important nesting ground for the leatherback was the Pacific coast of Mexico. Nesting in the U.S. Caribbean is reported in the Virgin Islands (NMFS 2002a). However, French Guiana in the western Atlantic now has the largest nesting population. Other important nesting sites for the leatherback sea turtle include Colombia, in the western Atlantic; and West Papua and Indonesia, in the western Pacific. U.S. nesting sites include the Florida east coast; Sandy Point, U.S. Virgin Islands; and Puerto Rico. Nesting occurs from March through July (USFWS 2002a). On average, individual females nest every 2 to 3 years, laying an average of five to seven nests per season. Average clutch size is 70 to 80 yolked eggs (USFWS 2002a). Critical habitat has been designated for the leatherback sea turtle in the U.S. Virgin Islands at Sandy Point Beach, St. Croix, and the waters adjacent to Sandy Point Beach (50 CFR17.95, 50 CFR 226.207).

Global nesting data indicate a severe decline from more than 115,000 females estimated in 1980 to recent estimates of 26,000 to 43,000 nesting females (USFWS 2002a). Numbers of leatherback sea turtles in the western Atlantic might be declining. Recent increases in mortalities are reportedly due to interactions with fishing gear (NMFS 2002a).

Adult leatherbacks forage in temperate and subpolar regions in all oceans (NMFS 2002a). Jellyfish are the major component of the leatherback diet. Leatherbacks are also known to feed on sea urchins, squid, crustaceans, tunicates, fish, blue-green algae, and floating seaweed (USFWS 2002a).

Leatherback sea turtles were sighted during the GulfCet I and GulfCet II surveys. In the GulfCet I survey, the majority of the sightings occurred from the Mississippi Canyon to the DeSoto Canyon. The GulfCet I survey indicated leatherbacks were primarily an oceanic species (typically found in waters greater than 200 m [656 ft]) (MMS 1996). These results were reiterated during the GulfCet II survey, when leatherback sea turtles were more commonly sighted on the continental slope than the shelf. The leatherback sea turtles that were sighted on the continental slope were 12 times more abundant during the summer than the winter (MMS and USGS 2000). Temporal variability in leatherback distribution and abundance suggests that specific areas might be important to this species, either seasonally or for short periods of time.

Hawksbill Sea Turtle. The hawksbill sea turtle has been recorded in waters of all of the states along the GOM (NMFS and USFWS 1993). However, the hawksbill is the least common sea turtle in the GOM (MMS 2002b). The hawksbill sea turtle has been federally listed as endangered throughout its range since 1970. The species is primarily coastal and seldom seen in waters deeper than 20 m (65 ft). Hawksbill sea turtles inhabit rocky areas, coral reefs, shallow coastal areas, lagoons or oceanic islands, and narrow creeks and passes. The species is found in tropical and subtropical waters in the Atlantic, Pacific, and Indian Oceans. The global population of hawksbill sea turtles has declined 80 percent over the last 100 years, with only approximately 15,000 females nesting worldwide. Only five regional populations remain with more than 1,000 females nesting annually (Seychelles, Mexico, Indonesia, and two in Australia) (USFWS 2002b).

The highest densities of nests for the hawksbill sea turtle occur on the GOM and Caribbean coasts of the Yucatán Peninsula, Mexico. Nesting also occurs in lower densities on scattered beaches. The Caribbean populations account for 20 to 30 percent of the hawksbill population worldwide (USFWS 2002b). Historically, the Panama breeding population used to be the most important breeding population in the Caribbean; now the Mexico population is the most important. In most locations, nesting occurs between April and November, but varies depending on the area. No more than four nests were recorded annually from 1979 to 2000 in Florida. Nesting on U.S. GOM beaches is extremely rare, with only one nest on Padre Island, Texas, documented in 1998 (NMFS 2002a).

On average, individual females nest every 2 to 3 years laying an average of 4.5 nests per season at approximately 2-week intervals. Average clutch size is approximately 140 eggs (USFWS 2002b). Critical habitat is designated for hawksbill sea turtles in Puerto Rico and the waters off Puerto Rico (50 CFR 17.95, 50 CFR 226.209).

Adults usually forage around coral reefs and other hard-bottom habitats at depths of 100 m (328 ft) or more. Sponges are the major component of the hawksbill sea turtle diet (USFWS 2002b). Hawksbill sea turtles have been sighted near coral reefs south of Florida and very few have been documented near Texas (NMFS 2002a). The GulfCet I and II surveys did not identify any hawksbill sea turtles, although there were some sightings of unidentified sea turtles (MMS 1996; MMS and USGS 2000).

Green Sea Turtle. The green sea turtle breeding colony populations in Florida and on the Pacific coast of Mexico have been federally listed as endangered; all other populations have been listed as threatened. The species was listed in 1978. The green sea turtle nests in tropical and subtropical waters worldwide and inhabits shallow waters (except when migrating) inside reefs, bays, and inlets. It is associated with marine grass and algae (USFWS 2002c). It is found in western Atlantic waters of the United States from Massachusetts to Texas, as well as in waters off Puerto Rico and the U.S. Virgin Islands (MMS 1999).

In the United States, green sea turtles nest in North Carolina, South Carolina, Georgia, Florida, the U.S. Virgin Islands, and Puerto Rico. The east coast of Florida is considered a principal nesting area for green sea turtles. Conservative estimates from 1990 through 1999 range from 470 to 1,509 nesting females per year in Florida (NMFS 2002a). Since historical data on green sea turtles are sparse, long-term nesting population trends are difficult to identify. Estimates indicate, however, that the species might be recovering. Green sea turtles rarely nest in the GOM, but nesting has been reported at Eglin Air Force Base, on the Florida Panhandle (MMS 1999). On average, individual females nest every 2 to 4 years, laying an average of 3.3 nests per season, at approximately 13-day intervals. Average clutch size is approximately 140 eggs (USFWS 2002c).

Green sea turtles are known to make extensive migrations between nesting and feeding habitats (NMFS 2002a). Hatchling green sea turtles eat a variety of plants and animals and forage in areas such as coral reefs, emergent rocky bottom, *Sargassum* mats, and lagoons and bays (MMS 2001). Adults feed on seagrasses and marine algae, including species of *Cymodcea*, *Thalassia*, and *Zostera* (USFWS 2002c; NMFS 2002b). Feeding grounds in the GOM include inshore south Texas waters, the upper west coast of Florida, and the northwestern coast of the Yucatán Peninsula, Mexico.

Green sea turtles occur in small numbers over seagrass beds along the south Texas coast and the Florida GOM coast. Reports of green sea turtles nesting along the central GOM coast are infrequent, and the closest important nesting aggregations are along the east coast of Florida and the Yucatán Peninsula (NMFS and USFWS 1991b). The GulfCet I and GulfCet II surveys did not identify any green sea turtles, although there were some sightings of unidentified sea turtles (MMS 1996; MMS and USGS 2000). Critical habitat is designated for the green sea turtle in the waters off Culebra Island, Puerto Rico (50 CFR 226.208).

3.2.5 Seabirds and Migratory Birds

3.2.5.1 Nonthreatened and Nonendangered Bird Species

The waters and adjacent coastal landforms of the northern GOM are inhabited by a diverse assemblage of resident and migratory birds (Clapp et al. 1982). There are four groups of coastal and marine birds that inhabit these areas, including seabirds, shorebirds, marsh and wading birds, and waterfowl (MMS 2001). Examples of these birds that would occur in the ROI are presented in Table F-2 in Appendix F. The discussion of these groups and terrestrial birds is limited to those species that might occur within coastal margins and nearshore and offshore waters of the northern GOM.

The GOM is an important pathway for migratory birds, including many coastal and marine species, and large numbers of terrestrial species. Most of the migrant birds (especially passerines or perching birds) overwinter in the neotropics (tropical Central America and South America), breed in eastern North America, and directly cross the GOM (trans-Gulf migration) or move north or south by traversing the GOM coast or the Florida Peninsula (MMS 2002b). Recent studies indicate that the flight pathways of the majority of the trans-Gulf migrant birds during spring are directed toward the coastlines of Louisiana and eastern Texas. During overwater flights, migrant birds (other than seabirds) commonly use offshore oil and gas production platforms for rest stops or as temporary shelter from inclement weather. Thus it is believed that these platforms could serve as artificial islands for these species during their migrations (MMS 2002a).

Seabirds are defined as those species that spend extended periods away from land and obtain all or most of their food from the sea while flying, swimming, or diving. Five taxonomic orders of seabirds are found in both offshore and coastal waters of the northern GOM. Some species of this group inhabit only pelagic habitats in the GOM (OCS and beyond) (e.g., boobies, petrels, and shearwaters) (Fritts and Reynolds 1981). Most GOM seabird species, however, inhabit waters of the continental shelf, and adjacent coastal and inshore habitats (Clapp et al. 1982).

GOM seabirds are categorized into four broad categories: summer migrant pelagics, summer residents, wintering marine species, and permanent residents (Fritts and Reynolds 1981). Summer migrant pelagic species are those that are present in the GOM during the summer but breed primarily elsewhere. Examples include black terns, boobies, shearwaters, storm-petrels, and tropicbirds. Summer residents are those which are present during summer months but also breed in the GOM. Examples include least terns, sandwich terns, and sooty terns. Wintering marine birds are those that might be found in the GOM only during winter months. Examples of wintering species include herring gulls, jaegers, and the northern gannet. Examples of permanent residents include bridled terns, laughing gulls, magnificent frigatebirds, and royal terns. Some species of seabirds inhabit only pelagic habitats in the GOM (OCS and beyond) (e.g., boobies, petrels, and shearwaters). Most GOM seabird species, however, inhabit waters of the continental shelf and adjacent coastal and inshore habitats (Clapp et al. 1982; MMS 2002b).

Seabird distributions and abundances in the offshore waters of the GOM were studied in the GulfCet I and II surveys. The GulfCet I survey identified 14 species represented more than 99 percent of the total sightings. The most abundant species sighted were terns, storm-petrels, jaegers, and laughing gulls. Distribution of species groups and individual species of seabirds was associated with water depth and varied both spatially and seasonally. Another environmental parameter that was identified to affect seabird distribution included surface productivity. Seabird groups tend to concentrate at fronts defined by steep temperature gradients, which are often areas of upwelling and higher productivity (Ribic et al. 1997). Geographically, the highest species diversity of seabirds is associated within cyclonic eddies, while the lowest species diversity occurred on the continental shelf. Seasonally, species diversity is greatest in spring and lowest in winter and fall. The number of birds sighted per day is highest in summer and lowest in fall (MMS 1996; MMS and USGS 2000).

Shorebirds include members of the Order Charadriiformes, which, outside of their migratory cycles, are generally restricted to coastline margins. Shorebirds are among the world's greatest migratory animals. Many North American shorebirds seasonally traverse between the high Arctic and South America, and occasionally spill over into Asia and Europe. Certain coastal and adjacent inland wetland habitats of the GOM serve as vital overwintering habitats and temporary "staging" habitats for shorebirds. Staging birds (those migrant species that reside temporarily along the Gulf Coast) forage within coastal habitats in an effort to accumulate energy reserves necessary for the completion of their migratory efforts (MMS 2001). Many shorebird species typically aggregate in large numbers within select GOM coastal habitats. In addition, many of the overwintering shorebird species remain within specific areas throughout the season and return to the same areas each year. These species are susceptible to localized habitat loss or degradation.

Marsh and wading birds live in or around marshes and swamps. Marsh birds forage primarily from atop marsh vegetation; wading birds forage primarily while standing in water. Marsh birds include species from the Order Gruiformes, such as rails, coots, moorhens, and gallinules; species from the Order Charadriiformes, such as jacanas; and species from the Order Podicipediformes, such as grebes. Wading birds are birds from the Order Ciconiiformes that have adaptations such as long legs, long necks, and probing bills, which allow them to forage in shallow water. These include bitterns, egrets, herons, ibises, and spoonbills. Prey for these species includes fish, frogs, aquatic insects, and crustaceans. The Louisiana coast supports the majority of the nesting GOM wading birds (MMS 2001).

Waterfowl are members of the Order Anseriformes that inhabit freshwater and marine aquatic habitats. Many of these birds are migrant species that, primarily during winter months, congregate on coastal waters, beaches, flats, sandbars, and wetland habitats along the northern GOM (MMS 2001). The Louisiana coast is one of the most productive areas for marine birds in the continental United States and supports enormous wintering populations of waterfowl (Clapp et al. 1982).

3.2.5.2 Threatened and Endangered Bird Species

The threatened and endangered birds that occur in the central and western GOM and inhabit or frequent coastal areas and waters of the inner continental shelf include the bald eagle (*Haliaeetus leucocephalus*), brown pelican (*Pelicanus occidentalis*), and piping plover (*Charadrius melodus*). Because of their normal coastal or inner continental shelf ranges, these species are not expected to occur in the ROI.

Bald Eagle. The bald eagle (*Haliaeetus leucocephalus*) is listed as threatened. It is a terrestrial raptor that is widely distributed across the southern United States, including coastal habitats along the GOM (USCG and MARAD 2003a). Bald eagles nest in Louisiana from October through mid-May. Eagles typically nest in bald cypress trees near fresh to intermediate marshes or open water in the southeastern parishes (Firmin 2003). Areas with high numbers of nests include the Lake Verret Basin south to Houma, the southern marsh ridge from Houma to Bayou Vista, the north shore of Lake Pontchartrain, and the Lake Salvador area. One hundred twenty bald eagle nests have been found in Louisiana; only three nests within 8 km (5 mi) of the coast (MMS 2002a).

Major threats to this species include habitat alteration, human disturbance, and environmental contaminants (i.e., organochlorine pesticides and lead) (Firmin 2003). Human activity near a nest late in the nesting cycle might also cause flightless birds to jump from the nest tree, decreasing their chance for survival. Populations of southern bald eagles have increased in recent years as a result of the ban of DDT pesticide and the efforts of intense recovery programs; however, it is currently listed as threatened (MMS 2002a).

Brown Pelican. The brown pelican (*Pelicanus occidentalis*) is listed as endangered in Mississippi, Louisiana, and Texas. It is one of two pelican species in North America. Associated primarily with coastal waters, brown pelicans are currently known to nest on Raccoon Point on Isles Dernieres, Queen Bess Island, Plover Island (Baptiste Collette), Wine Island, Rabbit Island (Calcasieu Lake), and islands in the Chandeleur chain. Pelicans change nesting sites as their habitats change. Thus, pelicans might also be found nesting on mud lumps at the mouth of South Pass (Mississippi River Delta) and on small islands in St. Bernard Parish. In winter, spring, and summer, nests are built in mangrove trees or other shrubby vegetation, although occasional ground nesting might occur (Firmin 2003).

Brown pelicans feed in shallow estuarine waters, using sand spits and offshore sand bars as rest and roost areas along coastal Louisiana. They are known to forage as far as 32 km (20 mi) off the shore of the Louisiana Gulf Coast, and it is possible that they could range slightly farther than 32 km (20 mi) offshore if they become lost or disoriented (Firmin 2003). As the proposed Port would be approximately 61 km (38 mi) off the shore of Louisiana, it is unlikely that brown pelicans would occur near the proposed Terminal area or pipeline corridors.

Major threats to this species include chemical pollutants, colony site erosion, disease, and human disturbance (Firmin 2003). Following the ban of DDT, this species has successfully recolonized much of its former range and has been delisted from its endangered status for most of its range; however, it is still listed as endangered in Louisiana (USFWS 1995).

Piping Plover. The piping plover (*Charadrius melodus*) is listed as endangered. The piping plover and its designated critical habitat occur along the GOM shoreline. Piping plovers winter in Louisiana, and are generally present for 8 to 10 months; they arrive from the breeding grounds as early as late July and remain until late March or April. Piping plovers feed extensively on intertidal beaches, mud flats, sand flats, algal flats, and wash-over passes with no or very sparse emergent vegetation; they also require unvegetated or sparsely vegetated areas for roosting. Roosting areas have debris, detritus, or micro topographic relief offering refuge to piping plovers from high winds and cold weather. In most areas, wintering piping plovers are dependant on a mosaic of sites distributed throughout the landscape, as the suitability of a particular site for foraging or roosting is dependent on local weather and tidal conditions. Piping plovers move among nesting sites as environmental conditions change (Firmin 2003).

Designated piping plover critical habitat includes those specific areas that are essential to the conservation of that species. The primary constituent elements for piping plover wintering habitat are those that support foraging, roosting, and sheltering, and have the physical features necessary for maintaining the natural processes that support those habitat components. Constituent elements are found in geologically dynamic coastal areas that contain intertidal beaches and flats between annual low tide and annual high tide, and associated dune systems and flats above annual high tide. Important components (or primary constituent elements) of intertidal flats include sand flats or mud flats with no or very sparse emergent vegetation. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting plovers. Major threats to this species include the loss and degradation of habitat due to development, disturbance by humans and pets, and predation (Firmin 2003).

3.2.6 Fisheries and Essential Fish Habitat

3.2.6.1 Fisheries Resources

The northern GOM has traditionally been one of the most productive fishery areas in North America (Gunter 1967). The GOM's marine habitats, ranging from coastal marshes to the deep-sea abyssal plain, support a varied and abundant fish fauna. Demersal and coastal pelagic fish assemblages are recognized within broad habitat classes for the continental shelf and oceanic waters of the GOM. The fish assemblage associated with the proposed Terminal area is referred to as the inner shelf assemblage (Gallaway 1981).

3.2.6.2 Demersal Fishes

Bottom-oriented or demersal fish fauna of the GOM are characterized by substrate composition and water depth (Gallaway 1981). Demersal fish assemblages are named by the dominant shrimp species found in the same sediment/depth regime. The dominant assemblage in the area of the proposed Port is the white shrimp assemblage (fine sediments, west of De Soto Canyon found in depths between 3.5 to 22 m [11.5 to 72.2 ft]). The white shrimp assemblage consists of species such as Atlantic croaker, star drum, Atlantic cutlassfish, sand sea trout, silver sea trout, Atlantic threadfin, and hardhead catfish. Most of these species spawn in shelf waters and spend their early life stages in estuarine waters (MMS 2002a).

3.2.6.3 Coastal Pelagic Fishes

Coastal pelagic fish inhabit the shelf waters of the GOM throughout the year. The major coastal pelagic fish in the GOM include requiem sharks, ladyfish, anchovies, herrings, mackerels and tunas, jacks, mullets, bluefish, and cobia. Some species form large schools (e.g., Spanish mackerel), while others travel independently or in smaller groups (e.g., cobia).

Coastal pelagic fish can be divided into two ecological groups: predators and planktivores. The predators include species such as king and Spanish mackerels, bluefish, cobia, dolphin, jacks, and little tunny. These species typically undergo migrations, grow rapidly, mature early, and exhibit high fecundity. Some large predator species (particularly bluefish, Spanish mackerel, and blue runner) might be attracted to large concentrations of anchovies, herrings, and silversides that congregate in nearshore areas. The planktivores have similar life history characteristics, but the species are smaller in body size. This group includes Gulf menhaden, Atlantic thread herring, Spanish sardine, round scad, and anchovies (MMS 1999, 2002b).

3.2.6.4 Managed Species

Commercial and recreational fisheries resources in Federal waters of the GOM are managed by the Gulf of Mexico Fishery Management Council (GMFMC) and NOAA Fisheries. The GMFMC is one of eight regional Fishery Management Councils established by the MSA. Fishery Management Plans (FMPs) developed by the GMFMC include

- *Shrimp Fishery of the Gulf of Mexico, U.S. Waters*
- *Red Drum Fishery of the Gulf of Mexico*
- *Reef Fish of the Gulf of Mexico*
- *Coastal Migratory Pelagic Resources (Mackerels) in the Gulf of Mexico*
- *Stone Crab Fishery of the Gulf of Mexico and South Atlantic*

- *Spiny Lobster in the Gulf of Mexico and South Atlantic*
- *Coral and Coral Reefs of the Gulf of Mexico*

Secretarial FMPs have been developed by NOAA Fisheries for highly migratory species and include Amendment 1 to the *Atlantic Billfish Fishery Management Plan* and *Final Fishery Management Plan for Atlantic Tuna, Swordfish, and Sharks*. EFH for federally managed species is addressed in Section 3.2.6.8.

3.2.6.5 Commercial Fisheries

Gulf menhaden comprised the bulk of the commercial landings in the GOM from 1997 to 2001. Average annual landings of Gulf menhaden for this time period were 1.29 billion pounds (lbs) (74 percent of the landings). Other species that dominated commercial landings for this time period were brown shrimp (8 percent), white shrimp (4 percent), blue crab (4 percent), and eastern oyster (4 percent). Louisiana landings were comprised predominantly of Gulf menhaden (83 percent), brown shrimp (4 percent), white shrimp (4 percent), and blue crab (3 percent). Texas landings were comprised predominantly of brown shrimp (54 percent), white shrimp (23 percent), blue crab (6 percent), eastern oyster (5 percent), and black drum (3 percent). Section 3.5.2 presents a description of the value of the GOM fisheries.

3.2.6.6 Recreational Fisheries

Spotted sea trout, Spanish mackerel, and Atlantic croaker were the most commonly caught nonbait species (numbers of fish). By weight, the largest harvests were of red drum, spotted seatrout, sheepshead, red snapper, Spanish mackerel, king mackerel, and dolphin (O'Bannon 2002). Spotted sea trout, red drum, Atlantic croaker, sand sea trout, and black drum dominated the Louisiana recreational harvest in 2001, in terms of numbers. By weight, the largest harvests were red drum, spotted sea trout, black drum, unclassified tunas and mackerels, and sheepshead.

3.2.6.7 Ichthyoplankton

As indicated by the fishery productivity of the GOM, ichthyoplankton (fish eggs and larvae) is abundant in the north-central GOM (Lyczkowski-Schultz 2003a). The distribution of fish eggs and larvae depends on spawning behavior of adults, hydrographic structure and transport on a variety of scales (e.g., tidal transport and diel migration), duration of the pelagic period, behavior of larvae, and larval mortality and growth (MMS 2002a). These factors can also result in the patchy distribution of plankton.

Research indicates that most eggs and yolk-sac larvae (defined as a fish larvae which has hatched from the egg but has not started feeding and still absorbs the yolk in the attached sac) are planktonic for a few days after being spawned. The presence of the stages is an indication of spawning areas and seasonal spawning migrations of adults (Ditty et al 1988). Spawning by adults is often triggered by water temperature.

Water temperature is a major influence on the distribution of larval fish (MMS 2002b). Larval densities are lowest during winter, increase during the spring, peak, during the summer, and decline during the fall. Table 3-4 presents the seasonality and peak seasonal occurrence of larval fishes in the north-central GOM. Most fish species would be in the ROI in the spring, late spring, and early fall. However, larval fish occur in the north-central GOM throughout the year.

Table 3-4. Seasonality and Peak Seasonal Occurrence of Larval Fish (< 10 mm standard length) in the North-Central GOM

Family (common name)	Taxa (common name)	Scientific Name	J	F	M	A	M	J	J	A	S	O	N	D
Herring and Menhaden	Gulf menhaden	*Brevoortia patronus*	*	*	X	X					X	X	X	*
	Round herring	*Etrumeus teres*	*	*	*	X	X	X					X	X
	Atlantic thread herring	*Opisthonema oglinum*			X	X	*	*	*	*	X	X	X	
Anchovy	Striped	*Anchoa hepsetus*	X	X	*	*	*	*	*	*	*	X	X	X
	Bay	*Anchoa mitchilli*	X	X	*	*	*	*	*	*	*	X	X	X
	Longnose	*Anchoa nasuta*	X	X	*	*	*	*	*	*	*	X	X	X
Sea Bass and Grouper	Sand perch	*Diplectrum formosum*	X	X	X	X	*	*	*	*	X	X	X	X
	Pygmy sea bass	*Serraniculus pumilio*					X	*	*	*	*	X	X	
Jacks, Scads, Pompanos, and relatives	Blue runner	*Caranx crysos*			X	X	X	*	*	*	X	X	X	
	Atlantic bumper	*Chloroscombrus chrysurus*				X	X	*	*	*	*	X		
	Round scad	*Decapterus punctatus*			X	*	*	*	*	*	*	X	X	
	Rough scad	*Trachurus lathami*	*	*	X	X	X						X	X
	Dolphin	*Coryphaena hippurus Linnaeus*					X	X	X	X	X	X	X	
Snapper	Red	*Lutjanus campechanus*				X	X	*	*	*	X	X	X	
	Gray	*Lutjanus griseus*				X	X	*	*	*	X	X	X	
	Lane	*Lutjanus synagris*				X	X	*	*	*	X	X	X	
Mojarras	Pigfish	*Orthopristis chrysoptera*	X	X	*	X	X							
Porgies	Sheepshead	*Archosargus probatocephalus*	X	*	*	*	X							
	Pinfish	*Lagodon rhomboides*	*	*	X	X						X	X	*
Drums, Croakers, Sea Trout	Spotted seatrout	*Cynoscion nebulosus*		X	X	*	*	*	*	*	X	X		
	Spot	*Leiostomus xanthurus*	*	X	X	X						X	X	*
	Atlantic croaker	*Micropogon undulates*	*	X	X	X					X	*	*	*
	Red drum	*Sciaenops ocellata*								X	*	*	X	
Spadefish	Atlantic spadefish	*Chaetodipterus faber*				X	X	*	*	*	X			
Mackerels, Tunas, Wahoo	Bullet mackerel	*Auxis rochei*	X	X	X	X	*	*	*	*	*	X	X	
	Little tunny	*Euthynnus alletteratus*				X	*	*	*	*	*	X	X	
	Skipjack tuna	*Euthynnus pelamis*				X	X	X	X	X	X	X		
	King mackerel	*Scomberomorus cavalla*					X	X	X	*	*	X	X	
	Spanish mackerel	*Scomberomorus maculates*				X	X	X	X	*	*	X		
	Bluefin tuna	*Thunnus thynnus*				X	X	X						
Butterfish	Gulf butterfish	*Peprilus burti*	*	*	*	X	X	X	X	X	X	X	*	*

Source: Ditty et al. 1988

Notes: X – Seasonality

* – Peak Seasonal Occurrence

Ichthyoplankton distribution can also be affected by hydrographic features (e.g., currents). Two of the most important hydrographic features in the GOM are the Mississippi River discharge plume and the Loop Current. Researchers hypothesize ichthyoplankton aggregate at the frontal zone of the Mississippi River and that the discharge plume might indicate that frontal waters provide feeding and growth opportunities for larvae. Bothids (lefteye flounders), carangids (jacks), engraulids (anchovies), exocoetids (flying fish), gobiids (gobies), sciaenids (drums), scombrids (mackerels and tunas), synodontids (lizardfish), and tetraodontids (puffers) are the most frequently caught taxa in the plume/shelf samples off the Mississippi River Delta (MMS 2002a).

Daily or diel migrations might result from changes in light intensity, nutrients, and density gradients in the water column (Nybakken 1997). Vertical diel migrations of larvae have been documented for red drum (Sciaenops ocellatus) in the north-central GOM, as well as for a wide range of other marine taxa (Helfman et al. 1997). Most commonly, larval fish migrate to lower depths during daytime, however, reverse migrations, where larvae migrate towards the surface during the daytime, have also been documented (USFWS 1983–1988; Schultz et al. 2003; Lyczkowsi-Shultz and Steen 1991; Jenkins et al. 1998).

In deeper waters, many ichthyoplankton taxa are collected within specific depth contours. Inshore demersal species, such as Atlantic bumper (Caranx ruber) (an important forage species), spotted seatrout (Cynoscion nebulosus), pigfish (Orthopristis chrysoptera), and black drum (Pogonias cromis), are found in water depths shallower than 25 m (82 ft). Several clupeids (herrings) (Brevoortia patronus, Opisthonema oglinum, and Sardinella aurita) and serranids (sea basses) (Centropristis striata, Diplectrum formosum, and Serraniculus pumilio) are found at depths less than 50 m (164 ft). Species collected exclusively at depths of 50 to 200 m (164 to 656 ft) were tuna (Auxis sp. and Euthynnus alletteratus), blue runner (Caranx crysos), round herring (Etrumeus teres), red barbier (Hemanthias vivanus), red snapper (Lutjanus campechanus), king mackerel (Scomberomorus cavalla), and rough scad (Trachurus lathami). Wide-ranging epipelagic species were collected in water depths exceeding 150 m (492 ft), including skipjack tuna (Euthynnus pelamis), sailfish (Istiophorus platypterus), and Atlantic swordfish (Xiphias gladius). Table 3-5 presents the primary depth distribution of larvae of some abundant fish species in the northern GOM. Species likely to occur in the ROI are the species distributed less than 100 m (328 ft).

Plankton surveys have been conducted in the GOM as part of the South East Area Monitoring and Assessment Program (SEAMAP) since 1982. Plankton is collected using both neuston net and bongo nets. The neuston net has a 1 by 2 m (3.28 by 6.56 ft) mouth opening and a mesh size of 0.950 mm. This net is fished at a depth of 0.5 m (1.64 ft) along the surface of the water. Neuston net data cannot be expressed in terms of water volume and were not used for this analysis. The bongo net has a 60 cm (23.6 in) diameter mouth opening and carries 0.333 mm mesh netting. The bongo net is fitted with a flowmeter that allows the volume of water filtered during the tow to be measured. This net is fished from approximately 1 to 5 m (3.28 to 16.4 ft) off the bottom to the water's surface and yields a sample from the water column that is integrated over depth (i.e., an oblique tow). Most of the year, the water column is mixed at depths similar to the ROI (Lyczkowski-Shultz 2003a). It is important to note that while EFH for white and brown shrimp are located within the ROI, the SEAMAP data do not include invertebrate eggs and larvae, only fish eggs and larvae (ichthyoplankton).

Ichthyoplankton abundance in the ROI and Alternate Site were estimated using bongo net samples from the 30 by 30 NM (34.5 by 34.5 mi) sampling station that overlaps the proposed Gulf Landing Terminal site (WC-213) and Alternate Site (WC-183). Estimates of abundance for both sites based on these data are presented in Table 3-6.

Table 3-5. Primary Depth Distribution of Larval Fish (< 10 mm standard length) in the GOM, North of 26° N Latitude

Common Name	Genus/Species	< 25 m (< 82 ft)[1]	< 50 m (< 164 ft)[1]	< 100 m (< 328 ft)[1]	50–200 m (164–656 ft)[1]	> 150 m (> 492 ft)[1]
Sheepshead	*Archosargus probatocephalus*[2]	X				
Atlantic spadefish	*Chaetodipterus faber*	X				
Atlantic bumper	*Chloroscombrus chrysurus*	X				
Sand seatrout	*Cynoscion arenarius*	X				
Spotted seatrout	*C. nebulosus*[2]	X				
Pigfish	*Orthopristis chrysoptera*	X				
Northern harvestfish	*Peprilus paru*	X				
Black drum	*Pogonias cromis*[2]	X				
Anchovies	*Anchoa* spp.	X	X			
Gulf menhaden	*Brevoortia patronus*[2]	X	X			
Black sea bass	*Centropristis striata*	X	X			
Sand perch	*Diplectrum formosum*	X	X			
Scaled herring	*Harengula jaguana*	X	X			
Pinfish	*Lagodon rhomboides*[2]	X	X			
Spot	*Leiostomus xanthurus*[2]	X	X			
Atlantic croaker	*Micropogonias undulates*[2]	X	X			
Atlantic thread herring	*Opisthonema oglinum*	X	X			
Round sardinell	*Sardinella aurita*	X	X			
Spanish mackerel	*Scomberomorus maculatus*	X	X			
Pygmy sea bass	*Serraniculus pumilio*	X	X			
Round scad	*Decapterus punctatus*	X	X	X		
Gulf butterfish	*Peprilus burti*	X	X	X		
Mackerel	*Auxis* spp.				X	
Blue runner	*Caranx crysos*				X	
Round herring	*Etrumeus teres*				X	
Little tunny	*Euthynnus alletteratus*				X	
Red barbier	*Hemanthias vivanus*				X	
Red snapper	*Lutjanus campechanus*				X	
King mackerel	*Scomberomorus cavalla*				X	
Rough scad	*Trachurus lathami*				X	
Skipjack tuna	*Euthynnus pelamis*					X
Sailfish	*Istiophorus* spp.					X
Swordfish	*Xiphias gladius*					X

Source: MMS 2002a

Notes:

[1] Depth ranges are those at which more than 75 percent of larvae were collected.

[2] Indicates larvae are estuarine dependent.

Table 3-6. Estimate of Egg and Larval Abundance at the Proposed and Alternate Site for the Gulf Landing Terminal, Based on SEAMAP Data

Sample Site	Number of Samples	Life Stage	Number of Eggs or Larvae/m^3 of Sea Water		Number of Eggs or Larvae/Million Gallons of Sea Water[1]	
			Mean	Standard Error[2]	Mean	Standard Error[2]
WC-213	35	Eggs	2.87	0.938	10,875	3,551
	33	Larvae	1.12	0.075	4,225	284
WC-183	25	Eggs	2.07	0.521	7,843	1,972
	50	Larvae	1.02	0.079	3,869	299

Source: Adapted from GL2003a

Notes: [1] Number of eggs or larvae/m3 multiplied by 3,785.4 for a conversion factor (3,785.4 m^3 in a million gallons)

[2] Standard error of the mean is a measure of variability of the samples (defined as the standard deviation of a distribution of means for the samples). Standard error of the mean is used to construct confidence limits. We can be 95 percent confident that the estimate of eggs or larvae from the sample is between the mean plus or minus 2 standard errors.

Table 3-7. Estimates of Egg and Larval Abundance at the Proposed and Alternate Site for the Gulf Landing Terminal, Based on Different Methodologies to Demonstrate Potential Range of Impacts

Sample Site	Life Stage	Number of Eggs or Larvae/Million Gallons of Sea Water			
		Mean	Adjusted Lower Confidence Limit[1]	Adjusted Mean[2]	Adjusted Upper Confidence Limit[3]
WC-213	Eggs	10,875	10,691	32,626	54,562
	Larvae	4,225	10,962	12,674	14,385
WC-183	Eggs	7,843	13,239	23,530	33,822
	Larvae	3,869	9,396	11,606	13,816

Source: Adapted from GL2003a

Notes: [1] Adjusted mean minus 2 adjusted standard errors (the standard deviation times 3/sqrt of the sample size)

[2] Mean multiplied by a factor of 3 as suggested by NOAA Fisheries (Thompson 2004)

[3] Adjusted mean plus 2 standard errors

Between 1982 and 1999, 33 samples were collected within 39 km (24 mi) of the proposed Gulf Landing Terminal location, (hereafter referred to as the WC-213 samples). The WC-213 samples indicate that an average of 10,785 eggs and 4,225 larvae occur in a million gallons of sea water in the area of the proposed Gulf Landing Terminal location (GL 2003a). However, studies indicate that a mesh size of 0.333 can underestimate fish eggs and larvae by a factor of 5 to 8 times (Thomspon 2004). A suggested correction factor is to multiply the SEAMAP fish egg and larvae abundances by 3 (Thompson 2004). However, the ichthyoplankton data are highly variable. Another approach would be to construct 95 percent confidence intervals around the adjusted mean by subtracting and adding two adjusted standard errors to the mean (calculations are presented in Table F-8, Appendix F). The three estimates of abundance (mean abundance, mean abundance multiplied by a correction factor of 3, and mean abundance minus and plus two adjusted standard errors) for the WC-213 samples are presented in Table 3-7.

The larvae in the WC-213 samples represent a total of 126 taxa (i.e., larvae identified to the lowest taxon possible) (GL 2003a). These taxa are presented in Table F-5, in Appendix F. The 10 most abundant taxa, in order of decreasing abundance, are red drum (*Sciaenops ocellatus*), star drum (*Stellifer lanceolatus*), Atlantic bumper (*Chloroscombrus chrysurus*), silversides (Family Atherinidae), puffer (Family Tetraodontidae), Atlantic thread herring (*Opisthonema oglinum*), Spanish mackerel (*Scomberomorus maculatus*), silver perch (*Bairdiella chrysoura*), tonguefish (*Symphurus sp.*), and anchovies (Family Engraulidae).

Twenty-five samples were collected within 47 km (29 mi) of the Alternate Site (hereafter referred to as the WC-183 samples). The WC-183 samples indicated that an average of 7,843 eggs and 3,869 larvae occur in a million gallons of seawater in the area of the proposed Alternate Site (GL 2003a). The three estimates of abundance (mean abundance, mean abundance multiplied by a correction factor of 3, and mean abundance minus and plus two adjusted standard errors) for the WC-183 samples are presented in Table 3-7.

The larvae in the WC-183 samples represent 122 taxa (i.e., larvae identified to the lowest taxon possible) (GL 2003a). These taxa are presented in Table F-6, in Appendix F. The 10 most abundant taxa, in order of decreasing abundance, are Atlantic bumper (Chloroscombrus chrysurus), spotted snake eel (*Myrophis punctatus*), feather blenny (*Hypsoblennius hentzi*), anchovy (Family Engraulidae), fringed filefish (*Monacanthus ciliatus*), scaled sardine (*Harengula jaguana*), Atlantic thread herring (*Opisthonema oglinum*), pompano/permit (*Trachinotus sp.*), leatherjacket (Family Balistidae), and sea bass (Family Serranidae)

While these estimates of ichthyoplankton densities are based on the best available data, there are data limitations. These limitations result from the inherent patchiness of plankton distribution (described above), limitations of the sampling methods, differing sampling gear, and lack of invertebrate data. Several attempts were made to account for these sources of variability in the estimates of abundance. The resulting estimates in abundance are presented in Table 3-7.

The patchiness of plankton distribution is a result of a number of factors such as water temperature, spawning events, hydrographic features, and diel migrations. How these factors affect ichthyoplankton distribution is described above. Patchiness of plankton distribution is demonstrated by the variability of the WC-213 and WC-183 samples (Table 3-7). Abundance of eggs in the WC-213 samples ranged from 106 to 72,051 eggs per million gallons of filtered sea water. Abundance of larvae in the WC-213 samples ranged from 1,760 to 7,571 larvae per million gallons of filtered sea water. Abundance of eggs in the WC-183 samples ranged from 45 to 36,397 eggs per million gallons of filtered sea water. Abundance of larvae in the WC-183 samples ranged from 291 to 10,096 larvae per million gallons of filtered sea water.

Limitations of the sampling method and sampling gear include a lack of data on the vertical distribution of ichthyoplankton, a lack of data throughout the year, and sampling gear mesh size that can under-estimate smaller eggs, larvae, and zooplankton.

Oblique tows (i.e., from the bottom to the top of the water column) that are used in the SEAMAP survey provide an estimate of ichthyoplankton that occur throughout the water column. However, vertical tows do not give an indication as to whether densities of ichthyoplankton are stratified or different throughout the water column. Stratified tows would provide information on where an organism is located in the water column (Wolff and Wormuth 1984). It is documented that ichthyoplankton are stratified in deeper waters. However, sources are unclear whether ichtyoplankton are well-mixed in the shallower waters, as in the ROI 16.7 m (55 ft).

One study indicates that certain species of larvae are found in different locations within the water column. The study area was at a water depth of 10 to 12 m (33 to 40 ft). The study made some general conclusions about the distribution of larvae species throughout the water column. Most anchovy (Engraulidae) larvae were collected at mid-depth, with some (11 percent) collected at the bottom. From the family Sciaenidae, most Atlantic croaker (*Micropogonias undulates*) were collected at mid-depth and sand sea trout (*Cynoscion arenarius*) were collected near the bottom. From the family Clupeidae, scaled sardines (*Harengula jaguana*) were collected near the surface, menhaden (*Brevoortia spp.*) were collected at all depths, and Atlantic thread herring (*Opisthonema oglinum*) were collected at mid-depth. From the family Carangidae, Atlantic bumper (*Chloroscombrus chrysurus*) were most abundant near mid-depth. From the family Scombridae, Spanish mackerel (*Scomberomorus maculatus*) were collected at mid-depth (Ditty 1986).

SEAMAP ichthyoplankton data are collected from June through November, when spawning and recruitment of fish species are seasonally high (see Table 3-4). For example, menhaden (*Brevoortia* spp.) spawn in the winter (Wolff and Wormuth 1984). Therefore, estimates of ichthyoplankton densities could be elevated when used as an annual average, because SEAMAP ichthyoplankton data does not include invertebrate data. Therefore, the abundance of commercially important species such as brown shrimp and white shrimp (which have EFH in the ROI) cannot be estimated.

Bongo nets used to sample ichthyoplankton data for the SEAMAP survey have a mesh size of 0.333 mm. This mesh size could potentially undersample fish eggs and larvae and undersample larger zooplankton resulting from net regurgitation by smaller mesh sizes. For example, comparison of ichthyoplankton samples taken with 0.333- and 0.202-mm mesh nets indicate the smallest red drum larvae sampled were 5 to 8 times more numerous when collected with the finer mesh net. These results are expected to be applicable to larvae of other species (Lyczkowski-Shultz 2003b).

3.2.6.8 Essential Fish Habitat

EFH has been designated for brown shrimp, white shrimp, red drum, reef fish, coastal migratory pelagic resources, and highly migratory species (HMS) in the GOM by the GMFMC in the *Generic Amendment for Addressing Essential Fish Habitat Requirements* (GMFMC 1998). For some species, EFH for only a particular life history stage occurs in the ROI. In general, for each species managed by GMFMC, inshore EFH is the estuaries where the species are "common," "abundant," and "highly abundant," and offshore EFH is adult areas, spawning areas, and nursery areas for each species. However, the ROI would not include inshore EFH.

EFH for HMS is described in separate FMPs, including *Final Fishery Management Plan for Atlantic Tuna, Swordfish, and Sharks*, and *Amendment 1 to the Atlantic Billfish Fishery Management Plan* (NMFS 1999; NOAA Fisheries 1999).

The species and life history stages that have EFH in the ROI are presented in Table 3-8. Associated prey and forage species that could occur at the ROI are also presented in the Table 3-8. A more detailed description of EFH for each GMFMC and HMS species that have EFH within the ROI is presented in Appendix F, Tables F-3 and F-4.

Table 3-8. Species and Life History Stages for Which Essential Fish Habitat Has Been Designated in the ROI

Managed Species	Life Stages	Prey Species
Brown shrimp	eggs, larvae, adults	some zooplankton, various fish species, polychaetes, amphipods, benthic infauna,
White shrimp	eggs, larvae, adults	phytoplankton, zooplankton, detritus, annelid worms, pericarid crustaceans, caridean shrimp, diatoms, gastropods, copepods, bryozoans, sponges, corals, various fish species, filamentous algae, vascular plants
Red drum	eggs, larvae, adults	copepods, mysids, amphipods, shrimp, polychaets, insects, fish species, isopods, bivalves, crabs, shrimp
Red snapper	all life stages	alga, rotifers, zooplankton, shrimp, squid, octopus, crabs
Vermilion snapper	juvenile	not available
Lane snapper	juveniles, adults	copepods, grass shrimp, other small invertebrates, fish species, crustaceans, annelids, mollusks, and algae
Greater amberjack	juveniles, adults	invertebrates, various species of fish, crustaceans, and squid
Lesser amberjack	juveniles, adults	squid
Gray triggerfish	all life stages	*Sargassum* complex, natural reefs, bivalves, barnacles, crabs, gastropods, sea stars, sea cucumbers, brittle stars, sea urchins, sand dollars
King mackerel	juveniles, adults	various fish species (clupeids, carangids, engraulids), squid, and shrimp
Spanish mackerel	all life stages	various larval fish species (engraulids and carangids), crustaceans, gastropods, and squid
Cobia	all life stages	zooplankton, shrimp, various fish species, primarily crabs
Dolphin	all life stages	planktonic crustaceans, fish larvae, various fish species (dolphin, carangids, scombrids, fly fish) squid, and crustaceans
Bluefish	juveniles, adults	Copepods, Shrimp, crabs, squid, eels, fish species (clupeids, sciaenids, jacks, mackerels, mullets)
Little tunny	juveniles, adults	variety of fishes (herring), squid, shrimp, crustaceans (whatever is locally abundant)
Atlantic bluefin tuna	eggs, larvae, spawning adults	initially zooplankton, switch to larval fishes, larger fishes and gelatinous zooplankton, squids, pelagic crustaceans, and schooling fishes (anchovies, sauries and hakes depending on seasonal prey availability)
Bonnethead shark	juveniles, adults	unknown
Atlantic sharpnose shark	juveniles	unknown

Sources: Croom 2004; GMFMC 1998; NMFS 1999

3.2.6.9 Artificial Reef Communities

The attraction of biota to artificial reefs and their longevity at particular structures vary depending on the ecological role of the species in question, as well as environmental conditions. Fish can generally be classified as either resident or transient.

Within the resident community, two groupings can be made. The first group includes species directly dependent upon the biofouling community for food or cover. The second group includes those species that appear attracted to the structures for cover, exhibiting little trophic dependence on the biofouling community. Fish that are trophically independent of platforms are often responsible for most of the fish biomass around production platforms. Atlantic spadefish (*Chaetodipterus faber*), lookdown (*Selene vomer*), Atlantic moonfish (*Selene setapinnis*), and the creole-fish (*Paranthias furcifer*) all occupy a similar trophically independent niche and comprise high biomass around production platforms (GMFMC 1998).

Resident benthic species around production platforms that appear trophically independent of the biofouling community include species such as the red snapper (*Lutjanus campechanus*). Red snapper exhibit site fidelity, and population levels have been observed as high as 7,000 individuals around major platforms. This species is trophically linked to the surrounding soft bottom motile epifauna, preying mainly upon shrimp, swimming crab, and fish. Red snapper feed at night over soft bottoms away from the platforms, and return to the platforms during the day for cover. Other species with a similar trophic mode include large tomtate (*Haemulon aurolineatum*) and several large groupers (GMFMC 1998).

Resident species that appear trophically dependent upon the biofouling community for food or cover include small cryptic forms such as blennies (*Blenniidae*), as well as large grazers (e.g., sheepshead [*Archosargus probatocephalus*]) and small grazers (e.g., butterflyfish [Chaetodontidae]). Sheepshead exhibit site fidelity with population levels proportional to the submerged area of structure. Normal density of sheepshead was estimated to be about 0.3 fish per meter of submerged platform substrate (GMFMC 1998).

With the exception of barracuda (*Sphyraena barracuda*), almaco jack (*Seriola rivoliana*), hammerhead sharks (*Sphryna* spp.), and cobia, most of the large predators around petroleum platforms do not appear to be residents, but rather are believed to be highly transient. The above-listed species, along with bluefish, are either known to or expected to feed upon other resident species and probably have a longer resident time at platforms than do the other large predators such as various mackerels (*Scombridae*), jacks (*Caranx* spp.), and the little tunny (*Euthynnus alletteratus*). The latter species migrate to platforms for periods of a few hours to a few days as they follow large schools of prey species. Both the pelagic prey and predator species are attracted to structures, but with different schools constantly moving into and away from the structures. Large variations in the daily number of pelagic species are normal. The results of one study showed that as many as 10,000 fish were attracted to small, floating structures 1 day after they were positioned (GMFMC 1998).

Zonation of fish other than cryptic blennies at shallower coastal platforms was not evident. Dominant species were sheepshead and schools of Atlantic spadefish. Also in schools were bluefish and blue runner (*Caranx crysos*). Individual specimens of lookdown and Atlantic moonfish were also observed. Other reef-associated species observed were whitespotted soapfish (*Rypticus maculatus*), gray triggerfish, lane snapper, and two species of grouper (*Epinephelus nigritus* and *Mycteroperca rubra*) (GMFMC 1998).

Dominant fish at an offshore platform were bluefish, spadefish, and mixed schools of moonfish and lookdowns. Blue runner and other jacks (crevalle jack [*Caranx hippos*], greater amberjack, and almaco jack) were common. Sheepshead and gray triggerfish were present but not abundant, and large predators were represented by barracuda, cobia, and a nurse shark (*Ginglymostoma cirratum*). Reef fish encountered included cocoa damselfish, cubbyu, whitespotted soapfish, bigeye, and bermuda chub. The snapper/grouper assemblage was a major component of the ichthyofauna, represented by large schools of gray snapper and medium-to-large schools of red and lane snapper. Scamp (*Mycteroperca phenax*) were also abundant (GMFMC 1998).

3.2.6.10 Threatened and Endangered Fish Species

Gulf Sturgeon. The Gulf sturgeon (*Acipenser oxyrinchus desotoi*) is the only fish in the GOM that is listed as threatened. The USFWS and Gulf States Marine Fisheries Commission have developed a recovery plan to ensure the preservation and protection of Gulf sturgeon spawning habitat (MMS 2002a). Overfishing and habitat degradation have led to the decline of the Gulf sturgeon. Habitat degradation includes damming of coastal rivers and the degradation of water quality. Gulf sturgeons occur in the eastern portion of the GOM, distant from the location of the proposed Gulf Landing Terminal.

Smalltooth Sawfish. NOAA Fisheries listed the smalltooth sawfish (*Prestis pictinata*) as an endangered species on April 1, 2003 (68 FR 62 pp. 15674-15680).

Sawfish species inhabit shallow coastal waters of tropical seas and estuaries throughout the world. They are usually found in shallow waters very close to shore over muddy and sandy bottoms. They are often found in sheltered bays, on shallow banks, and in estuaries or river mouths. Certain species of sawfish are known to ascend inland in large river systems, and are among the few elasmobranchs known to inhabit freshwater systems in many parts of the world (NOAA Fisheries 2003b).

Smalltooth sawfish has been reported in both the Pacific and Atlantic Oceans, but the U.S. population is found only in the Atlantic. Historically, the U.S. population was common throughout the GOM from Texas to Florida, and along the east coast from Florida to Cape Hatteras. The current range of this species has contracted to peninsular Florida, and smalltooth sawfish are relatively common only in the Everglades region at the southern tip of the state. No accurate estimates of abundance trends over time are available for this species. However, available records, including museum records and anecdotal observations by fishermen, indicate that this species was once common throughout its historic range and that smalltooth sawfish have declined dramatically in U.S. waters over the last century (NOAA Fisheries 2003b).

3.3 Cultural Resources

3.3.1 Definition of the Resource

Cultural resources or historic properties consist of prehistoric or historic sites, structures, buildings, objects, or features that are made or modified in the course of human activities. Their discovery, assessment, and management are mandated by Federal laws and regulations.

The most important of the Federal mandate concerned with cultural resources is the NHPA. Section 106 of the NHPA requires agencies to take into account the effect of their undertakings on properties in, or eligible for, listing on the NRHP and to afford the ACHP an opportunity to comment on the undertaking. Gulf Landing LLC, as a non-Federal party, is assisting the lead agency in meeting its obligations under Section 106, and implementing regulations of 36 CFR 800 and the EO for the *Protection and Enhancement of the Cultural Environment* (EO 11593). The USCG and MARAD are deferring to MMS guidance for cultural resources surveys on the OCS, found in 30 CFR 250.194, to determine whether cultural resources are present in the Area of Potential Effect (APE). Other guidance includes the MMS Notice to Lessees and Operators (NTL) No. 2002-G01, *Archaeological Resource Surveys and Reports*, and NTL 98-20, *Shallow Hazards Requirements.*

MMS authority is granted under 30 CFR 250.194 to require that an archaeological report based on geophysical data be prepared if there are indications that a significant archaeological resource might exist within a lease area. For offshore historic resources, this decision is based on whether a historic shipwreck is reported to exist within or adjacent to a lease area. For offshore prehistoric resources, all leases shoreward of the 45 m (146 ft) bathymetric contour are required to have an archaeological survey before initiating exploration and development activities.

If the survey finds evidence of a possible archaeological resource within the lease area, the lessee must either move the proposed activity to avoid the possible resource or conduct further investigations to determine if an archaeological resource actually exists at the location. If an archaeological resource is present at the location of a proposed activity and cannot be avoided, Gulf Landing LLC will consult with the USCG and the MMS Regional Director to determine the procedures required to protect the resource.

Archaeological properties in the GOM that could be affected by the Proposed Action include inundated prehistoric sites and offshore historic shipwrecks. Any properties that are encountered in the survey must have their eligibility to the NRHP assessed against significance criteria developed by the ACHP.

3.3.2 Existing Conditions

3.3.2.1 Previously Recorded Cultural Features

The location of the proposed Port in the GOM would seem to preclude any evidence of human activity except that resulting from material lost or discarded in the course of maritime activity. However, at one time the area was dry land that would support human settlement. At the height of the late Wisconsian glacial advance (approximately 19,000 years ago) global sea level was approximately 120 m (394 ft) lower than at present. During this time, large expanses of what is now the OCS were exposed as dry land. According to the sea level curve proposed for the northern GOM by Coastal Environments, Inc., (CEI 1982), sea level 12,000 B.P. (Before Present) would have been approximately 45 m (148 ft) lower than at present. The approximate date of 12,000 B.P. is generally accepted as the earliest date that prehistoric human populations are known to have been in the Gulf Coast region (Aten 1983). The location of the 12,000 B.P. shoreline is roughly approximated by the 45 m (148 ft) bathymetric contour. The continental shelf shoreward of this contour would have potential for prehistoric sites more recent than 12,000 B.P.

Thus, inundated prehistoric sites might exist on the continental shelf shoreward of the 45 m (148 ft) bathymetric contour. Since known prehistoric sites on land usually occur in association with certain types of geographic features, they should be found in association with those same types of features now submerged and buried on the continental shelf.

Regional geological mapping studies by the MMS provide a geological framework to help interpret lease block survey data. This regional framework allows interpretations to go beyond identifying relict geomorphic features to assessing their archaeological potential in terms of their general age, the type of system to which they belong, and the geological processes that formed and modified them. In addition to identifying areas with a high probability for site occurrence, the potential for site preservation must also be considered. In general, sites covered by sediments in a low-energy environment (e.g., floodplains, bays, lagoons, river terraces, and subsiding deltas) prior to the sea's inundation of the area would have a greater potential for a high degree of preservation. Other protected areas (e.g., depressions, ponds, lakes, and sinkholes) and areas subjected only to low wave energy would also favor site preservation.

Throughout the historic period, settlement and development of Louisiana have been closely tied to waterborne transportation and commerce in the GOM. Colonial- and historic-period shipping routes commonly traversed this area, typically hugging the coast. The early 20th century saw the abandonment of commercial sailing craft and the adoption of gasoline- and diesel-powered vessels. As oil production increased along the Gulf Coast and extended offshore, some of the largest shipyards in the Nation were established between Mobile, Alabama, and Galveston, Texas (CEI 1977). Fishing, oil, and gas production became the major offshore industries beginning in the mid-20th century.

Historic shipwrecks have a tendency to converge in shallow waters near the shoreline. However, relatively large numbers of shipwrecks are known to exist in scattered locations across the continental shelf and in occasional deepwater areas. Preservation of a shipwreck in such settings would likely be moderate to good (Garrison et al. 1989). Reference to lists and charts published by the USCG (1984), the National Ocean Service (1992, 2002), Berman (1972), and the cultural resource baseline studies by CEI (1977) and Garrison et al. (1989), as well as files maintained by the MMS and Fugro Geoservices, Inc., (Fugro) indicate that no shipwrecks have been reported in the proposed Terminal area. However, one wreck is reported in the general area of one of the proposed pipelines.

The proposed Port location contains areas that have a high probability for prehistoric resources, due to their position inside the 45 m (148 ft) bathymetric contour. However, WC-213 has been determined by MMS as a low-probability area for shipwrecks. Therefore, the proposed Terminal site does not require the more rigorous high-probability survey requirements. However, a more intense look at the portions of proposed pipeline corridors is mandated by their previously determined characteristics as high-probability areas for shipwrecks.

3.3.2.2 Terminal Area Archaeological Survey

The overall project entails the construction and placement of the proposed Port in WC-213 and a number of take-away pipelines. Five pipelines have been proposed to connect the Terminal to a number of existing subsea pipelines in the GOM. The proposed Terminal and five pipeline routes are in an area of extensive oil and gas development. The hazard survey and archaeological survey work was carried out in two parts. The proposed Terminal area lease block was surveyed by C&C Technologies (C&C). C&C prepared a report that discussed both hazard engineering and the potential archaeological impacts of the Proposed Action (C&C 2003). The five proposed pipeline routes were surveyed by Fugro. Their report also treated both the hazardous and possible archaeological impacts (GL 2003a).

C&C completed a marine geophysical survey of the proposed Terminal location at WC-213 between March 7 and 28, 2003. The survey was designed to reveal any cultural resources that might have been present in the lease block and the area of the proposed Terminal. The survey data were gathered aboard the *R/V Ocean Surveyor* utilizing geophysical instrumentation including an EM1000 multibeam bathymetric system, an Echotrac DF3200 single-beam bathymetric system, a SIS1000 side-scan sonar and subbottom profiler system, a GeoMetrics 880 Cesium magnetometer, and a Seismic Systems, Inc., 90-cubic inch (in^3) (1.475-cubic centimeter [cm^3]) air gun. An archaeological report was prepared based on that survey and submitted to the USCG and MMS (C&C 2003). The preparers of the C&C report meet the minimum Federal standards for "archaeologists."

The survey complied with the requirements of NTL 2002-GO1, the guidelines set forth by the MMS for submerged cultural resources compliance. The archaeological resource survey of the proposed Terminal site used the pattern and data acquisition instrumentation guidelines found in Appendix 1 of NTL No. 2002-GO1. WC-213 has been designated a low-probability lease block for historic shipwrecks requiring a minimum of 300-m (984-ft) lane spacing. C&C carried out their cultural resource survey at 100-m (329-ft) lane spacing; cultural resources data were collected every other line of their 50 m (164 ft) spaced seismic and bathymetric survey grid (C&C 2003). The survey grid was designed to provide complete coverage of the sea floor by side-scan sonar and representative sampling with the other systems. All of the survey data were reported as being of good quality (C&C 2003).

Field logs show that C&C maintained the magnetometer sensor depth range between 0.4 and 5.9 m (1.3 and 19.3 ft) off the sea floor over the course of the entire survey. This depth range conforms to the MMS NTL 2002-GO1 requirement to keep the magnetometer sensor within 6 m (20 ft) of the sea floor (C&C 2003).

The survey results for the subbottom profiler indicate that the Holocene/Pleistocene interface is approximately 7.6 m (25 ft) below the sea floor in this area. Two generations of relict channels occur within this lease block. The second generation channels have margins buried more than 4 to 5 m (12 to 17 ft) below the sea floor, with thalweg (line connecting the deepest part of a stream channel and marking the greatest surface velocity) depths of up to 10 m (53 ft). The margins of the first generation channels are buried 6 to 9 m (21 to 28 ft) below the sea floor, with thalwegs between 9 to 20 m (30 to 65 ft). Further analysis of the subbottom data indicated that the margin areas of these relict channels had been heavily eroded during marine transgression. No intact landforms, such as natural levees, which might be indicative of intact prehistoric sites, were observed. No undisturbed high probability areas for prehistoric archaeological sites were identified (C&C 2003).

The survey detected 108 magnetic anomalies. Of these, 74 corresponded to two wells (Well No. 1 [OCS-G-13835] and Well No. 2 [OCS-G-12768]) and two pipelines (Stingray 36-inch and ANR 20-inch) inside the lease block. The remaining 34 magnetic anomalies were unidentified. The majority (31) of these were low-amplitude deflections of 21 gammas or less and have been determined to represent point-source ferrous debris characteristic of the offshore oil and gas industry (C&C 2003).

C&C identified three magnetic anomalies (No. 18, No. 19, and No. 29) as possibly representing submerged cultural resources ("cultural resources" here is meant to refer to potential archaeological resources [i.e., cultural material more than 50 years in age that might represent an episode of meaningful historic activity]). Magnetic Anomaly No. 18 is a monopolar deflection with a medium amplitude of 60 gammas and a medium duration of 46 m (150 ft). Magnetic Anomaly No. 19 is also a monopolar deflection with a medium amplitude of 72 gammas and a medium duration of 41 m (135 ft). The last, Magnetic Anomaly No. 29 is a dipolar deflection with a high amplitude of 103 gammas and a long duration of 108 m (354 ft). Given the medium-to-high amplitude and the medium-to-long duration of these three anomalies within a 100 m (328 ft), line-spaced survey, these three anomalies might represent submerged cultural resources (C&C 2003). Avoidance of these anomalies is recommended (see Section 4.3.2.3)

Seven side-scan sonar, or acoustic, anomalies were identified within the study area. Two of these anomalies have magnetic correlates. Acoustic Anomaly No. 3 measures 9 m (31 ft) long and is associated with Magnetic Anomaly No. 25 (16 gammas with a 91 m [298 ft] duration). Acoustic Anomaly No. 5 measures 0.5 m by 5 m (1.6 ft by 15 ft) and is associated with Magnetic Anomaly No. 21 (4 gammas with a 39 m [127 ft] duration). All of the acoustic anomalies, including those with magnetic correlates, are interpreted as representing modern debris from fishing activities or from previous oil and gas development in this area (C&C 2003). No further archeological work on these acoustic anomalies is necessary.

3.3.2.3 Proposed Take-away Pipeline Routes

A high-resolution survey totaling 105.7 km (65.7 mi) along the five proposed pipeline routes was conducted within the West Cameron Area. These routes all extended from WC-213 to their respective ends in WC-167, WC-171, WC-177, WC-218, and WC-224 off the Louisiana coast. Data for the archaeological analysis were obtained aboard the *M/V L'arpenteur* during August and September 2003. The geophysical instrumentation included an Odom Echotrac DF-3200 bathymetric system, a SeaSpy GEM GSM-19 MD marine Overhauser-proton magnetometer, an O.R.E. Model 140 3.5 kHz subbottom profiler, and a 100/500 kHz EdgeTech 260-TH side-scan sonar. Positioning of the survey vessel was obtained with FUGRO STARFIX Differential GPS, which returned an accuracy of +/- 3.0 m (10 ft). All of the survey data were reported as being of good quality (GL 2003a). The Fugro report provides the names of the preparers. In is unclear from this report whether the preparers meet the minimum Federal standards for "archaeologists."

With a few notable exceptions discussed below, the Fugro Geoservices Pipeline Routes survey complied with the requirements of NTL 2002-GO1, the guidelines set forth by the MMS for submerged cultural resources compliance. The archaeological resource survey of the five proposed pipelines used the pattern and data acquisition instrumentation guidelines found in Appendix 1 of NTL No. 2002-GO1. The various lease blocks that fall within the five surveyed pipeline corridors are in Table 3-9. Most of these lease blocks have been designated as low-probability blocks requiring a minimum of 300 m (984 ft) lane spacing for the survey grid. Three lease blocks have been designated as high-probability (WC-167, EC-64, and EC-65) and require a minimum of 50-m (164-ft) lane spacing. These three lease blocks are shown in bold type in Table 3-9.

Table 3-9. West Cameron Lease Blocks Falling Within Pipeline Routes Survey Corridors

Pipeline	Start and End Points	Blocks Crossed
A	WC-213 to 177	WC-213, 214, 203, 215, 202, 201, 200, 191, 192, 177, 176, EC-**65, 64**
B	WC-213 to 171	WC-213, 214, 204, 203, 197, 182, 171
C	WC-213 to 167	WC-213, 212, 205, 206, 195, 190, 184, 185, 168, **167**
D	WC-213 to 224	WC-213, 224
E	WC-213 to 218	WC-213, 214, 215, 216, 217, 218

Each of the five pipeline survey routes contained a center line and a 50-m (164-ft) offset line on either side of the center line. An additional seven survey lines spaced at 75 m (246 ft) intervals were run on either side of the pipeline center line and 50-m (164-ft) offsets, except for WC-213, which was surveyed by C&C (see discussion above). When surveying in WC-167 for the proposed 76.2-cm (30-in) pipeline, Fugro reduced the lane spacing to a 50-m (164-ft) interval. Therefore, the survey of this proposed pipeline route conforms to MMS requirements for all lease blocks within the survey corridor of this route (GL 2003a).

Likewise, the proposed 91-cm (36-in), 51-cm (20-in), and 41-cm (16-in) pipeline routes were surveyed in accordance with MMS requirements for trackline spacing in all lease blocks falling within the survey corridors for those individual proposed routes. Survey blocks EC-64 and EC-65 within the proposed pipeline survey corridor are not designated high-probability lease blocks and require only 300 m trackline survey spacing. Trackline spacing in EC-64 and EC-65 was at more than 70 m (230 ft).

An examination of the Magnetic Anomaly Table produced by Fugro shows that they kept their magnetometer within 6 m (20 ft) of the bottom, as stipulated by the MMS, for approximately 99 percent of the survey. A total of 1,453 magnetic anomalies were recorded, along with the height of the magnetometer towfish above the sea floor. MMS requirements stipulate that the magnetometer be kept within 6 m (20 ft) of the sea floor. In 12 cases where magnetic anomalies were recorded, the height of the towfish above the sea floor exceeded this height ranging from 6.4 to 7.0 m (21 to 23 ft) (GL 2003a).

Two generations of relict channeling were observed in the subbottom record of the five proposed pipeline routes. The first generation of channeling was observed downcutting from 2 to 5 m (6.6 to 16 ft) below the sea floor. These channels trend northeast to southwest across the survey areas. Where discernable, thalweg depths ranged from 2 to 16 m (6.6 to 52 ft) below the sea floor. A second generation of relict channeling was observed downcutting from the sea floor. These channels trend northwest to southeast across the survey areas; where discernable, thalweg depths ranged from 1 to 19 m (3.3 to 62 ft) below the sea floor.

The second generation relict channel margins are reported to have been severely eroded during marine transgression. Therefore, intact archaeological within these second generation relict channels are unlikely to be present (GL 2003a). The margins of the first generation relict channels are reportedly intact. Therefore, Fugro notes that *in situ* archaeological sites might be present (GL 2003a). Fugro does not inventory these first generation relict channels in a table with positioning data and other pertinent information (i.e., the depth below the sea floor where downcutting begins). Thus, it is difficult to make a determination regarding the possible impact on channel margins of pipeline trenching or anchoring during pipeline construction. Therefore, absent a detailed inventory of these channels, we must assume that they originated at the minimum depth 1.5 m (5 ft) cited by Fugro. All five proposed pipeline routes bisect first generation relict channels. Construction of larger diameter pipes (e.g., 76–91 cm [30–36 in]) would require, at minimum, a trench in excess of 1.5 m (5 ft) in depth. Hence, it is possible that construction of some of these proposed pipelines routes would impact potentially significant prehistoric resources.

A total of 34 side-scan sonar, or acoustic, anomalies were recorded during the survey of the five proposed pipeline routes. Of these, Fugro determined that 33 represented ferrous debris. Many were identified as discarded pipe and cable sections and all were typical of the debris generated by the offshore gas and oil industry in this area. The single remaining side-scan sonar (Acoustic Anomaly No. 116) is an acoustic reflection measuring 20 m by 5 m (65 ft by 16 ft) and possibly represents the remains of an historic shipwreck (GL 2003a). This acoustic anomaly falls at the very edge of coverage in lease block WC-203 and is approximately 193 m (633 ft) from the proposed pipeline center line. This acoustic anomaly has two magnetic correlates, Magnetic Anomalies No. 211 and No. 214. Magnetic Anomaly No. 211 is a dipolar deflection with a low amplitude of 37 gammas and a long duration of 256 m (840 ft) and

Magnetic Anomaly No. 214 has a low amplitude of 8 gammas and a long duration of 285 m (935 ft). These two magnetic anomalies occur on adjacent tracklines.

Fugro identified 11 pipelines and one structure that are detailed in Fugro's Magnetic Anomaly Table (GL 2003a). There were an additional 870 unidentified anomalies noted within the pipeline survey areas. These anomalies ranged in amplitude from 2 to 1,887 gammas and had durations from 3 to 358 m (9.8 to 1,175 ft). Fugro identified two of these anomalies, those that correspond to Acoustic Anomaly No. 116 (discussed above), as possibly representing cultural resources. These two anomalies and 20 others corresponded to bottom features identified in the acoustic record. The remaining 848 magnetic anomalies Fugro interprets as ferrous material buried in the seafloor sediments or too small to be identified by side-scan sonar.

3.3.2.4 Alternate Site Location (WC-183)

WC-183 has been proposed as an alternative site for the proposed LNG Terminal. However no hazard or cultural resources survey has been conducted in this lease block. If WC-183 is selected for this project, a hazard survey and cultural resources survey will be conducted in accordance with all applicable and appropriate guidance (GL 2003a). A cultural resource survey in WC-183 would require 300-m (984-ft) lane spacing and would have to be conducted according to the protocols for archaeological resource and geohazard surveys and reports. Parameters outlined in MMS NTL 2002-G01 (archaeological resources) and NTL 98-20 (geohazards) should be considered guidelines (GL 2003a). Generalized geology mapping and cultural resource designations for these blocks indicated that the conditions at WC-183 should be relatively similar to the conditions at WC-213.

3.4 Geological Resources

3.4.1 Definition of the Resource

Geological resources within a given physiographic province consist of the surface and near-surface materials (i.e., rock and soil) of the earth and regional or local forces by which they are formed. These resources are typically described in terms of regional and local geology, soil resources, topography, mineral (paleontological, if applicable) resources, and geologic hazards. Regional and local geologic resources comprise earth materials within a specified region and the forces that have shaped them. This includes bedrock or sediment type and structure, unique geologic features, depositional or erosional environment, and age or history. Soils resources are the unconsolidated, terrestrial materials overlying the bedrock or parent material and are typically described in terms of their complex type, slope, and physical characteristics (i.e., strength, expansive potential, cohesion, and grain size). Topography is the discussion of the geomorphic characteristics of the land or seafloor surface, including elevations, relationship with adjacent land features, and geographic location. Mineral and paleontological resources include usable geologic materials that have some economic or academic value. Geologic hazards comprise the regional or local forces or conditions that could affect a proposed development or land use (e.g., seismicity, slope stability, expansive soils or bedrock, and subsidence or settlement). The ROI for this analysis includes the areas near the proposed Terminal (WC-213), the Alternate Site (WC-183), and the associated take-away pipelines required at each site.

3.4.2 Existing Conditions

3.4.2.1 Regional Geology

The GOM is recognized as a passive continental margin with a complex evolutionary history involving progradational deposition, delta systems, and glacio-eustatic sea level fluctuations. It is these processes that have largely determined the topography and morphology of the continental shelf off Texas and Louisiana and the distribution of sediments within these areas.

The GOM originated during the Late Triassic Period as a result of rifting between the North American, African/South American, and Eurasian plates; with the separation of the plates, a basin was formed in the newly created zone. During the Middle to Late Jurassic Period, sea water flowed intermittently into the basin leading to massive salt deposits. This was followed by the Late Jurassic age when carbonate deposition was a dominant geological process, and massive banks that would become the Florida and Campeche carbonate escarpments were formed. In the Middle Cretaceous, prolonged subsidence of these carbonate platforms, along with little terrestrial sediment input, allowed a reef system to form that extended from southern Texas eastward to southern Louisiana and along the shelf edges off the western Florida and eastern Campeche Escarpments. The Late Cretaceous saw massive sedimentation, as a result of mountain-building events in the continental interior (GL 2003a).

Variations in the earth's climatic environment and associated fluctuations in sea level during the late Pleistocene-Holocene Epoch resulted in cyclic depositional sequences. During episodes of glaciation, sea levels dropped, resulting in the deposition of comparatively thick sequences of clastic sediments farther out into the GOM. The deposition only occurred during the regression in the Pleistocene Epoch and has not occurred again to date. This regression of the sea resulted in the development of additional drainage networks and channelization of the previously existing submarine deltaic deposits. Interglacial warming episodes, resulting in sea-level elevation rises (transgression) and corresponding resumption of deltaic shelf-outbuilding conditions, restored the deltaic depositional environment, causing the infilling of the channels. This rise in sea level caused the infilling of stream channels with finer-grain sediments such as clays and carbonates, and the emergence of estuarine and ultimately shallow marine conditions (Roberts and Coleman 1988). This transgressive/regressive depositional environment resulted in the formation of channelized deltaic deposits with a mosaic of interwoven clastic (sand, silt, and clay) deposits characteristic of the Mississippi Delta region.

Currently, the Mississippi River remains the major sediment carrier for the GOM Basin. In addition, sediment from other river systems along the northern GOM is deposited on the broad shelves of the basin. Very little sediment comes from the rivers entering the GOM along the southwestern and western margins of the basin (i.e., Texas and Mexico) due to their relatively small drainage basins. Therefore, active deposition of sediments in the GOM basin is primarily restricted to the mouth of the Mississippi River (USCG and MARAD 2003a).

3.4.2.2 Local Geology

The ROI is in the Texas-Louisiana Continental Shelf of the GOM and is underlain by as much as 4,000 m (13,000 ft) of Cenozoic-age sediments (GL 2003b). Deposition was progradational in nature forming wedges of clastic sediments that dip and thicken toward the shelf margin. The prograded shelf sequence consists of deposits of interfingering deltas, nearshore brackish water, and marine sediments. The near-surface geology across the Gulf Coast region has been largely influenced by fluctuating sea levels associated with variations in climate during the Pleistocene Epoch. During periods of low sea levels due to glacial expansion, the shelf area was an exposed land mass that was subjected to subaerial weathering and erosional processes. Streams and rivers meandered and incised across the exposed shelf to deposit bedloads along the current position of the shelf-break (C&C 2003). As the climate warmed and the seas transgressed, marine sediments were deposited over the shelf filling in the rivers and entrenched valleys. As a result, unconformities and buried channels and channel segments are a common feature of the GOM subbottom profile.

Proposed LNG Terminal Location. Two separate marine surveys were conducted to assess the geologic and seafloor conditions within WC-213. The initial investigation, performed by C&C, was conducted between March 7 and 28, 2003, and consisted of a geophysical and multibeam seafloor mapping survey. The purpose of the survey was to address the seafloor and subbottom conditions in WC-213, map the bathymetry and assess potential geological hazards, and perform an archaeological assessment (C&C 2003). Fugro performed a subsequent geotechnical survey between June 8 and 11, 2003, to confirm the stratigraphy of near-surface sediments and to provide data for GBS design parameters. Data were collected using a combination of digital and analog recorders (e.g., multibeam bathymetric systems, magnetometers, 90-in^3 [1,475-cm^3] air gun, and side-scan sonar), *in situ* piezocone penetration tests (PCPTs), piston coring, and soil boring. The geotechnical assessment included one soil boring completed to a total depth of 30 m (97 ft) below the sea floor, 14 PCPTs to approximately 18 m (59 ft) below the sea floor, and 16 piston cores with recoveries ranging between 0.9 and 2.7 m (3 and 9 ft). The borehole and one PCPT were located within 15 m (50 ft) of the center of the proposed Terminal, while 10 PCPTs and four piston cores were performed within 61 m (200 ft) of the footprint of the proposed Terminal. The remaining PCPTs and piston cores were located in the general vicinity of the proposed Terminal.

Results of the geophysical survey conducted by C&C indicate that the sea floor in the eastern half of WC-213 is fairly smooth and featureless with the exception of a small topographic low in the northeastern corner of the surveyed area. In general, the average gradient is slight (0.01 percent) and to the south (C&C 2003). There are several local high spots in the western half of the block that rise from 1.8 to 3 m (6 to 10 ft) above the ambient sea floor. Two of the features, in the southwestern portion of the block, are described as linear shoals. The third feature, in the northwestern portion of the block, is described as a 3-m (10-ft) high mound (C&C 2003). Slopes on these topographic highs are steepest on their northern flanks, with gradients as high as 0.6 degrees in some locations (GL 2003a). These features were described by C&C as remnant shoals. The location of the proposed Terminal (i.e., GBS caissons and erosion control skirt) would be on the topographic high in the west central portion of WC-213.

Water depths across WC-213 range from 15 m (48 ft) on a topographic high spot in the northwestern corner of the block to 19 m (61 ft) in the southeastern corner of the block. Figure 3-4 provides water depths and features of the sea floor. The geophysical survey also revealed the following subbottom features (C&C 2003):

- Two generations of buried channels (multiple first and two second generation) lying between 3.7 and 8.5 m (12 and 28 ft) below the sea floor.
- Several acoustic voids with elevated amplitudes, or "bright spots," were mapped on the seismic data, which might represent high-pressure gas zones (C&C 2003).
- A reflector of medium intensity lying 5 to 10 m (16 to 33 ft) below the sea floor that was interpreted to be the Pleistocene/Holocene unconformity.
- Several small, benign, and inactive growth faults buried between 9 and 11 m (30 and 36 ft) below the sea floor were identified on the western side of WC-213, based on air gun data. These fault features appeared benign because there was no expression (i.e., growth) in the overburden.

Subbottom features are provided in Figure 3-4.

Laboratory and *in situ* PCPT geotechnical data collected from within the footprint of the proposed Terminal location were integrated to determine the shallow stratigraphy and engineering properties of the soil (GL 2003b). Based on the results, the underlying sediments were found to be reasonably uniform and comprised of four general strata. In descending order, the sequences are as follows: a 1.5-m- (5-ft-) thick layer of poorly graded fine-to-medium sand with shells and shell fragments, a 3-m- (10-ft-) thick layer of stiff lean clay with numerous laminations of silt and zones of fat clay, a 4-m- (13-ft-) thick layer of predominantly low-to-medium plastic lean clay, and a greater than 25-m (82-ft) layer of medium-to-high plastic lean clay (GL 2003b).

Proposed Take-away Pipeline Routes. Fugro conducted a marine geophysical survey of the proposed take-away pipeline routes leading from the proposed Terminal location to subsea tie-ins in WC-167, WC-171, WC-177, WC-218, and WC-224. The intent of the survey was to describe the sea floor and shallow geologic conditions that could impact pipeline construction operations. It was performed using side-scan sonar, magnetometer, analog subbottom profiler, and bathymetry data sets. The survey data were gathered aboard the *M/V L'arpenteur* from August 11–13 and 17–29, and September 6–8, 2003 (GL 2003b). Table 2-5 provides lengths for each of the proposed pipelines and total areas that would be disturbed during installation activities. The routes of the pipelines are presented in Figure 2-9.

The sea floor within the surveyed area generally slopes gently to the south with local occurrences of shoaling (WC-171). Water depths, which were adjusted to the MLLW tide level, range between 11 m (36 ft) MLLW in WC-171 to 19 m (62 ft) MLLW in WC-224. Average seafloor gradient ranges from a low of virtually flat to 0.62 degrees. The geophysical survey also revealed the following seafloor features (GL 2003b):

- A moderate-to-high reflectivity indicating coarser seafloor sediments comprised of sands and shell hash (WC-171)
- Broad areas of sand waves (WC-177)

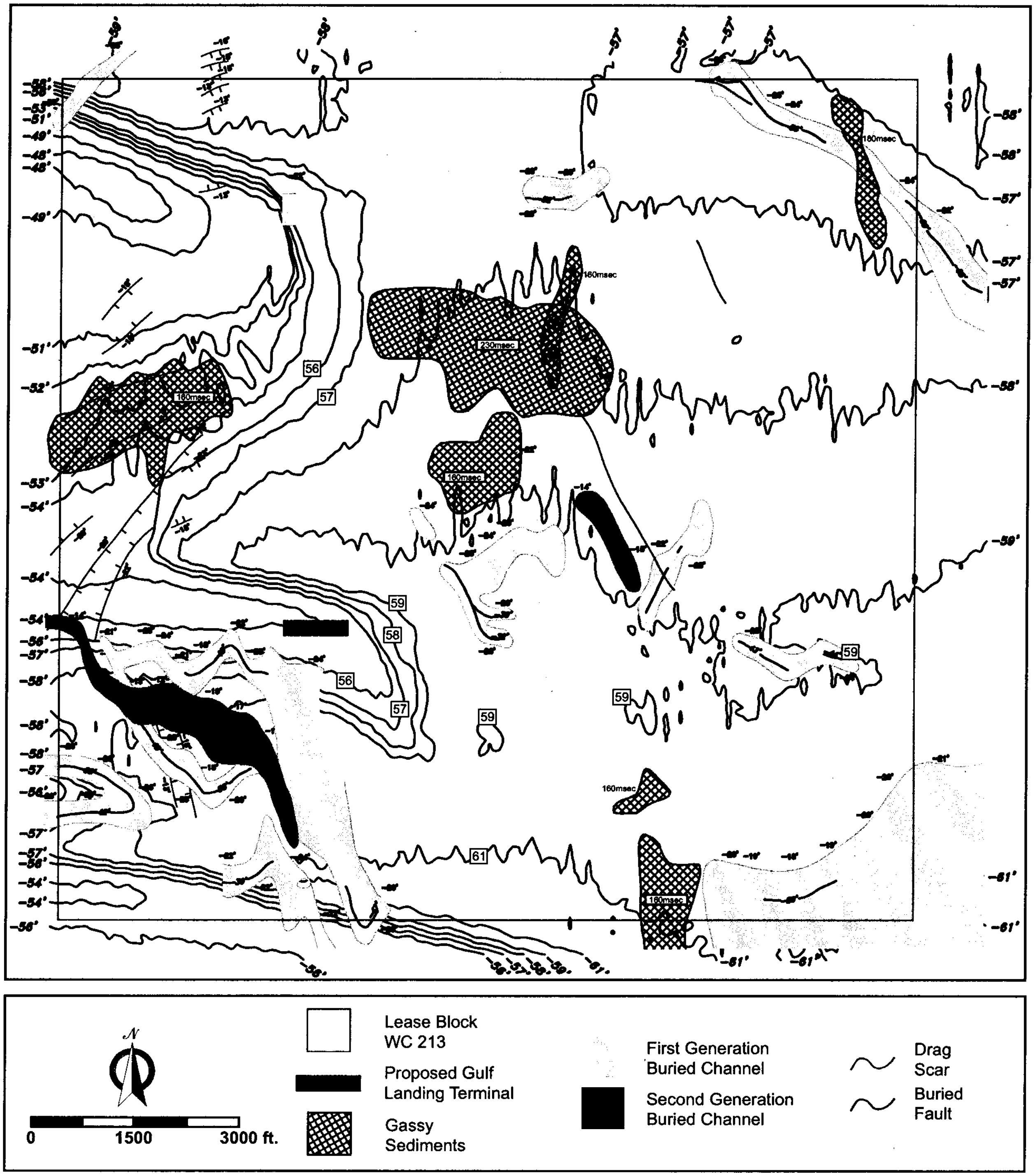


Figure 3-4. Bathymetry and Seafloor Features for West Cameron Block 213

- A debris field (WC-197)
- Drag marks
- Jack-up rig leg holes and a mat rig impression (WC-200)

Subbottom conditions were assessed from pinger profiles that were confined to the upper 15 feet of the seafloor sediments, although the profile view penetrated to depths of 15 m (50 ft). The geophysical survey revealed the following subbottom features (GL 2003b):

- Two prominent reflectors within the upper 4.5 m (15 ft) that were identified as low sea stands where sediments were exposed to subaerial weathering processes and represent the Holocene/Pleistocene unconformity.
- First- and second-generation channels and channel fragments with thalweg depths ranging between 2 and 16 m (6.6 and 52 ft), and 2 and 18 m (6.6 to 59 ft) below the sea floor, respectively (WC-182, WC-197, and WC-212).
- Three buried faults along the proposed 76-cm (30-in) pipeline route lying between 2.4 and 4.5 m (7.8 and 14.7 ft) below the sea floor (WC-167).
- Several areas exhibiting acoustic voids that were interpreted to be an accumulation of gas in the sediments in a state of low-pressure equilibrium (WC-204).

Although sediment cores were not collected during this survey, the composition of the sea floor was based on regional studies and borings taken during prior surveys. In general, the seafloor sediments across the majority of the surveyed area consist of clayey sand. Areas of sand were also reported and are supported by interpretation of the side-scan sonar records, which detected areas of high reflectivity and broad areas containing sand waves. Areas that exhibited sandy conditions include WC Blocks 191, 192, 193, 194, 197, 198, 199, 200, 201, 202, 203, 204, 214, 215, 216, 217, and 218.

Alternate Site Location (WC-183). Marine surveys of the Alternate Site Location (WC-183) were not conducted. Rather, the seafloor conditions were assessed based on previous surveys conducted in an adjacent block (WC-182) together with information gathered from the public domain.

Based on geophysical data collected from Block WC-182, the sea floor dips to the south at an average rate of 0.1 percent (GL 2003b). Water depth across the block ranged from 11 m (36 ft) to 18 m (59 ft) at the southwest corner. A smaller topographic feature rising approximately 1 m (3.3 ft) above the ambient sea floor was observed in the central eastern portion of the block, which interrupted an otherwise smooth seafloor dip to the south (GL 2003a). The GBS Terminal would be situated in the southeastern corner of the block in approximately 16 m (54 ft) of water (GL 2003b). The location of the alternate LNG Terminal is depicted in Figure 2-2.

During the survey, a topographic high, thought to be associated with a salt diapir, was noted near the northern boundary of the block. However, Gulf Ocean Services, Inc., did not observe any evidence of fault activity associated with this feature. The geophysical survey also revealed the presence of numerous buried channel segments spread across the surveyed area. Based on this finding, it was believed that the buried channels would also extend into WC-183 (GL 2003b).

Sediment borings and test results collected from Block WC-182 and adjacent to WC-183 were described as sand and muddy sand with thicknesses ranging between 0.6 and 2.4 m (2 and 8 ft). The data also indicated that below the recent sediments (i.e., sand and muddy sand) lie the stiff and unconsolidated sediments of the Beaumont/Prairie formation (GL 2003b).

Alternative Take-away Pipeline Routes. The five take-away pipelines required to service the Alternate Site Location would remain unchanged. Up to five new take-away pipelines totaling approximately 82 km (51 mi) would be installed to connect the Terminal to the existing offshore pipeline infrastructure. Table 2.5 provides lengths for each of the alternate pipelines and total area that would be disturbed during installation activities. The routes of the pipelines are presented in Figure 2-9.

Marine surveys of the alternate take-away pipeline routes were not conducted. An assessment of the seafloor conditions was based on interpretations of existing geophysical survey data collected from adjacent blocks (WC-182 and WC-170) together with public domain information on the regional and local geology.

Based on available bathymetric data, the pipelines would be placed in water depths ranging between 13 and 17 km (42 and 56 ft). Since the pipeline routes would have different headings, no gradient data were provided (GL 2003b).

No information was provided concerning the stratigraphy and composition of the seafloor sediments or the presence of buried channels, gassy sediments, diapirs, growth faults, or unconformities. However, the possibility that buried channels or channel fragments are present is considered likely given the omnipresence of these features in the surrounding blocks.

3.4.2.3 Soil Resources

By definition, soils are formed and located on land and, therefore, would not be directly impacted by the proposed Port. Under the current proposal, construction of new onshore support or supply facilities has not been identified. Once the LNG is regasified the natural gas will be delivered to the demand market using the existing offshore/onshore national pipeline grid. Shore-based support and supply services, when needed, could possibly be contracted out to existing offshore platform supply companies based out of the Cameron, Louisiana, area, which is approximately 61 km (38 mi) from the proposed Terminal site.

3.4.2.4 Topography

The continental shelf of the GOM includes the broad Western Florida Shelf that extends to 200 km (124 mi) in width (Roberts et al. 1999). Major relief along the shelf in this region is associated with roughly shore-parallel ridges, related to the positions of former shorelines during the rise of the sea level after the latest Pleistocene glacial maximum. The northeastern GOM continental shelf off the panhandle of Florida, Alabama, and Mississippi ranges in width from 25 to 125 km (15.5 to 78 mi), and depths at the shelf break range from 60 to 100 m (197 to 328 ft). The width of the Louisiana shelf varies from less than 20 km (12.4 mi) off the modern "birdfoot" delta of the Mississippi River to nearly 200 km (124 mi) off central and western Louisiana where the proposed Terminal would be situated. As is the case for the central/western Louisiana shelf, the Texas shelf is broad and without dramatic changes in topographic relief. The Yucatán shelf has a steep margin underlain by Cretaceous reefs. The northward sloping plateau is bounded by precipitous continental slopes that comprise the Campeche Escarpment and plunge to the deepest part of the GOM.

The proposed Terminal, Alternate Site, and associated take-away pipeline routes would be located on the Northern Gulf Shelf of the GOM approximately 61 km (38 mi) (proposed location) and 48 km (30 mi) (alternate location) miles south of the Louisiana coast. Some change in seafloor elevation is apparent in the western and northeastern portions of WC-213. In the western portion, there are several local high spots that rise from 1.8 to 3 m (6 to 10 ft) above the ambient sea floor. Two of the features are described as linear shoals, while the third feature is described as a 10-foot-high mound. In the northeastern portion of the block there is a topographic low of 0.3 to 0.6 m (1 to 2 ft) (C&C 2003). Current plans indicate that the proposed Terminal footprint (covering approximately 11 ac) would be situated on the topographic high in the west central portion of WC-213. The remaining sea floor is fairly smooth and featureless, with a slight gradient to the south. Water depths across WC-213 range from 15 m (50 ft) on the topographic high spot in the northwestern corner of the block to 19 m (62 ft) in the southeastern corner of the block.

In general, the sea floor within the proposed take-away pipeline routes slopes gently to the south with local occurrences of shoaling (i.e., WC-171). Water depths range between 11 m (33 ft) MLLW in WC-171 to 19 m (62 ft) MLLW in WC-224. Average seafloor gradients range from a low of virtually flat to 0.62 degrees.

The seafloor conditions within the Alternate Site Location (WC-183) were assessed based on previous surveys conducted in an adjacent block (WC-182) together with information in the public domain. According to bathymetric data obtained from the National Geophysical Data Center (NGDC) Geophysical Data System (GEODAS), water depths within WC-183 range between 14 m (46 ft) at the northern boundary to 17 m (56 ft) at the southern boundary of the block (GL 2003b). The sea floor slopes to the south at an average rate of 0.04 percent. Site-specific information concerning the presence of topographic highs (e.g., shoals), lows, or other surface relief features was not made available.

Seafloor conditions at the alternate pipeline take-away routes were based on GEODAS bathymetric data. According to NGDC, the pipelines would be in water depths between 13 and 17 m (42 and 56 ft). Since the pipeline routes would have different headings, no gradient data were provided (GL 2003b).

3.4.2.5 Mineral Resources

Louisiana mineral resources can be divided into on and offshore resources. Primary onshore mineral resources consist of clay, crushed stone, gypsum, sand and gravel, sulfur, oil, natural gas, and salt. Louisiana's economic offshore mineral resources include phosphate, sulfur, salt, lime, limestone, sand and gravel, magnesium, oil, and gas. Of these resources, oil and gas operations have become Louisiana's largest industrial enterprise; however, much of the state's present production actually takes place in federally leased waters south of the Louisiana coast in the GOM (USGS 2001).

Salt and sulfur, which are mined from salt domes and their associated caprock, make up about 70 percent of Louisiana's annual earnings from nonfuel minerals. Evaporation of the shallow sea from the early GOM produced thick salt deposits, which are now deeply buried. Salt domes form as the less dense salt intrudes upward into the overlying strata. Sand and gravel are Louisiana's next most valuable nonfuel resources. All of the state's sand and gravel come from onshore Quaternary deposits, most of which lie in the southeastern portion of the state. These deposits include Pleistocene river and coast-parallel terrace deposits and Holocene (the past 11,000 years) river alluvium. Lime is produced primarily from clam and oyster shells dredged in southern Louisiana (USGS 2001).

The continental shelf is a very active oil and gas producing area of the GOM, with interests increasing with the advancement of new technologies in exploration and recovery. Currently, there are more than 8,000 active leases in the central and western GOM for the purpose of exploration and extraction of mineral resources (GL 2003a). Even though WC-213 is within an area with active oil and natural gas facilities, there are no such facilities located within the block (GL 2003a). One of the selection criteria used to evaluate potential sites was whether the location had a low potential for economically recoverable mineral resources. Contrary to this, with the exception of Pipeline D, each of the proposed take-away routes cross leased blocks. Another evaluation criteria was that the subject property not currently have a lease, which WC-213 satisfied.

3.4.2.6 Geologic Hazards

Geologic hazards pose constructability and operational constraints that can usually be effectively mitigated through existing or new design engineering and technology. In the GOM area, major geologic and topographic features are seaward from the ROI and thus would not likely affect the proposed Terminal (WC-213), the Alternate Site (WC-183), or the associated take-away pipelines required at each site. For purposes of this study, geologic hazard categories include faulting and seismicity, slope stability, sediment degassing, diapiric structures, seafloor depressions, buried channels, and other seafloor features. The main geologic hazards that might occur on the continental shelf, and their principal impacts, are described below.

Faulting and Seismicity. The state of Louisiana and adjacent Northern Gulf Shelf are in the south-central area of the North American tectonic plate in a region of low seismic activity and faulting hazard. Historic records of seismic events in Louisiana indicate that the region does experience seismic shaking, but the magnitude and frequency are low (USGS 2001). Based upon recent seismic conditions of the region, the greatest likelihood of any scale of groundshaking would result from activity in the New Madrid Seismic Zone around northeastern Arkansas (Stevenson and McCulloh 2001). Consequently, there is a low probability of seismic shaking, fault rupture, or other seismically induced geologic hazard, such as liquefaction or tsunamis, which would affect the proposed Terminal or Alternate Site, and their associated pipelines.

Localized active faults within the Northern Gulf Shelf region are primarily attributed to the progradation of massive accumulation of sediments and associated settlement (or growth faults), and the vertical migration of salt or shale deposits. Growth faults continually form along with sediment deposition. These growth faults are found mostly on the upper continental slope and on the continental shelf where sediment accumulation is the thickest.

At the proposed Terminal site, several buried growth faults interpreted from the air gun data are located on the western side of WC-213. These features were classified by C&C as small, benign, and inactive features, because they are buried and exhibit no signs of growth in the overburden material (C&C 2003). The Terminal footprint (approximately 11 ac) would reportedly be positioned away from these faults to avoid potential stability problems (GL 2003a).

Three buried faults were detected during the Fugro geophysical survey of the proposed 30-inch pipeline route. The faults lie between 2.4 and 4.5 m (8 and 15 ft) below the sea floor in WC-167. Although no evidence was presented concerning their relative activity/inactivity, Fugro reported they should not pose a hazard to construction (GL 2003b). Based on the limited vertical extent of the faults, it is also unlikely that the faults would cause a future geologic hazard.

Geophysical surveys were not conducted within the Alternate Site Location (WC-183) and associated take-away pipeline routes. Therefore, the subbottom conditions cannot fully be assessed to evaluate potential hazards associated with faulting or seismic activity.

Slope Stability. Slope stability is influenced by two basic factors: slope angle and the degree of consolidation of the material (e.g., bedrock, sediment, soil). Slopes of less than 0.5 degrees (approximately 47.0 feet per mile) have failed in the GOM because of under-consolidation of the sediments. Geologic hazards associated with slope instability in marine environments include slumps, creep, mud or debris flows, and turbidity currents. Seafloor instability is considered the principal engineering constraint to construct a bottom-founded structure, which would include pipelines. Among the factors affecting the level of sediment consolidation are interplay between episodes of rapid shelf edge progradation and contemporaneous modification of the depositional sequence by diapirism, and mass-movement processes. Mass movement is the gravity-induced downslope movement of sediments. This type of slope failure might occur in response to seismic shaking, overloading or oversteepening of slopes, lowered shear strength of the sediments because of interstitial gas, cyclic loading (storms), or a combination of these factors (USCG and MARAD 2003). In addition, many slope sediments have been uplifted, folded, fractured, and faulted by diapiric action, resulting in slope failure.

The sea floor within the eastern portion of WC-213 is generally smooth and featureless, with only a localized topographic low in the northeastern section (see Figure 3-4). The gradient is minimal, averaging roughly 0.01 percent and dipping to the south. Several localized topographic high spots that range in height from 1.8 to 3 m (6 to 10 ft) above the ambient sea floor were detected in the western half of the block. Slopes on these topographic highs are steepest on their northern flanks, with gradients of 0.6 degrees occurring in some locations, and should be avoided to limit the possibility of stability problems. Currently, the proposed location of the proposed Terminal footprint would be situated on the topographic high located in the west-central portion of WC-213.

The sea floor within the surveyed area of the proposed take-away pipeline routes generally slopes gently to the south with local occurrences of shoaling in WC-171. Average seafloor gradient ranges from a low of virtually flat to 0.62 degrees (GL 2003a). There were no indications in the Fugro Archaeological, Engineering, and Hazard Survey report that stability problems associated with topographic highs (e.g., shoaling) would present a potential concern.

Bathymetric surveys were not conducted within the Alternate Site Location (WC-183) and associated take-away pipeline routes. Therefore, information on the seafloor conditions cannot be presented to evaluate potential hazards associated with slope stability.

Shallow Gas in Sediments. Shallow gas in near-seafloor sediments can contribute to sediment strength reduction, liquefaction, and slope failure by lowering the shear strength of the sediments. Decomposition of trapped organic matter is the primary source of biogenic interstitial gas. In addition, thermogenic gas, originating in deeply buried source rocks, can migrate upward and also become trapped in shallow marine sediments (USCG and MARAD 2003).

A geophysical survey conducted by C&C, mapped several elevated amplitudes, "bright spots," based on the seismic data (C&C 2003). According to the C&C Archaeological and Hazard Survey report, these acoustic voids might represent high-pressure gas zones (C&C 2003). Recommendations provided in the report suggested that a review of seismic exploration data and drilling records be conducted to identify other potential areas where high-pressure gas zones might be encountered (C&C 2003).

Fugro identified several areas in WC-204 during the survey of the proposed take-away pipeline routes that were interpreted to contain accumulations of gas in the sediments. The gas saturation within the sediments was determined to be in a state of low-pressure equilibrium since no evidence of active percolation into the water column was observed on the pinger profile or sonar data (GL 2003b). Low-pressure gas saturated sediments are normal bottom attributes in the GOM. In these particular occurrences, the gassy sediments are not considered to present a hazard. One potential problem that was identified involved lower vane shear strengths within gassy sediments which could create problems maintaining a trench during the installation of the pipeline. Fugro did not report any evidence of upward migrations of petrogenic gas from deep sources in the surveyed area (GL 2003b).

Detailed surveys were not conducted within the Alternate Site Location (WC-183) and associated take-away pipeline routes. Therefore, information on the subbottom conditions cannot be presented to evaluate potential hazards associated with gassy sediments or the upward migration of petrogenic gas from deep sources.

Diapiric Structures. The GOM has complex horizontal and vertical regional salt movement, which makes it a unique ocean basin. This movement greatly alters the seafloor topography forming sediment uplifts, mini-basins, and canyons. Salt moves horizontally like a glacier and can be extruded to form salt tongues, pillows, and canopies below an ever-increasing weight of sediment. Vertical salt forms range from symmetric bulb-shaped stocks to walls. While salt creates traps that are essential to petroleum accumulation, salt movement can cause potential hazards such as seafloor fault scarps, slumping from steep unstable slopes, shallow gas pockets, seeps and vents, and rocky or hard-bottom areas. Based on the shallow geophysical evidence, there is no evidence of diapiric structures and hydrates within the proposed Terminal site or along the proposed take-away pipelines (USCG and MARAD 2003).

Again, detailed surveys were not conducted within the Alternate Site Location (WC-183) and associated take-away pipeline routes. Therefore, information on the subbottom conditions cannot be presented to evaluate potential hazards associated with diapiric structures, hydrates, or the associated features.

Seafloor Depressions. Pockmarks are formed when gas bubbles, found along the sea floor, are released by natural events or human activities. Earthquakes, seafloor dragging, and even anchors dropped from boats might cause bubbles to be released in areas where gas has accumulated in adequate concentrations. Pockmarks appear to be unique to muddy, formerly glaciated areas. It is believed that thick glacial sediments might play an important role by trapping gas that would escape more rapidly in other depositional environments (USCG and MARAD 2003).

The geophysical survey conducted by C&C indicated that the sea floor at the proposed Terminal is generally smooth and featureless, with localized topographic highs in the western portion of the block and a topographic low in the northeastern portion of the block. Side-scan sonar records also revealed several areas with mottled seafloor features that are typically indicative of coarse bottom sediments, such as sand and/or shell hash. Side-scan sonar records provided evidence of vague pipeline trenches and drag scars within Block WC-213 (GL 2003a). Regardless, there was no evidence of gas vents or other indicators of gas escaping at the sea floor reported by C&C.

Detailed surveys were not conducted within the Alternate Site Location (WC-183) and associated take-away pipeline routes. Therefore, information on the seafloor conditions cannot be presented to evaluate potential hazards associated with pockmarks.

Seafloor Features. Sediment waves, brine-flow channels, and seabed furrows are all evidence of strong bottom currents of water with varying amounts of sediments. Brine-flow channels are caused by the dissolution of near-seafloor salt deposits generating high-density brines that move at sufficient velocity to erode and channelize the sea floor. All these features are generally found on the continental slope and basin in deep water. There was no mention of sediment waves, brine-flow channels, or large seabed furrows in the side-scan sonar record of the proposed Terminal and take-away pipeline routes.

The lowering of sea level during the Late Wisconsin Age was a response to the expansion of glacial ice sheets in the polar regions. By the peak of the glacial episode, the storage of water in the glaciers resulted in the lowering of the sea levels from about 91 to 152 m (300 to 500 ft) below the current high stand. As a result of this sea level recession, much of the continental shelf was left exposed as dry land. In response, there was a progressive lowering of base levels causing rivers to entrench channels and valleys into the upper Pleistocene strata, while leaving the areas outside the influence of the river courses to become overconsolidated by oxidation and weathering. As the climatic conditions warmed, melt-water from retreating glaciers gradually raised the sea level. During this late Wisconsin/Holocene transgression, there was a gradual reduction in river gradients entering the GOM and an associated load-bearing capacity that set off a progressive infilling of the channels and entrenched valleys (GL 2003b).

Multiple first- and second-generation buried channels were interpreted from the subbottom profiler data collected by C&C. The older channel margins are buried between 5.5 and 8.5 m (18 and 28 ft) below the sea floor with thalweg depths ranging from 11 to 18 m (36 to 58 ft) below the sea floor (C&C 2003). The younger second-generation channels have margins between 4 and 5 m (12 and 17 ft), with a minimum depth below the sea floor as low as 4 m (12 ft) and thalweg depths up to 16 m (53 ft) below the sea floor. According to *Gulf Landing Deepwater Port License Application*, bottom-founded construction activities would avoid the boundaries of these channels. The Holocene/Pleistocene unconformity was found at an average depth of 8 m (25 ft) below the sea floor (C&C 2003). It was noted that construction operations penetrating this depth could expect increased resistance in the formerly subaerially weathered sediments (GL 2003a).

Two generations of channeling and channel fragments were observed throughout the area surveyed along the take-away pipeline routes. The channels and channel segments are not expected to restrict pipeline construction activities (GL 2003b). However, Fugro did consider the possibility that maintaining a trench might prove to be difficult should the sediment properties within the channel vary. The depth at which the Holocene/Pleistocene unconformity was found is not expected to create any difficulties along the proposed take-away pipeline routes.

Detailed surveys were not conducted within the Alternate Site Location (WC-183) and associated take-away pipeline routes. Therefore, information on the seafloor conditions cannot be presented to evaluate potential hazards associated with buried channels, channel segments, or sediments associated with subaerial weathering. Based on the pervasiveness of buried channels, channel segments, and the Holocene/Pleistocene unconformity these subbottom features are most likely to be present in the Alternate Site (WC-183) and associated take-away pipeline routes.

A review of public and MMS information was conducted in conjunction with interpreting the geophysical data to confirm the presence of existing platforms, pipelines, and wells within WC-213 (C&C 2003). The review revealed that there are two pipelines within the block. A 91-cm (36-in) pipeline runs across the southwestern corner, while a 50-cm (20-in) pipeline diagonally crosses the block from the northwest to the southeast. One well (OCS-G-13835) lies in the extreme northwestern corner of WC-224, which was within the very southern edge of the survey area. The remaining well (OCS-G-12768) is in the northeastern portion of the block. The location of this well was detected by the magnetometer but was not seen on the side-scan sonar indicating that there has not been any activity at that location for some time (C&C 2003).

The side-scan sonar survey recorded seven contacts within Block WC-213 all of which reportedly represent man-made debris. Of the contacts, only Sonar Contact No. 6 was reported to have had measurable relief. The dimensions of Sonar Contact No. 6, which is located in the eastern portion of the block northeast of the well OCS-G-12768, were 5 m by 0.9 m by 0.5 m (16 ft by 3 ft by 1.6 ft) in relief. Two other contacts, Sonar Contact No. 3 and Sonar Contact No. 5, were associated with Magnetic Anomalies No. 25 and 21, respectively. Contact No. 3 was described as a 9.4-m (31-ft) linear piece of debris, while Sonar Contact No. 5 had dimensions measuring 4.5 m by 0.5 m (15 ft by 1.6 ft) (C&C 2003).

Thirty-four magnetic deflections were recorded that could not be correlated to existing infrastructure. Three of these magnetic anomalies were noted in particular for their size. Magnetic Anomaly No. 29, located in the southwestern quadrant of WC-213, was the largest deflection recorded. The remaining two recordings, Magnetic Anomaly Nos. 18 and 19, were located in the south-central portion and the northeastern corner of WC-213. The remaining unidentified anomalies were reported as relatively small deflections, some of which were clustered in the northwestern corner indicating bits of scattered ferrous debris (C&C 2003).

A review of public and MMS information was conducted by Fugro in conjunction with interpreting the geophysical data to confirm the presence of existing platforms, pipelines, and other man-made features within the proposed pipeline routes. The result of this review identified 13 structures, 19 wells, and 36 pipelines within the proposed routes. In addition, 870 unidentified magnetic anomalies were recorded, as were 34 sonar contacts. The survey also identified four debris fields. Of the recordings, Sonar Contact No. 3A and Magnetic Anomaly Nos. 211 and 214 could not be reliably identified from the collected geophysical data and it was recommended that these objects be avoided by 30 m (100 ft) during anchor placement. A 60-m (200-ft) buffer was recommended for unidentified Magnetic Anomalies Nos. 18, 19, and 29 (GL 2003b).

3.5 Socioeconomics

3.5.1 Definition of the Resource

NEPA requires an analysis of socioeconomic issues, if socioeconomic effects are interrelated with environmental effects. Socioeconomics are defined as the basic attributes and resources associated with the human environment, particularly population and economic activity. Regional birth and death rates and immigration and emigration affect population levels. Economic activity typically encompasses employment, personal income, and industrial or commercial growth. Changes in these two fundamental socioeconomic indicators might be accompanied by changes in other components such as housing availability and the provision of public services. Socioeconomic data at county or parish, state, and national levels permit characterization of baseline conditions in the context of regional, state, and national trends.

Data in three areas provide key insights into socioeconomic conditions that might be affected by a proposed action. Data on employment might identify gross numbers of employees, employment by industry or trade, and unemployment trends. Data on personal income in a region can be used to compare the "before" and "after" effects of any jobs created or lost as a result of a proposed action. Data on industrial or commercial growth or growth in other sectors provide baseline and trend line information about the economic health of a region. Demographics identify the population levels and changes to population levels of a region. Demographics data might also be obtained to identify, as appropriate to evaluation of a proposed action, a region's characteristics in terms of race, ethnicity, poverty status, educational attainment level, and other broad indicators.

On February 11, 1994, President Clinton issued EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. This EO requires that Federal agencies' actions substantially affecting human health or the environment do not exclude persons; deny persons benefits; or subject persons to discrimination because of their race, color, or national origin. The provisions of EO 12898 require that no groups of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the adverse environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, state, tribal, and local programs and policies. Consideration of environmental justice concerns includes race, ethnicity, and the poverty status of populations in the vicinity where a proposed action would occur. The demographic data presented in this section will be used to evaluate consistency with the intent of EO 12898.

3.5.2 Existing Conditions

The Port is proposed for an area of the GOM that supports multiple socioeconomic resources. Extraction, processing, and transport of oil and natural gas economically dominate the offshore area and coastal region that encompass the proposed Port area.

MMS has developed models to estimate regional economic impacts from OCS activities that include platform fabrication and installation, pipeline construction and installation, and various other construction and maintenance functions required to support the phases of development in the OCS. The projections for the coastal areas of the northern Gulf States show a range of 58,000 to 120,000 jobs in an average year. In Louisiana, the range is approximately 31,000 to 61,000 jobs in an average year related to OCS development activities. This amounts to 1.7 to 3.3 percent, respectively, of employment in Louisiana (MMS 2002a; U.S. Bureau of Census 2000).

3.5.2.1 Commercial Fisheries

Commercially fished areas of the GOM include the proposed Port area and coastal Louisiana. The proposed Port would be approximately 61 km (38 mi) south of the coast of Louisiana, in waters approximately 16.7 km (55 ft) deep. The proposed pipelines would be constructed in depths ranging between approximately 12 and 18 m (40 and 60 ft). Approximately 97 percent of trawl fishing in the GOM occurs in water depth of less than 61 m (200 ft) (USCG and MARAD 2003a). As discussed in Section 3.2.5, the proposed Port location is within areas designated by NOAA Fisheries as EFH for several species of shrimp, crab, reef fish, coastal pelagic fish, red drum, tuna, and sharks (GL 2003a).

The GOM has one of the most productive fisheries, providing almost 21 percent of the commercial fish landings in the continental United States (MMS 2002a). In addition to being productive, a wide variety of species are caught and landed in the GOM commercial fisheries. It has been estimated that this fishery includes at least 97 species from 33 families (GL 2003a). Table 3-10 presents the total commercial landings in the GOM from 1990 through 2001.

Table 3-10. Total Commercial Landings in the GOM, 1990–2001

Year	Pounds	Value ($)
1990	1,659,732,834	667,346,642
1991	1,672,274,707	681,223,248
1992	1,426,004,731	655,640,926
1993	1,717,301,349	623,835,142
1994	2,160,872,631	789,876,241
1995	1,489,482,088	764,633,274
1996	1,519,396,286	713,931,363
1997	1,807,889,578	767,373,932
1998	1,575,639,613	786,367,339
1999	2,002,808,415	820,312,134
2000	1,794,218,466	995,000,814
2001	1,608,888,221	803,389,598

Source: O'Bannon 2002

In 2001, Louisiana had the second highest commercial fisheries landings in the United States, following Alaska, at 1.3 billion lbs and valued at $400 million (O'Bannon 2002). Louisiana consistently had the highest landings in the GOM from 1997 to 2001 (NOAA Fisheries 2003c). The GOM shrimp fishery is the most valuable fishery in the United States, accounting for 69 percent of the total domestic production (MMS 2002a; O'Bannon 2002). Three species of shrimp—brown, white, and pink—dominate the shrimp landings by weight. The status of the stocks is as follows: (1) brown shrimp yields are at or near the maximum sustainable levels, (2) white shrimp yields are beyond maximum sustainable levels with signs of overfishing occurring, and (3) pink shrimp yields are at or beyond maximum sustainable levels (MMS 2002a).

The overall average for both grids combined was more than 40 million lbs of fish and invertebrates. The most important species in terms of value was shrimp. In Grid 17, shrimp accounted for 96 percent of the value of the average landing. In Grid 18, shrimp contributed 68 percent followed by oysters (20 percent), red snapper (4 percent), unclassified shrimp (3 percent), and blue crab (2 percent) (GL 2003a).

Continued fishing at the present levels could result in rapid declines in commercial landings and eventual failure of certain fisheries. Commercial landings of traditional fisheries such as red snapper, vermilion snapper, spiny lobster, jewfish, and mackerel have declined over the past decade despite substantial increases in fishing effort. Commercial landings of fisheries such as shark, black drum, and tuna have increased exponentially in recent years, and those fisheries are thought to be in need of conservation (MMS 2002a; Grimes et al. 1992; NMFS 1997). The number of species designated by NOAA Fisheries as "overfished" would likely continue to rise under new, more stringent definitions in the MMA.

3.5.2.2 Recreational Fisheries

Sport fishing is a very important activity in the OCS waters. In the GOM, 7 percent of recreational fishing is conducted from charter boats and about 50 percent is done from private or rented boats. The remaining 43 percent of recreational fishing occurs onshore (USCG and MARAD 2003). As shown in Tables 3-11 and 3-12, marine fishing is a prominent recreational activity in Louisiana that brings a considerable number of tourists to the coast every year. Private/rental vessels accounted for most of the estimated recreational trips made off the shore of Louisiana during the 1997 to 2001 period (Table 3-13). For this period, the number of recreational trips made by private/rental vessels averaged 86,237, whereas the estimated number of trips made by charter vessels averaged 12,885 (GL 2003a). Recreational fisheries are also discussed in Section 3.6.2.

3.5.2.3 Oil and Gas Leasing, Exploration, and Production Activities

The GOM region exhibits one of the highest concentrations of oil and gas activity in the world. The domestic oil and gas industry has experienced moderate to severe fluctuations over the past several decades. There are a number of OCS leasing activities in the general project area. The proposed Terminal, Safety Zone, Anchorage Areas, and Precautionary Area would occupy a portion of lease block WC-213. As shown in Table 3-14 the proposed routes for the five pipelines would traverse 23 lease blocks from WC-213 through to Blocks 167, 171, 177, 218, and 224. Pipelines A, B, C, D, and E would cross 9, 5, 8, 2, and 6 blocks, respectively. The proposed pipeline routes would also cross 23 existing pipelines, 8 of which are abandoned pipelines (GL 2003a).

3.5.2.4 Marine Shipping

The central and western GOM are used extensively by commercial shipping interests. The magnitude of offshore oil and gas activities and shipping operations through Gulf ports has led to the establishment of a series of safety fairways, or vessel traffic separation schemes, and anchorages to provide unobstructed approaches for vessels using U.S. ports (GL 2003a). Shipping safety fairways are lanes or corridors in which no fixed structure, whether temporary or permanent, is permitted. Fairway anchorages are areas contiguous to and associated with a fairway in which fixed structures may be permitted within certain spacing limitations (33 CFR 166). All offshore structures, including any proposed LNG regasification terminals, must be adequately marked and lighted. After structures are in place, they often become landmarks and aids to navigation for vessels that regularly operate in the area (GL 2003a).

3.5.2.5 Onshore Socioeconomic Conditions

Onshore Base. The Applicant is proposing to use only existing onshore facilities as part of its deepwater Port. Onshore services would include four tugs; supply vessels; Remotely Operated Vehicle (ROV)/diving support; maintenance/crane support; bunkering, mooring, and servicing for vessels; and

Table 3-11. Recreational Fish Catches in the Exclusive Economic Zone off the Coast of Louisiana

Year	Total Catch	Total Pounds
1995	1,455,325	3,237,616
1996	937,457	2,129,313
1997	1,117,157	2,332,581
1998	556,474	1,536,498
1999	855,617	2,276,602
2000	982,392	1,715,452
2001	722,716	2,277,270
2002	931,563	2,274,949

Source: NOAA Fisheries 2003d

Table 3-12. Marine Recreational Anglers in the Exclusive Economic Zone off the Coast of Louisiana

Year	Coastal	Non-Coastal	Out of State	Total	Percent Non-Coastal and Out of State
1995	421,374	40,870	75,861	538,105	21.7
1996	392,720	27,397	78,304	498,420	21.2
1997	471,045	48,795	95,750	615,590	23.5
1998	434,040	41,095	106,071	581,207	25.3
1999	409,175	33,115	90,648	532,938	23.2
2000	548,160	66,101	104,455	718,716	23.7
2001	588,132	65,351	122,232	775,715	24.2
2002	480,845	66,357	98,834	646,035	25.6

Source: NOAA Fisheries 2003d

Table 3-13. Estimated Number of Trips Made by Recreational Anglers off the Shore of Louisiana from 1997–2001

Mode	Year					Total
	1997	1998	1999	2000	2001	
Private/rental	91,225	61,522	112,762	80,433	85,243	431,185
Charter	15,554	12,286	7,993	12,564	16,026	64,423
Total	106,779	73,808	120,755	92,997	101,269	495,608

Source: GL 2003a

Table 3-14. Lease Blocks Crossed by the Proposed Pipelines

Pipeline	OCS Block Crossed by Pipeline	Operator(s)	Current Use Block	Planned/Current Block Use
Proposed LNG Terminal Site	WC-213	None	Open	Proposed LNG facility site
Pipeline A 36-inch	WC-213	None	Open	Proposed LNG facility site
	WC-214	None	Open (fairway block)	Future lease sale candidate
	WC-215	Energy Resource Technology	Leased (OCS-G4087) producing	Oil and gas production
	WC-202	Dominion	Leased (OCS-G24718) producing	Oil and gas exploration and production
	WC-201	Spinnaker	Leased (OCS-G22523)	Oil and gas exploration and production
	WC-200	None	Open	Future lease sale candidate
	WC-191	Denbury Offshore	Leased (OCS-G23748)	Oil and gas exploration and production
	WC-192	Denbury Offshore	Leased (OCS-G22522)	Oil and gas exploration and production
	WC-177	Stone Energy	Leased (OCS-G21539)	Oil and gas exploration and production
Pipeline B 24-inch	WC-213	None	Open	Proposed LNG facility site
	WC-204	Mariner Energy	Leased (OCS-G23750)	Oil and gas exploration and production
	WC-197	Union Oil	Leased (OCS-G3264)	Oil and gas production
	WC-182	Seneca Resources, Westport Resources	Leased (OCS-G15062) producing	Oil and gas production
	WC-171	Conn Energy	Leased (OCS-G1997) producing	Oil and gas production
Pipeline C 30-inch	WC-213	None	Open	Proposed LNG facility site
	WC-212	Callon Petroleum	Leased (OCS-G22524)	Oil and gas exploration and production
	WC-206	Forest Oil	Leased (OCS-G3496) producing	Oil and gas production
	WC-195	Union Oil		
	WC-184	None	Open	Future lease sale candidate
	WC-185	None	Open	Future lease sale candidate
	WC-168	Chevron	Leased (OCS-G5283) producing	Oil and gas production
	WC-167	Total Final Elf	Leased (OCS-G9400) producing	Oil and gas production
Pipeline D 16-inch	WC-213	None	Open	Proposed LNG facility site
	WC-224	None	Open	Future lease sale candidate
Pipeline E 20-inch	WC-213	None	Open	Proposed LNG facility site
	WC-214	None	Open (fairway block)	Future lease sale candidate
	WC-215	Energy Resources Technology	Leased (OCS-G4087) producing	Oil and gas production
	WC-216	Pioneer Natural Resources	Leased (OCS-G21542)	Oil and gas exploration and production
	WC-217	None	Open	Future lease sale candidate
	WC-218	None	Open	Future lease sale candidate

access to existing communication infrastructure with the exception of the four tugs. Marine support and supply for the Terminal would be provided by contracted marine services. An existing logistics and supply base in the Cameron area and an existing helicopter base would be contracted for by the Applicant. Potential helicopter bases are in Cameron, Abbeville, and Lafayette, Louisiana; and Sabine, Texas. The tugs would be based at an existing facility in the Cameron, Louisiana area (GL 2003a, b).

The high level of oil and gas activity on the OCS and nearshore state or territorial waters is supported by an extensive network of onshore support and service facilities. Refining, separation, and processing facilities are present to handle natural gas and crude oil produced offshore or tinkered into Gulf Coast ports or via Louisiana Offshore Oil Port (LOOP). Offshore infrastructure includes oil and gas platforms, pipelines, and terminals, which route their production to onshore facilities. Support facilities include pipe coating and storage yards, support bases and airports, and platform and construction yards. It is expected that the proposed Terminal and its supporting operations would use, to the greatest extent possible, the existing infrastructure of support and service facilities, as well as the extensive onshore natural gas transport system capabilities of the Gulf Coast region (GL 2003a).

Approximately 100 employees would be required to operate the proposed Port and for related support activities. It is assumed that the crew would be stationed at the proposed Terminal on a rotating basis. The Applicant has identified Cameron, Louisiana, in Cameron Parish, as the location of onshore support facilities. Therefore, socioeconomic data for Cameron Parish is used as baseline conditions for the socioeconomic analysis of onshore facilities. Data on Cameron Parish, Louisiana, and the United States are presented in Tables 3-15 and 3-16.

Table 3-15. Employment of Residents by Industry

Economic and Social Indicators	U.S.	Louisiana	Cameron Parish	Cameron
Agriculture, forestry, fishing and hunting, and mining	1.9%	4.2%	16.6%	31.5%
Construction	6.8%	7.9%	11.2%	1.3%
Manufacturing	14.1%	10.1%	7.1%	6.1%
Wholesale trade	3.6%	3.5%	3.4%	4.2%
Retail trade	11.7%	11.9%	10.2%	6.4%
Transportation and warehousing, and utilities	5.2%	5.3%	9.5%	12.4%
Information	3.1%	2.0%	1.2%	0.6%
Finance, insurance, real estate, and rental and leasing	6.9%	5.7%	3.7%	3.8%
Professional, scientific, management, administrative, and waste management services	9.3%	7.6%	4.9%	2.8%
Educational, health, and social services	19.9%	21.7%	16.2%	13.1%
Arts, entertainment, recreation, accommodation, and food services	7.9%	9.1%	6.4%	8.0%
Other services (except public administration)	4.9%	5.2%	5.1%	4.4%
Public administration	4.8%	5.8%	4.4%	5.5%

Source: U.S. Bureau of Census, 2000

Table 3-16. Economic and Business Characteristics

	U.S.	Louisiana	Cameron Parish
Private nonfarm establishments, 1999	7,008,444	101,020	178
Private nonfarm employment, 1999	110,705,661	1,579,949	1,882
Nonemployer establishments, 1999	16,152,604	228,628	730
Manufacturers shipments, 1997 ($1,000)	3,842,061,405	80,423,978	Not Available
Retail Sales, 1997 ($1,000)	2,460,886,012	35,807,894	29,098
Retail sales per capita, 1997	$9,190	$8,229	$3,256
Minority-owned firms, percent of total, 1997	14.6%	14.1%	Fewer than 100 firms
Women-owned firms, percent of total, 1997	26.0%	23.9%	22.6%
Housing units authorized by building permits, 2000	1,592,267	14,720	42
Federal funds and grants, 2001 ($1,000)	1,763,896,019	27,816,445	48,260
Local government employment – full-time equivalent, 1997	10,227,429	169,976	430

Source: U.S. Bureau of Census 2000

The population of Cameron Parish was 9,991 in 2000—a 7.9 percent increase over the population in 1990. The population of Cameron Parish between 1990 and 2000 grew faster than in Louisiana (5.9 percent), but slower than in the United States as a whole (13.2 percent). The unemployment rate in Cameron Parish was 4.6 percent in 2000, lower than both the Louisiana average (7.3 percent) and the nationwide average (5.8 percent). Unemployment in Cameron Parish has declined from the 1990 rate of 7.6 percent (U.S. Bureau of Census 2000).

Table 3-15 lists industry of employment for residents in Cameron, Cameron Parish, Louisiana and the U.S. As would be expected, a substantially larger portion of residents in Cameron (31.5 percent) and Cameron Parish (16.6 percent) work in agriculture, forestry, fishing and hunting or mining industries compared to the statewide average (4.2 percent). Larger portions of residents in Cameron Parish work in construction and transportation than in Cameron or the statewide or nationwide averages (U.S. Bureau of Census 2000). A smaller percentage of residents in Cameron and Cameron Parish are employed in manufacturing, and in professional, scientific, management, administrative, and waste management services than statewide or nationwide averages (U.S. Bureau of Census 2000).

The percent of residents who have obtained a high school diploma is much lower in Cameron (58.7 percent) and Cameron Parish (68.1 percent) compared to statewide (74.8 percent) or nationwide (80.4 percent) (Figure 3-5). Similarly, a substantially smaller percentage of residents in Cameron and Cameron Parish have achieved a college education (5.0 and 7.9 percent, respectively) compared to statewide (18.7 percent) or nationwide (24.4 percent) (U.S. Bureau of Census 2000).

3.5.2.6 Environmental Justice

This section presents the demographic data for Cameron and Cameron Parish required to facilitate the evaluation of potential environmental justice issues that might be associated with the Proposed Action.

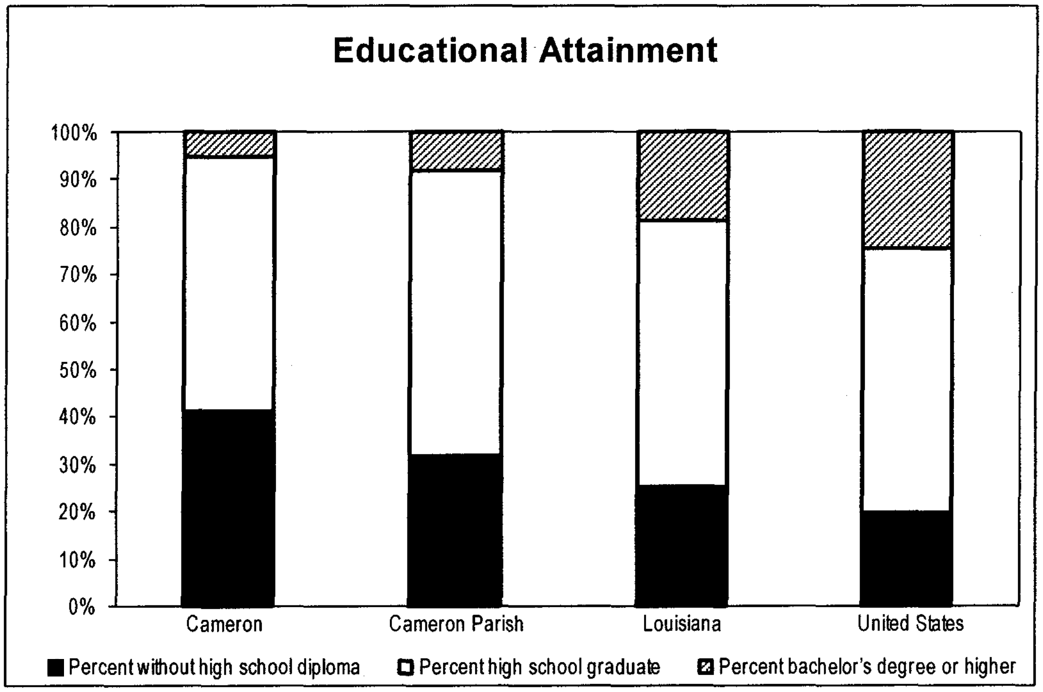


Figure 3-5. Educational Attainment of Residents

The populations of Cameron and Cameron Parish are predominantly White (82.5and 93.7 percent, respectively), followed by Black or African-American (11.9 and 3.9 percent, respectively). This is substantially the same as in 1990. About 22 percent of the population of Cameron Parish reported incomes that were below the poverty threshold in 2000; almost one-quarter of families with children below the age of 18 were living below the poverty level (Table 3-17). Both figures are higher than the state and U.S. average. The portion of the population living below poverty level has not changed appreciably between 1989 and 1999 (latest available data; U.S. Bureau of Census 2000).

Table 3-17. Race and Poverty Characteristics

	United States	Louisiana	Cameron Parish	Cameron
Total Population	281,421,906	4,465,430	9,991	1,965
Percent White	75.1	63.9	93.7	82.5
Percent Black	12.3	32.5	3.9	11.9
Percent American Indian, Eskimo, or Aleut	0.9	0.6	0.4	0.6
Percent Asian or Pacific Islander	3.7	1.2	0.4	0.4
Percent Other	5.5	0.7	0.9	3.4
Percent Reporting 2 or more races	2.4	1.1	0.7	1.4
Percent Living in Poverty	12.4	19.6	12.3	19.4

Source: U.S. Bureau of Census 2000

3.6 Recreation

3.6.1 Definition of the Resource

Recreational resources are natural and man-made conditions that offer coastal visitors and residents diverse opportunities for beach and waterways use. Since the proposed Onshore Base would be in an industrial area, and the proposed Terminal, Alternate Site Location, and associated pipeline routes (the ROI) would be offshore, shore-based recreation is only generally referenced.

3.6.2 Existing Conditions

The northern GOM coastal zone is one of the major recreational regions of the United States, particularly in connection with marine fishing and recreational beach-related activities. The shorefronts along the Gulf Coasts of Louisiana and Texas offer a diversity of natural and developed landscapes and seascapes. Residents and tourists use the coastal beaches, barrier islands, estuarine bays and sounds, river deltas, and tidal marshes for recreational activities. Commercial and private recreational facilities and establishments serve as primary interest areas and support services for people who seek the enjoyment of the recreational resources offered in the GOM (MMS 2002a).

The coastal zone of Texas and Louisiana is considered a major U.S. recreational region. Coastal recreational sources include recreational areas (e.g., national seashores, parks, beaches, wildlife lands), wilderness areas, wildlife sanctuaries, and scenic rivers, as well as resorts, marinas, amusement parks, and ornamental gardens. Publicly owned coastal recreational resources include national seashores, parks, beaches, and wildlife lands. They also extend to designated preservation areas such as historic and natural sites, landmarks, wilderness areas, wildlife sanctuaries, and scenic rivers. Private and commercial recreational facilities along the Gulf Coast include resorts, marinas, amusement parks, and ornamental gardens (MMS 2001).

Beaches are a major resource that attract tourists and residents to the Gulf Coast for a variety of activities (e.g., fishing, beachcombing, camping, picnicking, and birdwatching) (MMS 2002a). Beach use is a major economic component of many Gulf Coast communities, especially during the peak-use spring and summer seasons. Beach activities and the aesthetic value of the shoreline are important economic factors in the coastal zone. The scenic and aesthetic value of Gulf Coast beaches plays an important role in attracting both residents and tourists to the coastal zone.

Offshore recreational activities predominately involve sportfishing, boating, and diving. A substantial portion of the recreational fishing activities (including scuba diving) are directly associated with oil and gas production platforms, which function as high profile, artificial reefs that attract fish. A majority of the offshore recreational fishing in the central portion of the GOM is directly associated with oil and gas structures. Recreational anglers catch at least 46 fish species near oil and gas platforms in the central GOM (MMS 2002b). Interest remains high throughout the GOM region to acquire, relocate, and retain selected oil and gas structures in the marine environment for use as dedicated artificial reefs to enhance marine fisheries when the structures are no longer useful for oil and gas production (MMS 2001). Prominent natural features (e.g., Flower Garden Banks) also serve as primary diving destinations for sport divers.

According to the NOAA Fisheries Marine Recreational Fishery Statistics Survey (MRFSS), over 3 million marine recreational anglers participated in 22.8 million trips and caught a total of 163 million fish in the GOM (excluding offshore Texas) in 2001 (NOAA Fisheries 2003d). Sixteen percent of these trips were made in Louisiana. Table 3-18 records the recreational fish landings in Louisiana's Gulf waters from 1997 through 2001. There are nearly 17 million recreational marine anglers who fish in the GOM.

Louisiana recorded 101,269 recreational boat trips into its Federal EEZ in 2001. There is also an abundance of marine mammals in the GOM. They offer a potential recreational and aesthetic resource in terms of tourism and activities such as whale watching.

Table 3-18. Recreational Fish Catches in the EEZ Off the Coast of Louisiana

Year	Total Catch	Total Pounds
1995	1,455,325	3,237,616
1996	937,457	2,129,313
1997	1,117,157	2,332,581
1998	556,474	1,536,498
1999	855,617	2,276,602
2000	982,392	1,715,452
2001	722,716	2,277,270
2002	931,563	2,274,949

Source: NOAA Fisheries 2003d

3.7 Transportation

3.7.1 Definition of the Resource

Transportation refers to the movement of vessels and OCS-activity support helicopters in the vicinity of the proposed Port. Transportation within this region of the GOM includes a variety of vessels engaged in commercial, recreational, Federal, and state functions. In addition, large numbers of helicopter operations support offshore activities. Transportation also includes the existing infrastructure of roads, rails, and inland waterways that that could be affected by a proposed action.

3.7.2 Existing Conditions

Maritime Transportation. A wide-ranging domestic and foreign maritime industry exists in the northern GOM. Major trade shipping routes between Gulf ports and ports outside the northern GOM occur via the Bay of Campeche, the Yucatán Channel, and the Straits of Florida. Fourteen of the 50 leading U.S. ports (based on millions of short tons in 1999) are on the GOM. The five Gulf States, when ranked by state tons in 1999, are in the top 20; Louisiana is ranked first (MMS 2002a).

A large portion of GOM shipping traffic pertains to crude oil and petroleum products and is due to the region's extensive refinery capacity, easy port access, and a well-developed transportation system. Crude oil produced within the GOM region is piped and barged from Gulf terminals to reach refineries and onshore transportation routes. Petroleum products are barged, tankered, piped, or trucked from the large refinery complexes. Between 60 and 65 percent of the crude oil imported into the United States comes through GOM waters (MMS 2002a). The area also includes the Nation's Strategic Petroleum Reserve and LOOP, the only deepwater crude-oil terminal in the country.

More than 4,000 offshore platforms play a pivotal role in the development of offshore oil and gas resources in the GOM. Service vessels and helicopters are the primary modes of transporting personnel between service bases and near-coast offshore platforms, drilling rigs, derrick barges, and pipeline construction barges. Service vessels are used to carry the bulk of the cargo such as fresh water, fuel, equipment, and food to support offshore operations. There are 376 supply vessels (platform supply vessels and anchor-handling tugs/supply vessels) in the western and central portions of the GOM (increased from a 1993 low of 247 units) (MMS 2002a). Nearly three-quarters of the supply fleet is less than 61 m (200 ft) long and works primarily in shallow waters; the remaining is 61 m (200 ft) or larger and works primarily in deep water.

In some instances, helicopters are also used to carry equipment and supplies. The 29 helicopter facilities' "heliports" in coastal southeastern Louisiana are used primarily as flight support bases to service the offshore oil and gas industry. The Federal Aviation Administration (FAA) regulates helicopter flight patterns (MMS 2002a).

WC-213 lies adjacent to the Calcasieu Fairway, a north-south shipping safety fairway established by the USCG.[17] LNCGs traveling to WC-213 or WC-183 would use the Gulf Fairway and Sabine Pass Fairway, proceeding north on the Calcasieu Fairway for the final 153 km (95 mi) of their transit. No safety zones are presently designated in WC-213 or WC-183. Approximately 32 km (20 mi) south of WC-213, a fairway anchorage is established in WC-257 and WC-366 adjacent to and west of the Calcasieu Fairway.

[17] A shipping safety fairway or fairway is a lane or corridor in which no artificial island or fixed structure, whether temporary or permanent, may be permitted. Aids to navigation approved by the USCG may be established in a fairway. A fairway anchorage is an anchorage area contiguous to and associated with a fairway; fixed structures may be permitted within certain spacing limitations. 33 CFR 166.105.

In December 2003, the Louisiana Department of Transportation and Development published the *Louisiana Statewide Transportation Plan Update*. The following discusses that updated plan.

- *Ports.* Louisiana's water ports, some of the largest in the country, are critical for the movement of raw materials and finished products in support of the agricultural, mining, and industrial base of the state and other areas, particularly the Midwest. Louisiana is the Nation's second largest producer of natural gas and third largest producer of crude oil. In terms of offshore oil and gas production, the GOM accounts for more than 90 percent of U.S. production. Major public ports at Fourchon, Iberia, and Morgan City, and a large number of private terminals operate as supply bases to the offshore oil and gas industry in the state. Commercial fishing and recreational boating activities at these locations are much less important than other port activities (LDOTD 2003). The plan recommends increasing the state's Port Priority Contribution (for facility expansion and technical modernization) and continuing to develop the maritime marketing program. The plan also encourages addressing the backlog in improvements to federally maintained waterways and assures the adequacy of the Inland Waterway System to meet projected needs for industries (LDOTD 2003).
- *Aviation.* The state's aviation sector provides vital air service for business travel and tourism, and for the movement of time-sensitive, high-value cargo. The most recent forecasts of commercial passenger activity presented in FAA in FAA Aerospace Forecasts, Fiscal Years 2000–2011, reflect anticipated strong growth in both domestic and international passenger activity at U.S. airports with an annual growth rate of approximately 3.6 percent (LDOTD 2003). Recommendations in the plan include rehabilitation of airport system infrastructure deficiencies, airfield and terminal capacity improvements, an additional air carrier runway at New Orleans International Airport, and an aviation marketing system (LDOTD 2003).
- *Highways.* The state's highways are the cornerstone mode for transportation with which all other modes of transportation interconnect. The plan forecasts that urban areas will continue to experience worsening highway congestion, and highway congestion in rural areas will be limited to portions of Interstates 10, 12, and 20, particularly south of Baton Rouge. According to the plan, the magnitude of the highway safety problem cannot be overstated. The plan contains a prioritized list of highway projects totaling $3.1 billion. Other improvements to highway/railroad at-grade crossings and bridges are also identified (LDOTD 2003).
- *Rail.* The state's railroads are essential for moving freight. There are six Class 1 railroads serving Louisiana, operating more than 4,065 km (2,526 mi) of railroad. New Orleans is a major interchange point for western and eastern railroads; all of the Class 1 railroads connect in New Orleans. The plan notes that Louisiana is a major origin and destination for rail traffic. Growth of passenger trains is limited by a lack of passenger cars to increase train length. The state's small railroads have unmet capital needs to improve tracks for heavier car weights (LDOTD 2003). The state has actively encouraged development and application of a full spectrum of guided transport technologies, ranging from upgraded conventional rail services to magnetic levitation. Louisiana, in cooperation with the Federal Railroad Administration, Southern Rapid Rail Transit Commission, and the states of Alabama and Mississippi, is studying the feasibility of developing a Gulf Coast high-speed rail corridor from Mobile to New Orleans (FRA 2004).

3.8 Air Quality

3.8.1 Definition of the Resource

In accordance with Federal CAA requirements, the air quality in a given region or area is measured by the concentration of various pollutants in the atmosphere. The measurements of these "criteria pollutants" in ambient air are expressed in units of ppm or in units of micrograms per cubic meter ($\mu g/m^3$). The air quality in a region is a result not only of the types and quantities of atmospheric pollutants and pollutant sources in an area, but also surface topography, the size of the topological "air basin," and the prevailing meteorological conditions.

The CAA directed USEPA to develop, implement, and enforce strong environmental regulations that would ensure clean and healthy ambient air quality. To protect public health and welfare, USEPA developed numerical concentration-based standards, or National Ambient Air Quality Standards (NAAQS), for pollutants that have been determined to affect human health and the environment. USEPA established both primary and secondary NAAQS under the provisions of the CAA. NAAQS are currently established for six criteria air pollutants including ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), respirable particulate matter (including particulates equal to or less than 10 microns in diameter [PM_{10}], and particulates matter equal to or less than 2.5 microns in diameter [$PM_{2.5}$]), and lead (Pb). The primary NAAQS represent maximum levels of background air pollution that are considered safe, with an adequate margin of safety to protect public health. Secondary NAAQS represent the maximum pollutant concentration necessary to protect vegetation, crops, and other public resources along with maintaining visibility standards. Table 3-19 presents the Federal primary and secondary NAAQS.

When measured concentrations of regulated pollutants exceed standards established by the NAAQS, an area could be designated as a nonattainment area for a regulated pollutant. The number of exceedances and the concentrations determine the nonattainment classification of an area. There are five classifications of nonattainment status: marginal, moderate, serious, severe, and extreme.

3.8.1.1 Regulation of Air Quality on the OCS

The attainment status of OCS waters is unclassified. The OCS areas are not classified because there is no provision for any classification in the CAA for waters outside of the boundaries of state waters (the state seaward boundary for Louisiana extends 5 km (3 mi) from the shore). Only areas within state boundaries are to be classified as either attainment, nonattainment, or unclassifiable. (Attainment means that the air quality within an air basin or region is better than the NAAQS; nonattainment indicates that air pollutant concentration exceeds NAAQS; and an unclassifiable air quality designation means that there is not enough information to appropriately classify an air basin or region, so the area is considered attainment.) The proposed Port's proximity to sensitive air resources is presented in Figure 3-6.

Pursuant to CAA regulations promulgated in 40 CFR Part 328, USEPA does not normally administer the CAA in the GOM west of longitude 87° 30'. Typically, MMS is responsible for regulating such "OCS sources" in the area. However, a deepwater port constructed solely for the purpose of transporting imported resources does not meet the definition of an OCS source according to Section (a)(1) of the OCS Lands Act. Therefore, the MMS and USEPA have officially determined that air jurisdiction over the proposed LNG facility and the jurisdiction for administrative Clean Air Act Amendments (CAAA) belongs to USEPA Region 6. Currently, USEPA's national air program is attempting to develop a nationally consistent policy regarding the regulation of deepwater port air emissions.

Table 3-19. National Ambient Air Quality Standards

Pollutant	Standard Value		Standard Type
CARBON MONOXIDE (CO)			
8-hour Average	9 ppm	(10 mg/m^3) [2]	Primary and Secondary
1-hour Average	35 ppm	(40 mg/m^3) [2]	Primary
NITROGEN DIOXIDE (NO_2)			
Annual Arithmetic Mean	0.053 ppm	(100 $\mu g/m^3$) [2]	Primary and Secondary
OZONE (O_3)			
1-hour Average[1]	0.12 ppm	(235 $\mu g/m^3$) [2]	Primary and Secondary
8-hour Average[1]	0.08 ppm	(157 $\mu g/m^3$) [2]	Primary and Secondary
LEAD (PB)			
Quarterly Average		1.5 $\mu g/m^3$	Primary and Secondary
PARTICULATE < 10 MICROMETERS (PM_{10})			
Annual Arithmetic Mean		50 $\mu g/m^3$	Primary and Secondary
24-hour Average		150 $\mu g/m^3$	Primary and Secondary
PARTICULATE < 2.5 MICROMETERS ($PM_{2.5}$)			
Annual Arithmetic Mean		15 $\mu g/m^3$	Primary and Secondary
24-hour Average		65 $\mu g/m^3$	Primary and Secondary
SULFUR DIOXIDE (SO_2)			
Annual Arithmetic Mean	0.03 ppm	(80 $\mu g/m^3$) [2]	Primary
24-hour Average	0.14 ppm	(365 $\mu g/m^3$) [2]	Primary
3-hour Average	0.5 ppm	(1300 $\mu g/m^3$) [2]	Secondary

Notes: [1] In July 1997, the 8-hour ozone standard was promulgated and the 1-hour ozone standard was remanded for all areas, except areas that were designated nonattainment with the 1-hour standard when the ozone 8-hour standard was adopted. USEPA estimates that the revised 8-hour ozone standard rules will be promulgated in 2003–2004. In the interim, no areas can be deemed definitively nonattainment with the new 8-hour standard.

[2] Parenthetical value is an approximately equivalent concentration.

ppm – parts per million

mg/m^3 – milligrams per cubic meter

$\mu g/m^3$ – micrograms per cubic meter

The MMS and USEPA have officially determined that air jurisdiction over the proposed LNG facility and the jurisdiction for administrative Clean Air Act Amendments (CAAA) belongs to USEPA.

Regulated criteria pollutants and their effect on health and environmental welfare are discussed in more detail below.

The criteria pollutants and their impact on health and environmental welfare are discussed in more detail below.

O_3. Although O_3 is considered a criteria air pollutant and measurable in the atmosphere, it is not often considered a regulated air pollutant when calculating emissions because O_3 is typically not emitted directly from most emissions sources. O_3 is formed in the atmosphere by photochemical reactions involving sunlight and previously emitted pollutants or "O_3 precursors." These O_3 precursors consist

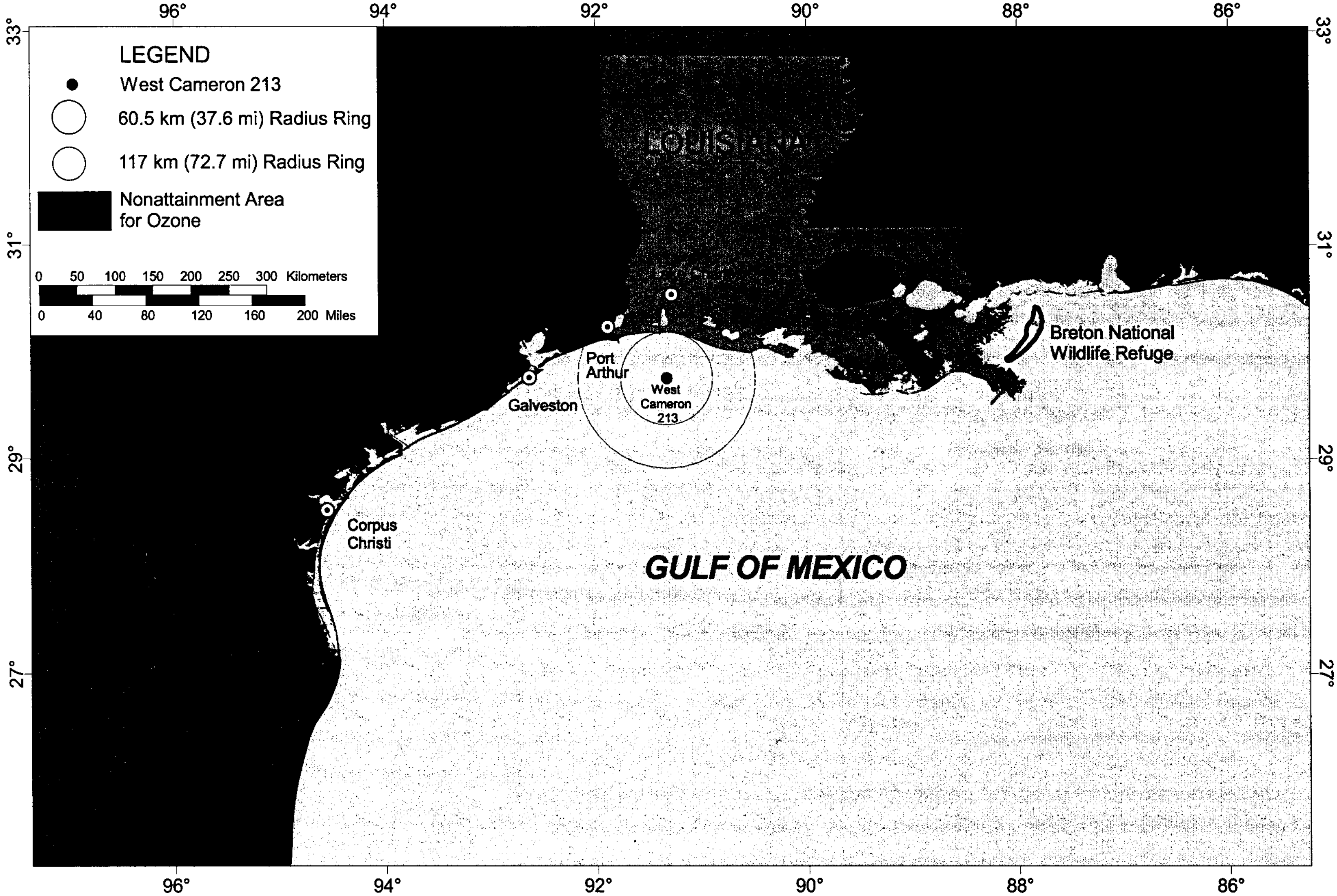


Figure 3-6. Proximity of Proposed Port to Sensititve Air Resources

primarily of nitrogen oxides (NO_x) and volatile organic compounds (VOCs) that are directly emitted from a wide range of emissions sources. For this reason, regulatory agencies attempt to limit atmospheric O_3 concentrations by controlling VOC pollutants (also identified as reactive organic gases or ROG) and NO_x.

NO_2. NO_x emissions are primarily generated from the combustion of fuels. NO_x includes nitric oxide and NO_2. Because nitric oxide converts to NO_2 in the atmosphere over time and NO_2 is the more toxic of the two, NO_2 is the listed criteria pollutant. It can penetrate deep into the lungs where tissue damage occurs. The control of NO_x is also important because of its role in the formation of O_3.

CO. CO is a product of fuel combustion, principally from automobiles and other mobile sources of pollution. The major immediate health effect of CO is that it competes with oxygen in the blood stream and can cause death by asphyxiation. However, concentrations of CO in urban environments are usually only a fraction of those levels that cause asphyxiation. Peak CO levels typically occur during winter months due to a combination of higher emissions rates and stagnant weather conditions.

SO_2. SO_2 is produced when any sulfur-containing fuel is burned. It is also emitted by chemical plants that treat or refine sulfur or sulfur-containing chemicals. Health and welfare effects attributed to SO_2 are due to highly irritant effects of sulfate aerosols, such as sulfuric acid, which are produced from SO_2.

Particulate Matter. Particulates in the air are caused by a combination of wind-blown fugitive dust; particles emitted from combustion sources (usually carbon particles); and organic, sulfate, and nitrate aerosols formed in the air from emitted hydrocarbons, sulfur oxides, and NO_x. Particulate matter might contribute to the development of chronic bronchitis and might be a predisposing factor to acute bacterial and viral bronchitis. In 1987, USEPA adopted standards for PM_{10} and phased out the total suspended particulate (TSP) standards that had been in effect until then. In 1997, USEPA adopted emissions standards for $PM_{2.5}$ pollutants which, due to their size, have been determined by USEPA to lodge deep in lung tissue and cause chronic health impacts.

Pb. Lead exposure can occur through multiple pathways, including inhaling air and ingesting lead in food from water, soil, or dust contamination. Excessive exposure to lead can affect the central nervous system. Lead gasoline additives were a significant contributor to atmospheric lead emissions. Legislation in the early 1970s required gradual reduction of the lead content of gasoline over a period of time, which has dramatically reduced lead emissions from mobile and other combustion sources. In addition, unleaded gasoline was introduced in 1975, and together these controls have essentially eliminated violations of the lead standard for ambient air in urban areas. Hence, many states do not provide a background level for lead.

3.8.1.2 Applicable Regulatory Requirements

As specified under USEPA guidance and Federal CAA regulations (40 CFR 55.15), the specific provisions of the CAA that might be relevant to construction and operational emissions sources from OCS sources include the following:

- New Source Performance Standards (NSPS)
- National Emissions Standards for Hazardous Air Pollutants (NESHAP)
- Prevention of Significant Deterioration (PSD)
- Title V Operating Permits (Title V)
- Compliance Assurance Monitoring (CAM)

- Nonattainment New Source Review (NSR)
- Louisiana Air Quality Regulations

In addition, USEPA Region 6 is currently reviewing Gulf Landing LLC's PSD Air Quality Permit Application and Application for Federal Operating Permit (Title V) for operation of the proposed deepwater port.

Each of these regulatory CAA components is discussed below, along with its relevance to the Proposed Action.

NSPS

Two NSPSs potentially apply to emission sources associated with the Proposed Action. The NSPS "Standards of Performance for Stationary Gas Turbines," (40 CFR 60, Subpart GG) are implemented by USEPA and apply to stationary gas turbines with a heat input at peak load equal to or greater than 10.7 gigajoules per hr (10 million Btu/hr), based on the lower heating value of the fuel. NO_x and SO_2 emission restrictions apply to applicable sources. In addition, 40 CFR 60, Subpart Kb applies to any volatile organic liquid storage unit with a capacity of 40 m^3 or greater, that is modified, constructed, or reconstructed after July 23, 1984.

NESHAP

NESHAP Parts 61 and 63 regulate the emission of hazardous air pollutants (HAP) from existing and new sources. The proposed Port is not expected to operate any processes that are regulated by Part 61. The CAAA of 1990, under revisions to Section 112, requires USEPA to list and promulgate NESHAP to reduce the emissions of HAPs, (such as formaldehyde, benzene, xylene, and toluene) from categories of major and area sources. As these standards are promulgated, they are published in 40 CFR 63. The major source threshold for NESHAP is 10 tons per year (tpy) of any single HAP or 25 tpy for all combined HAP emissions.

Stationary gas turbines are listed among the major source device categories that would be subject to Part 63 NESHAP emission standards. In January of 2003, the standards for stationary gas turbines were published in the proposed rule "National Emissions Standards for HAPs for Stationary Combustion Turbines" (40 CFR 63, Subpart YYY). The Proposed Action design and equipment specifications indicate that HAPs emissions from the proposed Port would be well below the major source thresholds. Therefore, the proposed turbine NESHAP standards would not apply to the proposed Port.

USEPA recently promulgated NESHAP for natural gas transmission and storage facilities (40 CFR 63 Subpart HHH). Owners and operators of facilities that transport natural gas are not subject to this regulation if their facility does not contain a glycol dehydration unit.

PSD

The PSD regulations are intended to preserve the existing air quality in attainment areas where pollutant levels are below (or better than) the NAAQS. In addition to requiring an extensive review of environmental impacts, viable emission control technologies, and related impacts, PSD regulations impose specific limits on the amount of pollutants that major new or modified stationary sources might contribute to existing air quality levels. Major sources are defined as facilities with a potential to emit listed pollutants in amounts equal to or greater than 250 tpy or 100 tpy for 28 specific source categories. In addition, a facility is subject to PSD permit requirements if net emission increases associated with source modifications within a contemporaneous 5-year period equal or exceed the following thresholds for criteria pollutants (40 CFR 52.21):

- CO: 100 tpy
- NO_x, VOC, and SO_x: 40 tpy
- $PM_{2.5}$: 25 tpy
- PM_{10}: 15 tpy
- Pb: 0.6 tpy

Under the PSD program, Class I areas are assigned to protect Federal wilderness areas such as national parks, where the least amount of air quality deterioration is allowed. Class I areas are designated as pristine natural areas or areas of natural significance. The Class II designation is used for all others areas, except Class III designations which are intended for heavily industrialized zones (40 CFR 51.166). Each classification differs in terms of the amount of growth allowed before significant deterioration of air quality occurs.

The proposed Terminal and Preferred Alternate location are approximately 280 mi southwest of the nearest Class I attainment area, the Breton Wilderness Area. Breton Wilderness Area is located off the shore of Louisiana in Breton Sound. It is regulated under the Federal PSD program, administered by USEPA (see Figure 3-6). The Class I area is a considerable distance from the proposed Terminal and Preferred Alternate location. USEPA has indicated that there would be no air quality impacts on this Class I area and that no PSD permit would be required for the Proposed Action.

Title V

Title V of the CAA Amendments of 1990 requires USEPA, states, or local agencies to permit major stationary sources. A major stationary source is a facility (i.e., plant, installation, or activity) that has the potential to emit more than 100 tpy of any one criteria air pollutant, 10 tpy of a hazardous air pollutant (HAP), or 25 tpy of any combination of HAPs. In addition to these thresholds, lower pollutant-specific "major source" permitting thresholds apply in nonattainment areas. The purpose of the permitting requirement is to establish regulatory control over larger activities and to monitor their effect on air quality.

USEPA Region 6 has made a determination that the proposed activities fall within its jurisdiction. Because stationary emissions sources at the proposed facility would have the potential to emit more than 100 tpy of criteria pollutants, the proposed Terminal would be designated as a Major Source under Title V of the CAAA.

Title V Major Sources within state or local jurisdictions are permitted by those jurisdictions under Title V Part 70. The proposed Port would be located on the OCS and would, therefore, be permitted by USEPA Region 6 under Title V Part 71. A Title V permit application with voluntary synthetic minor source limits for the proposed Gulf Landing Port was prepared and submitted to USEPA Region 6 in October 2003.

CAM

In accordance with regulations promulgated in 40 CFR Part 64, a CAM plan must be prepared for any new or modified facility with emissions units subject to Federal emissions limits. The Title V Permit Application submitted to USEPA Region 6 in October of 2003 included plans to monitor compliance with the Turbine NSPS.

Nonattainment NSR

New or modified air pollutant emissions sources proposed in nonattainment areas must undergo the NSR permitting process prior to operation or construction. Through the NSR permitting process, local or state regulatory agencies review and approve proposed construction plans, regulated pollutant increases or changes, emissions controls, and various other details. The agencies then issue construction permits that include specific requirements for construction and startup. Once construction is complete, the sources are issued operating permits that specify detailed operating conditions, emissions limits, fees, reporting and record keeping requirements, and various other operating parameters that must be met throughout the life of the permit. The applicability of the NSR permitting process depends on whether the proposed source(s) exceed specific emissions thresholds or source type thresholds established in local and state regulations. Because the proposed Port would not be within the boundaries of a nonattainment area, it would not be subject to NSR permitting.

Louisiana Air Quality Regulations

Although the proposed Terminal would be outside the jurisdictional boundary for Louisana, USEPA has determined that the facility would be subject to Louisiana regulations pertaining to individual pollutants and sources, as codified in the Louisiana Administrative Code (LAC) Title 33, Part III. Therefore, the emissions and plant operations of the proposed Port would comply with all applicable rules and regulations and with the intent of the Louisiana Clean Air Act (LCAA), including the protection of the health and physical property of the people.

3.8.2 Existing Conditions

3.8.2.1 Regional Climatology

This section describes the regional climate and meteorological conditions that influence the transportation and dispersion of air pollutants, as well as the existing levels of criteria air pollutants in the region. The data presented here represent the offshore project location where the proposed turbine generators and other air-emitting equipment could affect regional air quality.

Louisiana has a humid, subtropical climate, where summers are long and hot and winters are short and mild. The annual average temperature in southern Louisiana is about 20 °C (68 °F). Rainfall is distributed fairly evenly throughout the year, with an annual rainfall of about 152 mm (60 in). The 10-year rainfall is 8.9 centimeters per hour (cm/hr) (3.5 inches per hour [in/hr]), the 25-year rainfall is 9.9 cm/hr (3.9 in/hr), and the 50-year rainfall is 10.9 cm/hr (4.3 in/hr) (NCDC 2001).

Since the proposed Port would be 61 km (38 mi) off the shore of Louisiana, climatological data for the area were taken from NOAA's National Data Buoy Center. Data were obtained from Station 42011, which is the closest station to the Proposed Action. This buoy is approximately 48 km (30 mi) northwest of the Proposed Port location, between the Proposed Port and the Louisiana coastline. Climatic data for this buoy are available from September 1981 to August 1984, and include average wind speed (m/s), peak wind gust (m/s), wind direction (degrees from true north), sea-level pressure (millibars), and air temperature (°C) as shown in Table 3-20.

Temperature data were derived from Station 42035, which is 40 km (25 mi) east of Galveston, Texas, and 129 km (80 mi) west of the Proposed Port. Water temperature data (not available for Station 42011) were available from this station. Calendar year 2003 air and water temperature data were used.

Table 3-20. Representative GOM National Data Buoy Center Climatic Data Summary

Station Data		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Wind Speed (m/s)[1]	Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0**
	Mean	6.6	6.7	6.7	7.3	6.6	5.2	4.8	4.9	5.4	5.7	7.3	8.1	**6.3**
	Max	16.9	20.7	21.0	17.0	18.2	13.3	15.0	17.8	16.5	16.8	19.6	19.0	**17.7**
Peak Wind Gust (m/s)[1]	Min	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	N/A	0.0	0.0	**0**
	Mean	7.8	7.8	7.7	8.4	7.7	5.9	5.3	6.1		N/A	9.5	9.7	**7.6**
	Max	19.5	25.5	25.7	20.2	21.7	15.9	20.2	16.4	N/A	N/A	24.4	22.8	**21.2**
Wind Direction (from)[1]	Mean	SE	SE	SSE	SSE	SSE	S	S	S	SE	SE	SSE	SE	**SSE**
Sea Level Pressure (millibars)[1]	Min	999.3	996.4	992.6	997.3	1001.2	1007.4	1010.2	1008.0	1009.4	1009.0	999.7	1000.4	**1002.6**
	Mean	1020.2	1017.5	1014.8	1012.8	1014.5	1014.2	1016.6	1016.3	1017.5	1018.2	1015.9	1018.9	**1016.0**
	Max	1037.4	1031.6	1030.9	1028.4	1024.7	1021.1	1023.0	1022.1	1026.6	1028.5	1025.8	1043.0	**1028.6**
Air Temperature (°C)[2]	Min	0.9	4.8	9.7	7.5	22.2	22.2	23.7	23.8	21.1	14.4	6.1	5.9	**13.5**
	Mean	11.3	12.3	15.8	20.0	25.1	27.5	28.1	28.4	26.7	23.4	20.6	14.4	**21.1**
	Max	17.3	16.7	20.4	25.0	29.0	29.3	29.9	30.8	29.9	26.9	26.7	20.0	**25.2**
Sea Temperature (°C)[2]	Min	11.0	11.1	13.4	17.2	22.7	26.9	27.4	28.4	26.1	22.7	18.0	14.1	**20.0**
	Mean	13.5	13.2	16.7	20.3	26.1	28.7	29.2	29.6	28.4	24.8	22.3	16.0	**22.4**
	Max	16.4	14.8	20.3	23.5	29.7	31.3	31.5	32.0	31.5	26.6	25.9	19.1	**25.2**

Sources: [1]NOAA 2004a, [2] NOAA 2004b
Notes: m/s – meters per second
°C – degrees Celsius

3.8.2.2 Existing Ambient Air Quality

Background air quality in the area surrounding the proposed Port is normally obtained from air quality monitoring stations in the vicinity of the project. However, because of the location of the proposed Port, the closest air quality monitoring stations are onshore (64 km [40 mi] from the proposed Port). Data from several air quality monitoring stations were used to characterize the background air quality in the region.These stations were used because they are the closest to the project sites and because they record area-wide ambient conditions rather than localized impacts (data are reported for calendar year 2003, see Table 3-21). For some criteria pollutants, ambient air monitoring data in the vicinity of the proposed Port were not available; therefore, the best available data in the applicable parishes of the state of Louisiana were used.

An air quality study on the GOM determined that, based on comprehensive modeling results, the OCS petroleum development contribution to O_3 concentrations in onshore nonattainment areas in Louisiana parishes and Texas counties was very small (MMS 1995).

Table 3-21. Background Air Quality Summary

Parish	CO (ppm)		O_3 (ppm)		SO_2 (ppm)		PM_{10} (µg/m^3)	
	2nd Max 1-hr	2nd Max 8-hr	2nd Max 1-hr	2nd Max 8-hr	2nd Max 24-hr	Annual Mean	2nd Max 24-hr	Annual Mean
St. Mary	--	--	0.097	0.077	--	--	--	--
LaFourche	--	--	0.097	0.08	--	--	--	--
Jefferson	--	--	0.104	0.088	--	--	--	--
St. Bernard	--	--	0.103	0.083	0.019	0.003	--	--
Orleans	6.5	3.5	0.084	0.074	--	--	22	37

Source: USEPA undated

Notes: Not all stations collected data for all the criteria pollutants. Blank cells indicate no monitoring data were collected.

CO – carbon monoxide

O^3 – ozone

SO_2 – sulfur dioxide

PM_{10} – particulate matter equal to or less than 10 microns in diameter

ppm – parts per million

µg/m^3 – micrograms per cubic meter

3.9 Noise

3.9.1 Definition of the Resource

This section defines noise standards and methodology; discusses the impacts of noise on humans and marine organisms; and describes the existing ambient sound level in the ROI. To understand the impact of noise on humans and marine organisms it is necessary to understand the properties of noise in air and water and the existing ambient noise levels in the ROI.

Noise is customarily measured in decibels (dB). A dB is defined as the ratio between a measured pressure and a reference pressure. It is a logarithmic unit that accounts for large variations in amplitude and is the accepted standard unit of measurement for sound. The ambient sound level of a region is defined by the total noise generated, including sounds from both natural and artificial sources. The magnitude and frequency of environmental noise can vary considerably over the course of the day and throughout the week, due in part to changing weather conditions.

Waterborne (underwater) sound measurements are different from airborne sound measurements. Because of the differences in reference standards, noise levels cited for air do not equal underwater levels. The reference pressure used for underwater noise measurements is 1 micro-Pascal (μPa) at 1 meter (re 1μPa-m), which is lower than that used for airborne sound measurements. In addition, underwater sound measurements typically do not have any frequency weighting applied (i.e., A-weighted or C-weighted), while airborne noise is often measured using one of several frequency weighting scales. In many cases, underwater noise levels are reported only for limited frequency bands, while airborne noise is usually reported as an integrated value over a very wide range of frequencies. To compare noise levels in water to noise levels in air, one must subtract 61.5 dB from the noise level referenced in water in order to account for the difference in reference pressure (NOAA 2003).

Furthermore, because the mechanical properties of water differ from those of air, sound moves at a faster speed in water than in air. For example, sound waves that move at a speed of 1,500 m/s (4,921 ft/s) in water is equivalent to 340 m/s (1,115 ft/s) in air (NOAA 2003). Temperature also affects the speed of sound, traveling faster in warm water than in cold water. A lower frequency sound has a longer wavelength, and the wavelength of a sound equals the speed of sound in either air or water divided by the frequency of the wave. Therefore, a 20-Hertz (Hz) sound wave in the water is 75 meters long, whereas a 20-Hz sound wave in air is only 17 meters long (NOAA 2003).

3.9.2 Existing Conditions

Existing noise levels in the GOM are primarily associated with OCS oil and gas development and result from seismic surveys, the operation of fixed structures such as offshore platforms and drilling rigs, and helicopter and service-vessel traffic (MMS 2002a). Noise generated from these activities can be transmitted through both air and water, and could be stationary or transient. Offshore drilling and production involves various activities that produce a stationary composite underwater noise field. The intensity level and frequency of the noise emissions are highly variable, both between and among the various industry sources. Anticipated noise impacts resulting from the Proposed Action will be compared to existing noise levels associated with OCS oil and gas development and other noise-generating activities in the GOM.

Seismic Surveys. A sound source specific to operations in the OCS originates from seismic surveys. Marine seismic surveys direct a low-frequency energy wave (generated by an airgun array) into the ocean floor and record the reflected energy wave's strength and return arrival time. The pattern of reflected waves, recorded by a series of hydrophones embedded in cables towed by the seismic vessel (streamers), is used to "map" subsurface layers and features. Seismic surveys are used to check for foundation stability, detect groundwater, locate mineral deposits (coal), and search for oil and gas. Airguns produce an intense but highly localized sound energy.

A typical source would output approximately 220 dB re 1µPa-m, although the peak-to-peak source level directly below a seismic array could be as high as 262 dB re 1µPa-m (MMS 2002a). Sound-energy levels are expected to be less than 200 dB re 1µPa-m at distances beyond 90 m (295 ft) from the source. At distances of about 500 m (1,640 ft) and more (farfield), the array of individual airguns would effectively appear to be a single point source.

More recently, it has been estimated that a typical 240 dB seismic array would have a 180 dB re 1µPa-m level at approximately 225 m (738 ft) from the array. The 180 dB re 1µPa-m level is an estimate of the threshold of sound energy that might cause hearing damage in whales and cetaceans. It is unclear which measurements of a seismic pulse provide the most helpful indications of its potential impact on marine mammals. However, it is speculated that peak broadband pressure and pulse time and duration would be most relevant at short ranges (hearing damage range) while sound intensity in one-third octave bands is a more useful measurement at distance (behavioral effects) (MMS 2002a). In March 2004, MMS implemented seismic survey mitigation guidelines for protected species (MMS 2004).

Fixed Structures. Information on drilling noise in the GOM is unavailable to date. Drilling operations in Alaskan waters often produce noise that includes strong tonal components at low frequencies, including infrasonic frequencies in at least some cases. Drillships are apparently noisier than semisubmersible drills. (MMS 2002a). Sound and vibration paths to the water in a semisubmersible drill are through either the air or the risers, in contrast to the direct paths through the hull of a drillship.

Machinery noise generated during the operation of fixed structures could be continuous or transient, and variable in intensity. Underwater noise from fixed structures ranges from about 20–40 dB above background levels within a frequency spectrum of 30–300 Hz at a distance of 30 m (98 ft) from the source (MMS 2002a). These levels vary with type of platform and water depth. Underwater noise from platforms standing on metal legs would be expected to be relatively weak because of the small surface area in contact with the water and the placement of machinery on decks well above the water.

Vessel Traffic. Service vessels and helicopters are the primary modes for transporting personnel and supplies between service bases and offshore platforms, drilling rigs, derrick barges, and pipeline construction barges. Service vessels and helicopters might add noise to broad areas. Sound generated from helicopter and service-vessel traffic is transient in nature. The intensity and frequency of the noise emissions are highly variable, both between and among these sources. The level of underwater sound detection depends on receiver depth and aspect, and the strength/frequencies of the noise source. The duration that a passing airborne or surface sound source can be received underwater might be increased in shallow water by multiple reflections (echoes) (MMS 2002a).

Service and other vessels transmit noise through both air and water. The primary sources of vessel noise are propeller cavitation, propeller singing, and propulsion; other sources include auxiliaries, flow noise from water dragging along the hull, and bubbles breaking in the wake. Propeller cavitation is usually the dominant noise source. The intensity of noise from vessels is roughly related to ship size, load size, and speed. Large ships tend to be noisier than small ones, and ships under way with a full load (or towing or pushing a load) produce more noise than unladen vessels. For a given vessel, relative noise also tends to increase with increased speed. Commercial vessel noise is a dominant component of man-made ambient noise in the ocean (MMS 2002a). A summary of typical underwater sound levels for various vessel types is presented in Table 3-22.

Table 3-22. Underwater Sound Pressure Levels for Various Vessels

Vessel Length and Description	Frequency	Source Level (dB re 1μPa-m)
Outboard drive – 23 ft (2 engines, 80 horsepower each)	630, 1/3 octave	156
Twin Diesel – 112 ft	630, 1/3 octave	159
Small Supply Ships – 180 to 279 ft	1,000, 1/3 octave	125–135 (at 50 meters)
Freighter – 443 ft	41, 1/3 octave	172

Source: Richardson, et al. 1995

Note: These underwater sound pressure levels cannot be directly compared to airborne decibel levels.

Helicopter Traffic. Helicopters typically travel to some facilities in the GOM at least once per week. Normal offshore work schedules involve 2-week (or longer) periods with some weekly crew changes. According to the Helicopter Safety Advisory Conference, the number of helicopter flights supporting Gulfwide OCS operations has been increasing steadily since 1994 to more than 1.7 million trips annually, carrying 3.7 million passengers during 417 thousand flight hours (MMS 2002a).

FAA regulates helicopter flight patterns. Because of noise concerns, FAA Circular 91-36C encourages pilots to maintain higher-than-minimum altitudes near noise-sensitive areas. Corporate policy (for all helicopter companies) states that helicopters should maintain a minimum altitude of 213 m (700 ft) while in transit offshore and 152 m (500 ft) while working between platforms and drilling rigs. When flying over land, the specified minimum altitude is 305 m (1,000 ft) over unpopulated areas and coastlines, and 610 m (2,000 ft) over populated areas and sensitive areas including national parks, recreational seashores, and wildlife refuges. In addition, the guidelines and regulations promulgated by NOAA Fisheries require helicopter pilots to maintain 305 m (1,000 ft) of airspace over marine mammals (MMS 2002a).

Helicopter sounds contain dominant tones (resulting from rotors) generally below 500 Hz (MMS 2002a). Helicopters often radiate more sound forward than backward; thus, underwater noise is generally brief in duration, compared with the duration in the air. In addition to the altitude of the helicopter, water depth and bottom conditions strongly influence propagation and levels of underwater noise from passing aircraft.

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