# 4.0 ENVIRONMENTAL ANALYSIS

The environmental consequences of constructing and operating the proposed LNG Clean Energy Project, including impacts from the operation of LNG vessels in the waterway from the territorial seas to the berthing area at the facility, would vary in duration and significance. Four levels of impact duration were considered: temporary, short term, long term, and permanent. A temporary impact generally occurs during construction with the resource returning to preconstruction condition almost immediately afterward. A short-term impact could continue for up to 3 years following construction. Impact was considered long term if the resource would require more than 3 years to recover. A permanent impact could occur as a result of any activity that modifies a resource to the extent that it would not return to preconstruction conditions during the life of the project, such as the construction of an LNG terminal. We considered an impact to be significant if it would result in a substantial adverse change in the physical environment.

In this section, we discuss the affected environment, general construction and operational impact, and proposed mitigation for each resource. Gulf LNG, as part of its proposal, agreed to implement certain measures to reduce impact. We evaluated Gulf LNG's proposed mitigation to determine whether additional measures are necessary to reduce impact. These additional measures appear as bulleted, boldfaced paragraphs in the text. We will recommend that these measures be included as specific conditions to authorizations that the Commission may issue to Gulf LNG.

Conclusions in this EIS are based on our analysis of the environmental impact and the following assumptions:

- Gulf LNG would comply with all applicable laws and regulations;
- the proposed facilities would be constructed as described in section 2.0 of this document; and
- Gulf LNG would implement the mitigation measures included in the application and supplemental filings to the FERC.

## 4.1 GEOLOGY

### 4.1.1 Geologic Setting

The entire State of Mississippi, including the LNG Clean Energy Project area, lies within the Gulf Coastal Plain Physiographic Province along the southern coastline of the Gulf of Mexico. The location of the proposed facilities is in southern Jackson County southeast of the City of Pascagoula along the northern shoreline of the Mississippi Sound. The topographic relief of this area is generally low. Elevations range from sea level at the coast to as much as 200 feet above sea level in northern Jackson County (Strom and Oakley, 1996). In the immediate vicinity of the proposed LNG terminal, the existing grade does not exceed 13 feet AMSL (Fugro Consultants, LP (Fugro), 2005). Topographic maps indicate that the elevation of land on which the proposed project and associated facilities would be located does not exceed 20 feet AMSL.

Based on published geologic information, the project facilities would be constructed on surficial deposits of gravel, sand, silt, and clay (Bicker, 1969) that were deposited during the Holocene epoch over the last 8,000 years. These deposits are underlain by marine and alluvial sediments of the Quaternary and Tertiary Periods. The advance and retreat of the shoreline over geologic time have induced heterogeneous stratification of sands, silts, and clays both laterally and vertically (Strom and Oakley, 1996). Table 4.1.1-1 lists each geologic unit found in the Pascagoula, Mississippi area and its associated hydrogeologic properties.

TABLE 4.1.1-1

**Hydrostratigraphic Units Found in the Pascagoula, Mississippi Area**

| Coastal Lowlands Aquifer Permeable Zone | Epoch or Series | Geologic Unit | Description |
|---|---|---|---|
| A | Holocene | Alluvium | Alluvial deposits. |
| B | Pleistocene | Prairie Formation | Alluvial deposits. |
| | | Citronelle Formation | Fine to medium grained sands, with interbedded silts and clays; a bedded clay formation at the bottom forms an effective aquitard. |
| C | Pliocene | | |
| | | Graham Ferry Formation | Deltaic sediments. |
| D | Miocene | Pascagoula Formation | Interbedded sands and clays. |
| | | Hattiesburg Formation | |
| | | Catahoula Formation | |
| E | | | |

Notes: Divisions are approximate, given the discrepancies between multiple sources of information.
Dashed line denotes that Permeable Zone E contains geologic units older than Miocene age.
Sources: Lusk, 1953; McLean, 2005; Renken, 1998; Schmid and Otvos, 2004; and Strom and Oakley, 1996.

The Holocene deposits extend north from the Gulf Coast shoreline through the east central portion of Jackson County to its northern border with George County, where they laterally transition into the Miocene Hattiesburg and Pascagoula Formations. The thickness of the Holocene age deposits varies as a function of historical depositional regimes. Initial deposition occurred during the worldwide sea

level rise at the end of the Pleistocene epoch, resulting in inland migration of the shoreline. The tidal marshes that exist in the area today were created under this depositional environment. Subsequent erosional and depositional processes controlled the variable thickness now seen in the Holocene deposits (Oivanki, 1994), with thicknesses ranging from as little as 10 feet near relatively exposed shorelines to more than 50 feet in river deltas and shorelines under light wave action. Holocene sediments consist primarily of clays deposited in brackish marine waters of the Gulf of Mexico, typically with thin layers of silt, silty sand, and sand, and sporadic inclusions of organics, shells, and microfauna.

The Prairie Formation is a fluvial Pleistocene unit that is underlain by the Pleistocene-Pliocene Citronelle Formation. These units underlie the Holocene deposits and tend to consist of coarser grained sandy materials. A geotechnical study, titled *Reconnaissance Geotechnical Study, Gulf LNG Terminal, Pascagoula, Mississippi* (Fugro, 2005) and commissioned by Gulf LNG for the proposed LNG terminal site, indicates that Pleistocene deposits occur approximately 35 to 50 feet below the existing grade at the site. The Citronelle Formation overlies the Miocene aquifer system, which is comprised of the Graham Ferry, Pascagoula, Hattiesburg, and Catahoula Formations. Miocene deposits in the area of the site are approximately 3,000 feet thick, occurring at depths as shallow as 500 feet (Champlin et al., 1994). Tertiary age sediments continue with depth and overlie Cretaceous bedrock units occurring at depths exceeding 5,000 feet.

Fugro (2005) concluded that the proposed LNG terminal site was entirely submerged beneath the Mississippi Sound in 1952 but appears to have been reclaimed sometime during the 1950s and 1960s. Surface soils at the site consist of dredged fill materials that were hydraulically placed in the center of the site, with finer grained sediments dispersing outward in all directions and causing a circular ponding effect around the middle near the center of the proposed LNG storage tank locations.

The existing topography at the LNG terminal site would be permanently changed by the grading, filling, and dredging required to construct the LNG storage tank area, process area, and marine facilities. The existing grade, ranging in elevation from 4 to 13 feet AMSL in the LNG storage tank area, would range from 4 to 6 feet AMSL following modification. Similarly, the existing grade in the process area, which ranges from 1 to 6 feet AMSL, would be raised to an approximate elevation of 14.5 feet AMSL using soils cut from the LNG storage tank area and imported fill. Construction of the marine facilities would involve dredging the ship berth and maneuvering area to an elevation of -42 feet MLLW, with an additional 2 feet for advance maintenance and up to 2 feet of potential overdredge allowance. Details of these modifications are discussed in section 2.4.1.

Construction and operation of the proposed natural gas sendout pipeline would not materially alter the geologic or natural topographic conditions in the affected area. The natural topographic slope and contours would be temporarily altered along much of the pipeline route by grading and trenching activities. However, Gulf LNG would restore topographic contours and drainage conditions to preconstruction conditions to the extent practicable following installation of the pipeline, except at those locations where permanent changes in drainage would be required to prevent erosion, scour, and possible exposure of the pipeline.

### 4.1.2 Mineral Resources

Two types of economic geologic resources have the potential to be developed in the project area: 1) sand and clay deposits for commercial and industrial uses, and 2) petroleum.

Sand and clay deposits throughout most of the State of Mississippi are used in diverse commercial and industrial applications such as glass, cement, brick, and ceramic tile production; however, no sand or clay deposits are being mined in the vicinity of the proposed project. Additionally,

fluvial processes of the Pascagoula River from the Cretaceous Period to the present have concentrated heavy minerals, such as kyanite, staurolite, limente, tourmaline, and zirconium (Foxworth et al., 1962). These minerals are present in the sand deposits along the entire length of the sendout pipeline route. However, these minerals are not currently mined anywhere in the State of Mississippi and no future mining is planned for them (Booth and Schmitz, 1983). Therefore, the LNG Clean Energy Project is not expected to have an impact on mining activities.

A former petroleum field that likely produced from Cretaceous and Jurassic age bedrock exists near the northern extent of the sendout pipeline route (Gazzier and Bogard, 1988). However, documented well locations in the immediate project vicinity are currently listed as "dry holes" (Mississippi State Oil and Gas Board, 2005), and no future development of petroleum is anticipated within this area (Booth and Schmitz, 1983). Therefore, project facilities are not expected to interfere with petroleum production in the area.

### 4.1.3 Geologic Hazards

Geologic hazards identified for the project area include seismic-related hazards, subsidence, flooding/storm surge, and shoreline erosion. Slope instability and inadequate load-bearing capacity of soils could also pose a hazard at the proposed LNG terminal. Conditions necessary for the development of other geologic hazards, including karst terrain, landslides, avalanches, and volcanism are not present in the project area.

In general, the potential for geologic hazards to significantly affect construction or operation of the proposed project is low. The risk of damage resulting from geologic hazards would be avoided or reduced by specific engineering design criteria, ground modification and other construction techniques, and operating procedures implemented by Gulf LNG. Geologic hazards, their potential to occur in the project area, and proposed mitigation measures, where applicable, are discussed below.

#### 4.1.3.1 Seismicity and Faulting

Potential seismic-related hazards include earthquakes, surface faulting, soil liquefaction, and related soil failures. The Gulf Coast region of the United States is tectonically stable and the likelihood of a major earthquake occurring in the project area is very low. Seismic risk can be quantified by the motions experienced by the ground surface or structures during a given earthquake, expressed in terms of the acceleration due to gravity (g). The U.S. Geological Survey (USGS) has developed a series of maps for the entire United States that describe the likelihood for shaking of varying degrees to occur in a given area. Based on published geologic data, no active or major inactive faults exist in the immediate vicinity of the project. The project is located in an area that could experience ground accelerations of approximately 6 percent g with a 2 percent probability of exceedance in 50 years (USGS, 2005a). The project area can be described as among those least at risk nationwide for significant impacts associated with seismic events (Frankel et al., 1997).

The Richter Magnitude scale (RM) is a measure of earthquake energy interpreted from a seismogram based on the amplitude of the seismic waves. On this scale, most earthquakes felt in Mississippi have been in the 2 to 4 RM range (Bogard, 2002). An event with RM equal to 2 is generally not felt by people near the epicenter; an event with RM equal to 4 is felt by many people indoors near the epicenter and by few people outdoors near the epicenter. For comparison, an event having RM of 7 or more is considered a major earthquake that can result in severe damage to structures.

A site-specific reconnaissance study was conducted at the proposed LNG terminal site to evaluate the potential for geologic faulting and land subsidence (Fugro, 2005). Based on a literature search of

surface faulting, aerial photographs, topographic maps, subsurface structure maps, and a site reconnaissance, the study concluded that the risk of active surface faulting at the site is very low. The study also concluded that damaging ground motions due to seismic activity are not expected in the vicinity of the proposed LNG terminal site because of its geologic setting on a passive margin of a tectonic plate and the great distance to any large active faults.

Previous studies (e.g., O'Rourke and Palmer, 1994) have concluded that modern arc-welded gas pipelines in good repair are generally highly resistant to traveling ground waves and moderate amounts of permanent deformation. Therefore, the low levels of ground motion predicted for the project area would not be expected to damage the proposed sendout pipeline.

Based on the information presented above, earthquakes and surface faulting are not anticipated to have a significant impact on the LNG Clean Energy Project.

#### 4.1.3.2 Soil Liquefaction

Secondary seismic effects triggered by strong ground shaking are often more serious than the shaking itself. The most damaging secondary seismic effect is often soil liquefaction, a physical process in which saturated, non-cohesive soils temporarily lose their bearing strength when subjected to strong and prolonged shaking. As loose granular soils are shaken, they tend to contract, which may lead to positive pore pressures that can result in a loss of shear strength. Soils most prone to liquefaction are poorly graded (i.e., have a uniform grain size). Soil liquefaction can also lead to other ground failures, including settlement and lateral spreading.

Fugro (2005) assessed the potential for liquefaction at the proposed LNG terminal site. The study identified interlayered silty sands and clays beneath the site, and concluded that the silty sand layers could be susceptible to liquefaction under sufficiently strong levels of shaking. These layers occur at the following intervals: 2 to 12 feet, 12 to 20 feet, 30 to 36 feet, and 40 to 50 feet. Because no surface manifestation of liquefaction below 50 feet has been observed in past earthquakes, it is not necessary to consider the liquefaction potential of deeper sediment layers. The study concluded that, due to the relatively low magnitude of potential ground motions estimated for the area, there is a relatively low potential for seismically-induced liquefaction to occur at the proposed site.

#### 4.1.3.3 Subsidence

As part of the geotechnical study of the project area, Fugro (2005) evaluated the potential for subsidence to occur in the project area resulting from three different phenomena: 1) general subsidence coupled with worldwide sea level rise, 2) depressuring of aquifers from groundwater extraction and of oil and gas reservoirs from production, and 3) sinkhole development from karst conditions and mining.

Along the Gulf Coast, regional subsidence is occurring as a result of natural consolidation of the wedge of Cenozoic age sediments and downwarping of basement rocks in response to more recent deposition. Using a map of elevation change along the Gulf Coast based on geodetically releveling benchmarks, Holdahl and Morrison (1974) suggest a regional subsidence rate of 1 millimeter (mm)/year. Analyzing data from four tide gauges maintained by the COE, Wilson (2001) evaluated the relative rise in sea level and concluded that a gauge located 2 miles southwest of the site had a relative average rise in sea level of 3.63 mm/year. Fugro (2005) observed that this rate was greater than for the other stations in the area and suggested that it may indicate a component of land surface subsidence not seen in the other stations, especially since the historical rate of worldwide sea level rise is 1.2 mm/year. Over the proposed lifetime of the project, this rate of relative sea level rise would have a minimal effect on the project.

Fugro (2005) evaluated historical water levels in an area within approximately 2 miles of the proposed project in relation to localized subsidence. They concluded that, although some subsidence in the Pascagoula area may have occurred in response to groundwater drawdowns, rebounds in the piezometric surface over the last 30 years should have been enough to stop the subsidence. According to Fugro (2005), there is little risk of future subsidence from groundwater extraction, unless drawdowns exceed approximately 125 feet. No wells are planned as part of the LNG Clean Energy Project.

Depressuring oil and gas reservoirs in Miocene and younger deposits can cause subsidence of the ground surface. No shallow commercial oil or gas production is known to occur in the coastal counties of Mississippi (Champlin et al., 1994). The only commercial quantities to date are from Upper Jurassic age rock formations (Ericksen and Thieling, 1993). Therefore, subsidence associated with oil or gas production in the area is not anticipated.

Fugro (2005) indicates that the shallowest carbonate rock unit with potential for karst development occurs in the Lower Miocene at a depth of 3,000 feet, where it would not be affected by karst development. There are no known mining activities in the project area that would cause sinkhole development.

#### 4.1.3.4 Flooding/Storm Damage

The Gulf Coast is susceptible to hurricanes and tropical storms, which may produce storm surge, flooding, and high winds. Storm surge, the abnormal rise in sea level due to the wind and pressure forces associated with hurricanes and other tropical storms, is often the most significant cause of damage to facilities and property in low-lying coastal areas. Freshwater flooding can occur along river or stream valleys and adjacent, poorly-drained areas. However, freshwater flooding is not likely to affect the proposed LNG terminal, given that it is located adjacent to the Mississippi Sound rather than any riverbanks. Flooding of the canal adjacent to portions of the proposed sendout pipeline route could cause temporary delays during construction of the pipeline but would be unlikely to affect the pipeline during operation due to the erosion control measures required by our Procedures, which would be implemented by Gulf LNG.

Gulf LNG assessed two models for evaluating future hurricane surge events. One model was the Federal Emergency Management Agency (FEMA) Flood Insurance Study Model, which is widely used for evaluating flood risks in both coastal and river floodplains. The other was the COE's Sea, Lake and Overland Surges from Hurricanes Model (SLOSH Model), which is used primarily for modeling coastal flood risk from hurricane events. Data from the FEMA Flood Insurance Study for the City of Pascagoula, dated September 15, 1983, predicted a 100-year recurring storm surge elevation at the site of 9.7 feet and a corresponding wave crest elevation at the site of 13.8 feet. For an area 4,000 feet north of the proposed LNG terminal site at Chevron's Pascagoula Refinery, the SLOSH Model predicted maximum surge floods of 7.2 feet for a Category 1 storm, 11.9 feet for Category 2, 15.6 feet for Category 3, 18.8 feet for Category 4, and 22.2 feet for Category 5.

After comparing the actual storm surge data along the Mississippi coast (including 18 feet at Pascagoula) caused by Hurricane Katrina in August 2005 with the FEMA and COE model predictions, Gulf LNG determined that the SLOSH Model for a Category 4 hurricane would provide the most appropriate results to use as a design basis for the LNG Clean Energy Project. Further evaluation of potential waves on top of the storm surge was conducted by performing computer modeling to predict the wave height at the project site based on an offshore Category 4 storm wave height propagating shoreward with Category 4 wind speeds. Based on the research and analysis conducted, the Category 4 storm surge elevation at the site was determined to be 19.5 feet AMSL. Based on the wave modeling analysis, the

Category 4 storm significant wave height at the site was determined to be 11.4 feet, with a corresponding wave crest elevation of 27.3 feet AMSL.

In order to mitigate the potential hazards associated with storm-induced flooding and waves, Gulf LNG would construct a dike wall 45 feet wide and 27 feet high to surround the entire 33.3-acre LNG terminal site. Gulf LNG has designed the dike wall to provide tertiary containment and to serve as a first line of defense against surge waves during future storms. The jetty platform and pipe trestle would be constructed at an elevation above the Category 4 storm significant wave crest elevation of 33.1 feet AMSL. The landward portion of the approach trestle would be constructed below this elevation; however, it would be designed to withstand the horizontal and vertical uplift wave forces that would accompany such an event.

#### 4.1.3.5 Shoreline Erosion

The shoreline along the Gulf Coast exists in various states of erosion, accretion, or equilibrium. These processes are dynamic and vary with time as well as location. Coastal erosion along the East Gulf Coastal Plain, in particular, is a pervasive problem and is commonly exacerbated by anthropogenic activities such as construction and shoreline stabilization, land use, coastal dredging and dredged material placement, and modification of natural drainage patterns. In the geotechnical study for the proposed project, Fugro (2005) presented aerial/satellite photographs over time that show shoreline erosion is removing significant coastal segments of Point aux Chenes and minor barrier islands and shorelines within Point aux Chenes Bay to the east of the proposed project facilities.

As discussed in section 2.4.1, the design of the marine facilities includes an area of rock or concrete units on the slope parallel to the shoreline to minimize scour potential within the berth area from LNG ship propeller wash. During the transit along the navigation channels, LNG ships would be operating at low speeds and would not create wakes that would increase the potential for shoreline erosion in the project area. In addition, because the project is located at the southernmost end of the existing land mass, LNG ships calling at the terminal would not pass reaches of the Bayou Casotte shoreline subject to erosion. Implementation of the shoreline scour protection in the berth area would minimize the potential for shoreline erosion associated with the project.

We received a scoping comment regarding the potential for shoreline erosion in the Horn Island Pass area, which includes the eastern portion of Horn Island and the western portion of Petit Bois Island. Shoreline erosion can be caused by wave action associated with an increase in marine traffic in the area. LNG ships would be among the largest vessels to use the Horn Island Pass, and larger size generally equates to a greater potential for shoreline erosion. However, LNG ships are restricted to lower speeds, and they have a relatively high under-keel clearance (compared to oil tankers), both of which tend to lessen erosional effects. As a result, the potential for shoreline erosion in the Horn Island Pass area associated with LNG ships should be similar to, or less than (due to their higher under-keel clearance), these other large vessels using the area.

#### 4.1.3.6 Slope Stability and Load-Bearing Capacity

The geotechnical study conducted by Fugro (2005) indicated that the uppermost soils at the proposed LNG terminal site have very low load-bearing capacities due to the very soft and cohesive soils and loose granular soils occurring within the upper 35 to 50 feet. Therefore, soil improvements and engineering designs must be implemented to ensure the stability of the LNG storage tanks, process structures, and marine facilities. The preliminary design measures recommended by Fugro (2005) are discussed below. The preliminary design measures would be reviewed once a detailed subsurface investigation is performed within the areas to determine whether they should be revised.

The geotechnical evaluation recommended supporting the LNG storage tanks on pile foundations with a pile cap. The finished grade in the LNG storage tank area would range from 4 to 6 feet AMSL and the base of the pile cap would be elevated by about 1 foot above grade. Open-ended, driven steel pipe piles would be used to support the tank foundations and would be the preferred foundation type for the tank loading and the soil conditions at the site. The piles would be driven at least 5 feet into the dense to very dense granular soils at a depth of at least 138 feet below the existing grade. Further analysis as construction proceeds would ensure that the measures achieve the soil stability objectives.

The final site grade at the LNG process area would be raised to an elevation of 14.5 feet AMSL. The process area structures would be supported by open-ended, driven steel pipe piles. The soft, weak, loose soils present at the site would require that structures be supported on deep foundations, although most of the process structures would be lightly loaded. For preliminary design purposes, the geotechnical report indicates that the piles should penetrate at least 95 feet below finished grade for structures that are lightly loaded and at least 147 feet below finished grade for structures that are heavily loaded or have a low tolerance to settlement.

The structures associated with the marines facilities would be supported with both vertical and battered piles. A 5:1 slope would be created from the crest of the slope to the toe of the slope at depth -44 feet MLLW. According to the results of a slope stability analysis for the LNG terminal site, the proposed slope configuration would meet safety criteria (Fugro, 2005).

### 4.1.4 Blasting

Based on the regional and local geology, no areas of shallow bedrock are present. As a result, no blasting is anticipated for development of the LNG Clean Energy Project.

### 4.1.5 Paleontological Resources

Numerous fossils of marine origin are present in the coastal deposits of Mississippi. Most of these fossils originate from the Cenozoic Era. Principal deposits of buried reef shell occur in the Mississippi Sound. Although productive reef shell areas have not been delineated, a principal deposit is mapped approximately 3 miles west of the proposed project. In addition, rich deposits of fossils, marine microfauna, and foraminifera occur in coastal clay deposits offshore and inland (Upshaw et al., 1966). Based on available information, no sites within the proposed project area have been identified and designated to have paleontological significance.

## 4.2 SOILS AND SEDIMENTS

### 4.2.1 Soil Resources

Information provided by Gulf LNG and contained in the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) database for Jackson County, Mississippi (NRCS, 2005a) was used to evaluate likely project-related impacts on soils within the proposed LNG terminal site as well as along the proposed sendout pipeline route and associated aboveground facilities. The SSURGO database is a digital version of the standard county soil survey. Soils affected by project facilities would be disturbed by grading, excavation, heavy equipment traffic, and the construction and operation of aboveground facilities. Issues to be addressed include erosion and sediment control; shallow-to-bedrock soils; permanent conversion of prime farmland to other uses; hydric soils; and the potential for soil compaction, contamination, and corrosion.

To address potential impacts on soil resources in the project area, Gulf LNG would implement our Plan and Procedures. Some of the relevant mitigation measures specified in our Plan and Procedures include requirements to:

- segregate a maximum of 12 inches of topsoil in all actively cultivated or rotated croplands, pastures, residential areas, hayfields, and at other areas at the request of the landowner or land management agency;
- provide temporary erosion and sediment control measures such as silt fence, straw bales, slope breakers, seeding, mulch, and erosion control fabric to minimize any impacts related to soil erosion and sedimentation that may result from precipitation runoff;
- mitigate soil compaction following construction and right-of-way restoration activities;
- ensure revegetation of all areas disturbed by project-related activities. Disturbed upland areas would be seeded in accordance with written recommendations from local conservation authorities or as requested by the landowner;
- provide post-construction monitoring of mitigation practices to ensure their success; and
- utilize at least one EI to ensure implementation of the practices outlined above.

Our Plan states that the construction right-of-way width in upland areas should not exceed 75 feet or the width described in the FERC application. The Plan also allows for up to an additional 25 feet of right-of-way width where required for topsoil segregation or where required by site-specific soil or topographic conditions. Gulf LNG proposes to use a 110-foot-wide construction right-of-way for the majority of the pipeline route in upland areas. We agree that the wider construction right-of-way for the 36-inch-diameter pipeline in uplands would accommodate the workspace requirements and safety considerations for construction personnel.

#### 4.2.1.1 Soil Characteristics

Soils at the proposed LNG terminal site and along the proposed natural gas sendout pipeline are variable with surface textures ranging from sandy clay loams to loamy sands. Table 4.2.1-1 summarizes the characteristics of the soils at the proposed facilities.

TABLE 4.2.1-1

**Soils Characteristics at the Proposed Facilities**

| Beginning MP [a] | End MP [a] | Soil Series [b] | Severe Erosion Potential [c] | Shallow to Bedrock [b] | Prime Farmland [b] | Drainage Class [d] | Compaction Potential |
|---|---|---|---|---|---|---|---|
| LNG Terminal Facilities | | | | | | | |
| NA | NA | Axis | No | No | No | VP | Yes |
| Pipeline Right-of-Way and Temporary Extra Workspace | | | | | | | |
| 0.0 | 0.7 | Axis | No | No | No | VP | Yes |
| 0.7 | 0.8 | Udorthents | No | No | No | W | Yes |
| 0.8 | 1.6 | Axis | No | No | No | VP | Yes |
| 1.6 | 3.0 | Udorthents | No | No | No | W | Yes |
| 3.0 | 4.3 | Bayou | No | No | No | P | No |
| 4.3 | 4.7 | Ocilla | No | No | No | SP | No |
| 4.7 | 4.8 | Harleston | No | No | Yes | MW | Yes |
| 4.8 | 4.9 | Smithton | No | No | No | P | Yes |
| 4.9 | 5.0 | Harleston | No | No | Yes | MW | Yes |
| 5.0 | 5.3 | Atmore | No | No | No | P | Yes |
| 5.3 | 5.3 | Ocilla | No | No | No | SP | No |
| Contractor Yards and Support Areas | | | | | | | |
| 0.3 | 0.3 | Axis | No | No | No | VP | Yes |
| 2.0 [e] | NA | Udorthents | No | No | No | W | Yes |
| 5.1 | 5.1 | Atmore | No | No | No | P | Yes |
| Gulfstream and BP Gas Processing Interconnects/Meter Stations | | | | | | | |
| 4.6 | 4.6 | Atmore | No | No | No | P | Yes |
| Destin Interconnect/Meter Station | | | | | | | |
| 5.3 | 5.3 | Ocilla | No | No | No | SP | No |

[a] The total surveyed length of the proposed pipeline is 5.0 miles. Mileposts are used for reference and do not reflect actual surveyed distances.

[b] As designated by the NRCS.

[c] Determined through an examination of the typical slope angle, flooding frequency, surface texture, drainage characteristics, and the K factor (a factor used in calculating erosion potential).

[d] VP = Very Poorly Drained. Water is removed from the soil so slowly that free water remains at or very near the ground surface during much of the growing season. The occurrence of internal free water is very shallow and persistent or permanent.

P = Poorly Drained. Water is removed so slowly that the soil is wet at shallow depths periodically during the growing season or remains wet for long periods. The occurrence of internal free water is shallow or very shallow and common or persistent.

SP = Somewhat Poorly Drained. Water is removed slowly so that the soil is wet at a shallow depth for significant periods during the growing season. The occurrence of internal free water commonly is shallow to moderately deep and transitory to permanent.

MW = Moderately Well Drained. Water is removed from the soil somewhat slowly during some periods of the year. Internal free water occurrence commonly is moderately deep and transitory to permanent.

W = Well Drained. Water is removed from the soil readily but not rapidly. Internal free water occurrence commonly is deep or very deep; annual duration is not specified.

[e] This contractor yard and support area would be located about 0.3 mile west of MP 2.0.

NA Not Applicable

**LNG Terminal Facilities**

According to the NRCS soil survey database, soils at the proposed LNG terminal site are comprised entirely of the Axis soil series. The LNG terminal facilities would have a 42.6-acre footprint on land, including 33.3 acres for the LNG terminal and 9.3 acres for the permanent access road to the terminal. Additional impacts on soils could occur as a result of construction and operation of the nonjurisdictional facilities associated with the LNG terminal (i.e., electric transmission facilities and water supply pipeline); however, the final route for these facilities has not been determined (see section 2.2).

The proposed LNG terminal site was utilized for placement of dredged material from Bayou Casotte as recently as the 1970s. The deposition of these materials created the land area at the southernmost point where the LNG terminal is proposed. Based on aerial photographs and topographic maps, the proposed LNG terminal site was entirely submerged beneath the Mississippi Sound as recently as 1952. Reclamation of this land through placement of dredged material occurred sometime during the 1950s and 1960s (Fugro, 2005). This is verified by the very soft to soft clays and very loose to loose sands and silts encountered in the upper 35 to 50 feet of the geotechnical soil borings conducted across the proposed terminal site. Aerial photographs show that the present northwest-southeast COE levee very closely approximates the position of the pre-1950 coastline.

The construction of the LNG terminal facilities would involve removing the existing surface soils to expose the most stable subsoils. Fill would be used to raise the surface grade where the LNG terminal would be constructed, with the exception of the tank storage area, which would be lower in elevation for secondary containment purposes. Additional soil amendments would also be used to re-engineer the soils at the site to provide a stable land surface for construction. These activities would not have a significant impact on soils at the LNG terminal site because these soils were already impacted by previous dredged material placement activities. Because the soils within the LNG terminal would be permanently converted to an industrial use following construction, mitigation of compaction impacts on soils at the terminal would not be necessary.

**Pipeline and Associated Aboveground Facilities**

The proposed pipeline would cross the Udorthents (30 percent of the route), Axis (30 percent of the route), Bayou (26 percent of the route), Atmore (6 percent of the route), Ocilla (4 percent of the route), Harleston (2 percent of the route), and Smithton (2 percent of the route) soil series. A description of each of these soils series is provided below.

- Udorthents series – nearly level, well drained soils that formed from smoothed spoils from excavations in marine sediments. Surface textures typically vary from sandy loam to sandy clay loam, with slopes ranging from 0 to 2 percent.

- Axis series – deep, very poorly drained, moderately permeable soils that formed in thick loamy marine sediments. These soils are on narrow to broad, level coastal marshes where the water table fluctuates with the tide. Slopes are less than 2 percent. When dry, the upper portion of this soil can be very acidic.

- Bayou series – deep, poorly drained soils that formed in loamy marine sediments and occupy broad, level areas of the Gulf Coast with slopes ranging from 0 to 2 percent.

- Atmore series – deep, poorly drained, moderately slowly permeable soils that formed in loamy marine sediments. These soils are on coastal plain depressions and interstream divides with slopes ranging from 0 to 5 percent (NRCS, 2005b).

- Ocilla series – nearly level, somewhat poorly drained soils occurring as loamy sand to sandy loam on smooth landscapes with slopes ranging from 0 to 2 percent.

- Harleston series – moderately well drained soils that formed in thick beds of sandy loam alluvium or marine deposits with slopes ranging from 0 to 12 percent.

- Smithton series – very deep, poorly drained soils. These soils formed as loamy alluvium on Pleistocene terraces on the coastal plain with slopes dominantly less than 1 percent, but ranging up to 3 percent.

Pipeline construction such as clearing, grading, trench excavation, backfilling, and the movement of heavy construction equipment along the construction right-of-way may result in adverse impacts on soil resources. Clearing activities remove the protective cover and expose the soil to the effects of wind, sun, and precipitation. This exposure can lead to the transport of sediment to sensitive areas. Grading and equipment traffic have the potential to compact soil, reducing porosity and infiltration rates, which could cause increased runoff potential or difficulty in revegetating. Trench excavation and backfilling could lead to a mixing of the soil layers, bringing potentially less productive subsoil to the surface or introducing rocks from deeper horizons to the soil surface. The soils could also potentially be impacted due to contamination from spills or leaks of fuels, lubricants, and coolants from construction equipment.

#### 4.2.1.2 Erosion

Erosion is a continuing natural process that can be accelerated by human disturbance. Factors that influence the degree of erosion include soil texture, soil structure, length and percent of slope, vegetative cover, and rainfall or wind intensity. Soils most susceptible to erosion by water are typified by bare or sparse vegetative cover, noncohesive soil particles with low infiltration rates, and moderate to steep slopes. Wind erosion processes are less affected by slope angles. Clearing, grading, and equipment movement could accelerate the erosion process and, without adequate protection, result in discharge of sediment to adjacent waterbodies and wetlands. Soil loss due to erosion could also reduce soil fertility and impair revegetation.

The presence or absence of severe erosion potential in the project area was evaluated by examining typical slope angle, flooding frequency, surface texture, drainage characteristics, and the K factor (a factor used as part of the universal soil loss equation to calculate soil loss potential). Based on these characteristics, none of the soils that would be disturbed by construction of the LNG terminal facilities or sendout pipeline and associated aboveground facilities are susceptible to water erosion processes. Shoreline erosion at the LNG terminal site and along the waterway that would be used by the LNG ships is addressed in section 4.1.3.5.

Gulf LNG has adopted our Plan to establish a baseline for minimizing the potential for erosion as a result of water or wind action and to aid in reestablishing vegetation after construction. In addition to our Plan, Gulf LNG would develop a site-specific SWPPP as a requirement of the general permit for construction stormwater discharges. The SWPPP would incorporate BMPs as specified in our Plan, as well as guidance established in the following documents developed for erosion control and stormwater management in the State of Mississippi:

- *MDEQ Office of Pollution Control Large Construction Forms Package* (MSR10), Department of Environmental Quality, Jackson, Mississippi, March 2000;

- *Mississippi Storm Water Pollution Prevention Plan (SWPPP) Guidance Manual for Construction Activities*, General Permits Branch, Office of Pollution Control, Department of Environmental Quality, Jackson, Mississippi, March 2000; and

- *Planning and Design Manual for the Control of Erosion, Sediment and Stormwater*, NRCS, Jackson, Mississippi, 1994.

The SWPPP would be submitted to the MDEQ for review and approval at least 30 days before the start of construction. BMPs planned for construction would include, but are not limited to, erosion control fabrics, silt fences, and temporary seeding and revegetation of areas disturbed by construction activities. Gulf LNG would employ at least one EI to ensure that the measures identified in our Plan, as well as its SWPPP, are implemented appropriately.

Gulf LNG would also develop an Industrial SWPPP as a requirement of coverage under the National Pollutant Discharge Elimination System (NPDES) Industrial Stormwater General Permit. The Industrial SWPPP would be submitted to the MDEQ, along with an application for coverage, at least 60 days before commencement of facility operations to allow for agency review. The Industrial SWPPP would, in part, identify areas with a high potential for soil erosion and specify prevention measures to limit erosion. This plan would be updated on an as-needed basis at least annually in accordance with the terms of the general permit.

#### 4.2.1.3 Shallow-to-Bedrock Soils

According to the NRCS, soils with shallow bedrock are those where bedrock is encountered within 60 inches of the soil surface. Based on available soil survey information, Gulf LNG does not anticipate encountering shallow bedrock in any portion of the project area.

#### 4.2.1.4 Prime Farmland

Prime farmland is designated by the NRCS as those soils with the best combination of physical and chemical characteristics for producing agricultural crops with the minimum inputs of fuel, fertilizer, pesticides, and labor. Prime farmland typically contains few or no rocks, is permeable to water and air, is not excessively erodible or saturated with water for long periods, and is not subject to frequent or prolonged flooding during the growing season. Soils that do not meet these criteria may be considered prime farmland if the limiting factor is mitigated (e.g., artificial drainage). A soil series may be considered prime farmland although not actually in active cultivation.

None of the land within the project area is currently under active cultivation. The Harleston series is the only soil series within the project area that is considered prime farmland (see table 4.2.1-1). The Harleston soils would be encountered along the sendout pipeline route between MPs 4.7 and 4.8 and MPs 4.9 and 5.0, which is within the Stennis Industrial Park. No aboveground facilities would be constructed on this soil type; therefore, no prime farmland would be permanently converted as a result of the project. Gulf LNG did not identify any drainage tiles along the pipeline route.

#### 4.2.1.5 Hydric Soils

Hydric soils are defined as "soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part" (Federal

Register, July 13, 1994). Soils that are artificially drained or protected from flooding (e.g., by levees) are still considered hydric if the soil in its undisturbed state would meet the definition of a hydric soil. Hydric soils include poorly and very poorly drained soils as well as a limited number of somewhat poorly drained soils. Based on the soil drainage classifications listed in table 4.2.1-1, about 64 percent of the soils along the proposed sendout pipeline route are considered hydric.

Due to extended periods of saturation, hydric soils can be prone to compaction and rutting as discussed below. In accordance with our Procedures, Gulf LNG would minimize rutting of hydric soils by using construction mats where hydric soils cannot support equipment and/or employing low-ground-weight equipment. In addition, shallow groundwater associated with hydric soils could create a buoyancy hazard for the pipeline (see section 4.3.1.4).

#### 4.2.1.6 Compaction Potential

Soil compaction modifies the structure and reduces the porosity and moisture-holding capacity of soils. Construction equipment traveling over wet soils could disrupt the soil structure, reduce pore space, increase runoff potential, and cause rutting. The degree of compaction is dependent on moisture content and soil texture. Fine-textured soils with poor internal drainage that are moist or saturated during construction are the most susceptible to compaction and rutting. About 70 percent of soils along the sendout pipeline route are susceptible to impacts associated with compaction.

Gulf LNG would minimize compaction and rutting impacts by implementing measures outlined in our Plan and Procedures (e.g., use of construction mats or low-ground-weight equipment) during construction in soft or saturated soils. In addition, the EI could recommend restricting construction activities during unfavorable conditions (e.g., wet weather) to further reduce compaction and rutting. Compaction impacts would be mitigated through the use of deep tillage operations during restoration activities using a paraplow or similar implement. Post-construction monitoring of the right-of-way would be completed in accordance with our Plan to ensure successful revegetation.

#### 4.2.1.7 Soil Contamination

Contamination from spills or leaks of fuels, lubricants, and coolant from construction equipment could adversely affect soils. The effects of contamination are typically minor because of the low frequency and volumes of spills and leaks. Gulf LNG has developed an SPCC Plan (see Appendix C) that would minimize the likelihood and potential impact of a hazardous spill during construction of the onshore and offshore project facilities. The SPCC Plan describes preventative measures such as employee training, equipment inspection, and proper refueling procedures to minimize the likelihood of spills and leaks. The same practices would be employed at locations of hazardous material storage. The SPCC Plan also describes mitigative measures, such as containment and cleanup, to minimize impacts should a spill occur. Gulf LNG would develop a separate SPCC Plan after construction of the project to identify similar preventative measures that would be employed during operation of the LNG terminal and associated facilities. Implementation of Gulf LNG's SPCC Plans would minimize the potential for project activities to contaminate soils.

Gulf LNG conducted a search of federal and state environmental databases to identify hazardous waste sites and areas of known contamination in the vicinity of the proposed project facilities. No known sites were identified directly on the LNG terminal site or along the centerline of the sendout pipeline route; however, a number of sites with reported contamination or potential contamination were identified within a 0.125-mile radius of the proposed project facilities (see section 4.8.6). Gulf LNG evaluated the reported sites to determine if any contamination on these properties could have an adverse impact on construction or operation of the proposed facilities. Based on the results of this review, Gulf LNG does

not anticipate encountering contaminated materials during construction of the proposed facilities. However, if areas of potential contamination are discovered during the course of construction, Gulf LNG would instruct the contractor to stop work at the discovery location to allow time to evaluate the potential contamination and to develop a plan for safe handling and disposal of the contaminated materials in accordance with all applicable federal, state, and local regulations.

#### 4.2.1.8 Corrosion Potential

Pipeline corrosion can be caused by extended exposure to water and chemical soil characteristics, such as soil acidity. Corrosion can damage the outer surface of the pipeline and weaken pipeline integrity. Soils with the potential to be saturated have been described in section 4.2.1.5. According to the NRCS description, the Axis soil series can be extremely acidic within lower soil horizons, typically as the soil dries. Approximately 30 percent of the sendout pipeline route would cross the Axis soil series. In addition to the published information, Gulf LNG completed a geotechnical study that also identified the Axis soils series in the proposed LNG terminal area. In an effort to assess soil corrosion potential, soil pH, electrical resistivity, chloride, and sulfate ion tests were performed on soil samples acquired in borings drilled throughout the site. One sample, collected at a depth of 5 feet, showed a pH, chloride ion concentration, and electrical resistivity with a high to very high potential for steel corrosion. The sample also showed a sulfate ion concentration with severely aggressive potential for concrete degradation (Fugro, 2005).

According to NRCS staff (Thornton, 2005), Axis soils in the project area have the potential to become very acidic when shallow, saturated subsurface soil horizons are exposed to air (e.g., by dewatering during excavation or within excavated spoil piles). Such conditions could result in corrosion of equipment during pipeline construction. Because the area in which the Axis soil series occurs is near the coast and has a ground surface elevation near sea level, the water table is consistently high. Therefore, the likelihood of saturated soils beneath the water table becoming dry during pipeline operation, and in turn very acidic, is minimal (Thornton, 2005). Gulf LNG would follow the DOT Minimum Federal Safety Standards in 49 CFR Part 192, which include protection of the pipeline from internal, external, and atmospheric corrosion. The use of both an external protective coating and a cathodic protection system has been required on all pipelines installed after July 1971. The interior of the pipe would be periodically monitored for corrosion using internal corrosion probes and/or in-line pigging tools.

### 4.2.2 Sediments

Construction of the LNG terminal would require the dredging of about 2.96 million $yd^3$ of sediment to create the marine facilities associated with the proposed project. These facilities include an LNG ship berth and maneuvering area (see figure 2.1.1-1). The ship berth and maneuvering area would be dredged to an elevation of -42 feet MLLW, with an additional 2 feet for advance maintenance and up to 2 feet of potential overdredge allowance. The total volume of dredged material (i.e., project depth, advance maintenance, and potential overdredge allowance) would be about 2,958,000 $yd^3$ of sediment. The dredged material is proposed to be placed offshore in the EPA-designated ODMDS.

Projects involving the transportation of dredged material for the purpose of disposal in ocean waters outside the baseline must be evaluated pursuant to section 103 of the MPRSA to determine whether the proposed discharge would unreasonably degrade or endanger human health, welfare or amenities, or the marine environment, ecological systems, or economic potentialities. A summary of the physical, chemical, and biological testing that was conducted by Gulf LNG to assist the COE and EPA in evaluating the proposed dredged sediment relative to section 103 of the MPRSA is provided below. The COE and EPA were provided a complete copy of Gulf LNG's initial draft section 103 evaluation in

January 2006. The COE and EPA reviewed this initial draft and determined that it was incomplete and requested additional information. Gulf LNG revised its section 103 evaluation and filed it with the COE on May 18, 2006 as part of its Joint Application and Notification for the LNG Clean Energy Project. Gulf LNG's revised section 103 evaluation is provided in Appendix D. Gulf LNG is continuing to consult with the COE and EPA to finalize its section 103 evaluation.

After receiving approval of its Sampling and Analysis Plan (SAP) from the COE and the EPA, Gulf LNG conducted sampling and analysis of the sediments contained within the proposed dredge area following standard guidelines for assessing dredged material (EPA and COE, 1991; EPA, Region 4 and COE-SAD, 1993; and EPA and COE, 1998a). Gulf LNG collected six cores from throughout the proposed dredging footprint (see figure 4.2.2-1). Based on a review of the historical potential for contamination at the site from surrounding industrial activities and the lack of previous sediment data for the site (Tier I analysis), Gulf LNG subjected the sediment samples to chemical analysis for a suite of metals, cyanide, ammonia, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), chlorinated pesticides, chlorinated benzene compounds, and a limited number of phenolic compounds and phthalate esters as specified in the guidance documents cited earlier (Tier II analysis). In addition, based on its initial consultations with the COE and EPA, Gulf LNG carried out a Tier III evaluation of the proposed dredged sediments for biotoxicity and bioaccumulation of potential contaminants.

It is the responsibility of the EPA and COE under the MPRSA to manage and monitor the ODMDS. ODMDS management involves monitoring the site environment to verify that unanticipated or significant adverse effects are not occurring from past or continued use of the site and that permit conditions are met. The Pascagoula ODMDS Site Management and Monitoring Plan provides guidelines in making management decisions necessary to fulfill mandated responsibilities to protect the marine environment. A phased and tiered approach would be used to determine the level of monitoring required following the placement event associated with the LNG Clean Energy Project. Gulf LNG has prepared a Monitoring Plan that provides details on the monitoring that would be conducted after placement of the dredged material at the ODMDS. Gulf LNG's Monitoring Plan is provided in Appendix E.

#### 4.2.2.1 Physical Characteristics of the Sediments

The sediments that would be dredged for the marine facilities consist primarily of clays and silts (see table 4.2.2-1). The average clay content of the proposed dredged sediment is about 51 percent and the average sand content is about 27 percent. The average percent fines (i.e., all material passing a #200 sieve) is about 73 percent. The percent fines parameter provides an estimate of the potential for sediments to be resuspended during dredging and dredged material placement operations. The relatively high average value for percent fines measured for the proposed dredged material suggests that the sediment is likely to be resuspended during dredging (resulting in elevated total suspended solids (TSS) concentrations), and may produce elevated levels of TSS at the offshore dredged material placement site. Additional information on turbidity and TSS levels with regard to water quality is provided in section 4.3.2.

# Non-Internet Public

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Figure 4.2.2-1 Proposed Dredge Area and Sediment Core Locations

Public access for the above information is available only through the Public Reference Room, or by e-mail at public.referenceroom@ferc.gov.

TABLE 4.2.2-1

**Physical Characteristics of Sediment Samples**

| Parameter (dry weight basis) | Sediment Core Number | | | | | |
|---|---|---|---|---|---|---|
| | B-9 | B-10 | B-11 | B-12 | B-8/B-13 (0 to 20 feet) | B-8/B-13 (20 to 40 feet) |
| Moisture Content (percent) | 30 | 40 | 30 | 33 | 34 | 25 |
| Sand (percent) | 34.2 | 11.3 | 42.4 | 35.7 | 13.0 | 27.8 |
| Clay (percent) | 46.6 | 58.7 | 39.1 | 44.7 | 56.2 | 57.5 |
| Percent Fines [a] | 65.8 | 88.7 | 57.6 | 64.3 | 87.0 | 72.2 |

[a] Based on percent of sediment passing a #200 sieve.

Given the proposed offshore placement of the dredged material, the sediment would likely be removed using a mechanical clamshell dredge and would be transported to the placement site using bottom dumping barges or scows (see section 2.4.1.3). Studies by the COE indicate that clamshell dredging generally results in greater sediment resuspension than other forms of dredging (e.g., hydraulic cutterhead dredges) (COE, 1988a). However, the use of a clamshell dredge is the only practical alternative available based on open water placement of the dredged material. Although elevated levels of TSS are expected during dredging operations, the local background TSS conditions in the Mississippi Sound are generally high (see section 4.3.2.1) and the added TSS levels resulting from the dredging proposed by Gulf LNG would not likely have a significant impact on water quality or aquatic organisms present within the dredging footprint or nearby waters. However, the proposed dredging activity would destroy the current benthic populations of organisms living in the sediment (see section 4.6.2.2). Gulf LNG would also be required to conduct water quality monitoring as a condition of its section 401 Water Quality Certification. Based on the results of water quality monitoring, Gulf LNG could adjust the rate of dredging to reduce impacts resulting from elevated TSS levels. At the dredged material placement site, use of bottom dumping barges or scows would minimize resuspension of sediments because dredged material placement would occur rapidly.

#### 4.2.2.2 Chemical Characteristics of the Sediments

None of the organic contaminants (i.e., PAHs, PCBs, or organo-pesticides) analyzed were identified above detection limits in any of the sediment samples taken from the proposed dredge area. Except for aluminum, iron, and manganese, the proposed dredged material contains generally low to very low concentrations of the 17 metals that were analyzed (see table 4.2.2-2). Aluminum and iron are major components of the minerals composing all sediments and elevated levels of these constituents would be expected to occur naturally. Elevated concentrations of manganese are common in saturated soils and marine sediments, and generally pose little risk to aquatic organisms.

As indicated in its agency-approved SAP, Gulf LNG compared the results of the chemical characterization of the sediment cores with sediment quality screening parameters. The sediment quality parameters approved in the SAP were the effects range-low (ERL) values published in Long et al. (1995) and the probable effects level (PEL) parameters published by the Florida Department of Environmental Protection (1994). The ERL values represent chemical concentrations at which toxicity effects may begin to be observed in sensitive species of aquatic organisms. The PEL values represent chemical concentrations above which adverse effects on aquatic organisms are frequently expected (Buchman, 1999).

TABLE 4.2.2-2

**Chemical Characteristics of Sediment Samples**

| Parameter mg/kg (dry weight) | Sediment Core Number | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | B-9 | B-10 | B-11 | B-12 | B-8/B-13 (0 to 20 feet) | B-8/B-13 (20 to 40 feet) | ERL Value [a] | PEL Value [b] |
| Metals | | | | | | | | |
| Aluminum | 16,000 | 20,000 | 16,000 | 18,000 | 16,000 | 10,000 | NA | NA |
| Antimony | <2.7 | <2.9 | <2.7 | <2.9 | <2.5 | <2.1 | NA | NA |
| Arsenic | 8.6 | 9.9 | 6.7 | 9.0 | 6.2 | 5.5 | 8.2 | 41.6 |
| Beryllium | 1.0 | 1.6 | 0.96 | 1.3 | 1.2 | 0.73 | NA | NA |
| Cadmium | <0.68 | <0.72 | <0.67 | <0.72 | <0.63 | <0.53 | 1.2 | 4.21 |
| Chromium | 25 | 33 | 24 | 27 | 25 | 17 | 81 | 160.4 |
| Copper | 9.4 | 9.3 | 8.1 | 11 | 12 | 5.5 | 34 | 108.2 |
| Iron | 20,000 | 28,000 | 2,1000 | 25,000 | 21,000 | 16,000 | NA | NA |
| Lead | 11 | 13 | 9.5 | 12 | 12 | 7.0 | 46.7 | 112.18 |
| Manganese | 240 | 360 | 320 | 390 | 120 | 130 | NA | NA |
| Mercury | <0.021 | <0.024 | <0.014 | <0.028 | 0.022 | 0.016 | 0.15 | 0.70 |
| Nickel | 13 | 17 | 12 | 18 | 12 | 7.9 | 20.9 | 42.8 |
| Selenium | <1.4 | <1.4 | <1.3 | <1.4 | <1.3 | <1.1 | 1.0 | 1.77 |
| Silver | <1.4 | <1.4 | <1.3 | <1.4 | <1.3 | <1.1 | NA | NA |
| Thallium | <1.4 | 2.4 | 1.7 | <1.4 | <1.3 | <1.1 | NA | NA |
| Tin | <1.4 | <1.4 | <1.3 | <1.4 | <1.3 | <1.1 | NA | NA |
| Zinc | 48 | 62 | 39 | 64 | 71 | 32 | 150 | 271 |
| Cyanide | <1.4 | <1.6 | <1.4 | <1.4 | <1.0 | <0.93 | NA | NA |
| Total Organic Carbon | <1,600 | 5,000 | 5,300 | 3,500 | <1,400 | 5,900 | NA | NA |

[a] Effects range-low (ERL) value; based on values provided in Long et al., 1995.
[b] Probable effects level (PEL); based on values provided in Florida Department of Environmental Protection, 1994.
NA No value available for this constituent.
mg/kg milligrams per kilogram

Arsenic concentrations in three of the sediment samples were slightly above the ERL values (see table 4.2.2-2). The remaining constituents were all substantially below both the ERL and PEL values, suggesting limited, if any, impacts would result from disturbance of the sediments during dredging activities.

To estimate the possible release of chemical constituents to the water column during dredging operations and dredged material placement, Gulf LNG conducted elutriate testing of the sediments (see table 4.2.2-3). Elutriate testing simulates the potential transfer of chemicals from the dredged sediments into the water column during dredging or in-water placement operations. There are two types of elutriate tests, the standard elutriate and the effluent elutriate. Both tests were developed by the COE and are applied in different dredged material management situations. In both testing protocols, a volume of dredged material is vigorously mixed with a larger volume of water. The solids are allowed to settle out and the resulting water is then chemically analyzed. If the contaminants of concern (COCs) remain adsorbed (i.e., chemically attached) to the solids, they simply settle out of the water with the solids. However, if the COCs go into solution in the water, they could be transported in the water column.

TABLE 4.2.2-3

**Chemical Characteristics of Elutriate Samples**

| Parameter (mg/L) | Sediment Core Number: B-8/B-13 (0 to 20 feet) | B-9 / B-10 | B-11 / B-12 | EPA Water Quality Criterion [a] | Mississippi Water Quality Standard [a] |
|---|---|---|---|---|---|
| Metals | | | | | |
| Aluminum | 9.3 | <0.2 | <0.2 | NA | NA |
| Antimony | <0.02 | <0.02 | <0.02 | NA | NA |
| Arsenic | <0.01 | <0.01 | <0.01 | 0.069 | 0.069 |
| Beryllium | <0.004 | <0.004 | <0.004 | NA | NA |
| Cadmium | <0.005 | <0.005 | <0.005 | 0.04 | 0.043 |
| Chromium [b] | 0.013 | <0.01 | <0.01 | 1.1 | 1.1 |
| Copper | <0.02 | <0.02 | <0.02 | 0.0048 | 0.0048 |
| Iron | 7.7 | <0.05 | <0.05 | NA | NA |
| Lead | <0.005 | <0.005 | <0.005 | 0.21 | 0.21 |
| Manganese | 0.18 | 0.37 | 0.04 | NA | NA |
| Mercury | <0.0002 | <0.0002 | <0.0002 | 0.0018 | 0.0018 |
| Nickel | <0.04 | <0.04 | <0.04 | 0.074 | 0.075 |
| Selenium | <0.01 | <0.01 | <0.01 | 0.29 | 0.29 |
| Silver | <0.01 | <0.01 | <0.01 | 0.0019 | 0.0019 |
| Thallium | <0.2 | <0.01 | <0.01 | NA | NA |
| Tin | <0.01 | <0.01 | <0.01 | NA | NA |
| Zinc | <0.02 | <0.02 | <0.02 | 0.09 | 0.09 |
| Cyanide | <0.01 | <0.01 | <0.01 | 0.001 | 0.001 |

[a] Values reported are for saltwater Criteria Maximum Concentration, an acute concentration of the constituent. Concentrations for these parameters are listed in micrograms per liter (µg/L) in the original references; the values in these columns have been converted to milligrams per liter (mg/L) to allow easier comparisons with the analytical results.

[b] The valance state of chromium was not reported; to be conservative, we have assumed the reported value to be entirely chromium VI.

NA No value available for this constituent.

mg/L milligrams per liter

As discussed above for sediment testing, none of the organic compounds analyzed were identified above their detection limits in any of the elutriate samples. No comparisons of the organic compounds with water quality criteria are presented because none of the organic compounds were identified above the detection limits. The results of the elutriate testing for the metals analyzed and cyanide were compared with national water quality criteria and Mississippi state water quality standards (EPA, 2006a; MDEQ, 2003) (see table 4.2.2-3). No metals were detected at concentrations above water quality standards; however, detection limits for two metals (copper and silver) and cyanide were higher than the standards. Therefore, given the uncertainty of the actual concentrations of these contaminants present in the elutriate samples, it is conservative to assume that copper, silver, and cyanide could be released to the water column at concentrations exceeding water quality criteria during dredging operations. In addition, dredged material placement at the ODMDS could result in water quality impacts on the receiving waters at the site as a result of the same three constituents. We note, however, that elutriate testing yields conservative estimates of potential water quality impacts because the tests simulate a greater level of sediment mixing and aeration than actually created by mechanical dredging. This is supported by a study conducted by the COE to evaluate the release of chemical constituents at the point of dredging, which found elutriate test results are a conservative predictor of chemical concentrations within the water

column (COE, 1988b). Actual water quality impacts are better evaluated based on biotoxicity and bioaccumulation testing as discussed in more detail below.

#### 4.2.2.3 Biological Testing of the Sediments

As noted above, Gulf LNG conducted biological testing to evaluate the potential effects of offshore, open water placement of the proposed dredged material. The biological testing involved bioassay and bioaccumulation testing, including 10-day whole-sediment tests using *Leptocheirus plumulosus* and *Nereis arenaceodentata*, 96-hour elutriate tests with *Cyprinodon variegatus* and *Mysidopsis bahia*, and a 48-hour elutriate test for mussel larvae development using gametes from *Mytilus californicus*. Bioaccumulation tests (28-day) were conducted with *Nereis virens* and *Macoma nasuta*. The results of each stage of the biological testing are described below.

**Whole-sediment Bioassay Summary**

Bioassays were conducted with whole sediments collected from the area to be dredged. Neither of the species tested (nereid polychaete and amphipod crustacean) exhibited significant mortality due to exposure to test sediments. These tests demonstrated that the sediments are not toxic to marine organisms and would be suitable for open ocean placement.

**Elutriate Bioassay Summary**

Mysid shrimp, sheepshead minnow, and mussel larvae were exposed to varied concentrations of elutriates prepared from sediments to be dredged at the project site. Even at the 100 percent concentration, none of these elutriates caused significant mortality among any of the test species, demonstrating that these sediments would comply with the criteria for open ocean placement of dredged material. The MPRSA regulations require that marine water quality criteria be met to obtain EPA authorization for open water placement of dredged material in federal waters. As indicated in Appendix D, water quality criteria for heavy metals were not exceeded in any of the elutriate test results. Because no water quality criteria exceedances were observed and because none of the sediment elutriates resulted in significant mortality in the bioassay test organisms, modeling to further evaluate compliance with water quality criteria or determination of a limiting permissible concentration was not necessary.

**Bioaccumulation Testing Summary**

Despite the generally low levels of heavy metal concentrations demonstrated by the initial sediment testing, the proposed dredge sediments were evaluated for heavy metal bioaccumulation potential. The bioaccumulation test organisms (polychaetes and clams) demonstrated no toxicity effects after exposure to the sediments for 28 days. Tissues from the test organisms analyzed for heavy metals at the end of the test period showed no bioaccumulation of any of the constituents of concern for either species. These results indicate that there would be no significant bioaccumulation potential for any of the heavy metals detected in the proposed dredge sediments.

## 4.3 WATER RESOURCES

### 4.3.1 Groundwater

#### 4.3.1.1 Hydrogeologic Setting

The LNG Clean Energy Project is located within the Coastal Lowlands aquifer system in southeastern Mississippi (Renken, 1998). The Coastal Lowlands aquifer system underlies most of the Gulf Coastal Plain, extending from southern Texas to the Florida panhandle. It contains numerous local aquifers within a complex sequence of mostly unconsolidated beds of clay, silt, sand, and gravel deposited during numerous Cenozoic oscillations of sea level and shorelines. The sequence is generally wedge-shaped and thickens towards the Gulf of Mexico, where it is thousands of feet thick. It overlies the Vicksburg-Jackson confining unit, which separates the aquifer system from the underlying Mississippi embayment aquifer system. All sediments that overlie the Vicksburg-Jackson unit in Southern Mississippi are part of the Coastal Lowlands aquifer system.

The Coastal Lowlands aquifer is a significant source of water in Mississippi, Louisiana, and Arkansas. Fifty-one percent (585 mgd) of withdrawals from the Coastal Lowlands aquifer in these areas is attributed to agricultural use, 25 percent (283 mgd) to public supply, and 16 percent (178 mgd) to domestic and commercial uses. Industrial, mining, and thermoelectric power withdrawals account for the remaining 8 percent (95 mgd). Most groundwater withdrawals in the Coastal Lowlands aquifer are concentrated in New Orleans, Baton Rouge, and southwestern Louisiana (Renken, 1998). The Graham Ferry aquifer is the most widely used source of drinking water in the Pascagoula area (McLean, 2005).

Where the stratigraphic units of permeable sediments in the Coastal Lowlands aquifer system are exposed in the outcrop area to the north, groundwater is unconfined. Moving south from the outcrop area toward the Gulf of Mexico, permeable units may be overlain by less permeable sediments, and the groundwater is considered to be confined. The direction of groundwater flow is generally toward the Gulf of Mexico but may vary locally due to such influences as surface water features and pumping wells.

The Coastal Lowlands aquifer system has been separated into five permeability zones referred to as Permeable Zones A through D (see table 4.1.1-1). Each permeability zone consists of unconsolidated beds of sand and clay, which range in age from Oligocene to Holocene. These sediments were deposited in an environment that alternated between deltaic and marginal marine, forming a highly interbedded mix of sand and clay, in which the oldest sediments are exposed farthest inland with bands of progressively younger sediments exposed in a coastward direction. These deposits typically extend to the surface where recharge occurs through infiltration of rainwater in outcrop areas. The sediments dip and thicken as the Coastal Lowlands aquifer system extends from the coastal plains to the continental shelf in the Gulf of Mexico, reaching a maximum thickness of 14,000 feet off the Louisiana shore (Renken, 1998).

Permeable Zone A consists of Holocene to late Pleistocene age deposits, is widespread, contains freshwater in most places, and is the most heavily pumped zone. Permeable Zone B underlies Permeable Zone A and is comprised of Pleistocene to late Pliocene age deposits. Differences in vertical hydraulic gradient and hydraulic conductivity define the separation of these two zones; no confining unit is present. Freshwater portions of Permeable Zone B in southern Mississippi are generally at depths of more than 500 feet below sea level. Permeable Zone B is the second most intensively pumped aquifer in the Coastal Lowlands aquifer system. Permeable Zone C consists of Pliocene to late Miocene age deposits, permeable Zone D consists of deposits from the middle Miocene age, and Permeable Zone E consists of deposits of early Miocene to the late Oligocene age. Permeable Zones C, D, and E extend out as narrowing bands across central Louisiana and southern Mississippi, thickening as they extend coastward (Renken, 1998).

In the immediate vicinity of the proposed LNG terminal and natural gas sendout pipeline, surficial alluvial deposits make up the uppermost, unconfined aquifer (McLean, 2005). These sediments locally comprise Permeable Zone A and the uppermost portion of Permeable Zone B of the regional Coastal Lowlands aquifer. The Citronelle Formation underlies this alluvium and represents most of Permeable Zone B and the top of Permeable Zone C of the Coastal Lowlands aquifer. The Citronelle Formation is made up of fine and medium grained sands with interbedded silts and clays of Pleistocene to Pliocene age (Strom and Oakley, 1996) up to 200 feet thick. A bedded clay formation makes up the bottom of the Citronelle Formation and defines an aquitard between these sediments and the Graham Ferry Formation below (McLean, 2005). The Graham Ferry Formation is comprised of deltaic sediments that are generally regarded as Pliocene age (Strom and Oakley, 1996; Ingram, 2004), although it has also been interpreted as Miocene (Agency for Toxic Substances and Disease Registry, 2005). This formation is part of Permeable Zone C of the Coastal Lowlands aquifer and is also considered by some to be part of the Miocene aquifer system (Agency for Toxic Substances and Disease Registry, 2005), which is a grouping of all the southern Mississippi deposits of the Miocene Series. Roughly 60 percent of the groundwater used in the Pascagoula area comes from the Graham Ferry Formation (McLean, 2005).

The project would not affect any EPA-designated Sole Source Aquifers listed under section 1424(e) of the Safe Drinking Water Act. Sole or principal source aquifers are designated as aquifers that supply 50 percent or more of the drinking water for an area and for which there are no other reasonably available alternative sources should the aquifer become contaminated. As currently planned, water for the facility would be obtained from the Port of Pascagoula industrial water supply system (see section 2.2). The Port of Pascagoula industrial water supply system draws its water from the Pascagoula River, approximately 15 miles north of the proposed LNG terminal site. Gulf LNG would not make any direct water withdrawals from the Pascagoula River.

Because the facilities associated with the LNG Clean Energy Project would be located very near the Mississippi Sound, water table elevations are expected to be near mean sea level (Fugro, 2005).

#### 4.3.1.2 Public Water Supply and Wells

In the State of Mississippi, a public water system (PWS) is "a system that provides water via piping or other constructed conveyances for human consumption to at least 15 service connections or serves an average of at least 25 people for at least 60 days of each year." There are three types of PWSs, including community (e.g., towns), non-transient non-community (e.g., schools and factories), or transient non-community systems (e.g., rest stops or parks) (MDEQ, 2004a). There are no springs or community PWS wells within 150 feet of the proposed facilities (Caviness, 2005a; Ferrill, 2005; Hutchinson, 2005; Smith, 2005). The nearest PWS wells are two non-community wells located over 1,000 feet from the sendout pipeline route. These wells are used by Chevron's Pascagoula Refinery (Caviness, 2005b; Gregory, 2005). The nearest community PWS well supplying the City of Pascagoula municipal water supply system is located nearly 3 miles to the northeast of the proposed LNG terminal facility (Caroway, 2005).

There are two private wells located within 150 feet of the construction right-of-way for the natural gas sendout pipeline (see table 4.3.1-1). One of the wells, located approximately 5 feet from the construction right-of-way near MP 1.5, is owned by Chevron and is designated as "unused." The second well is located approximately 150 feet from the proposed pipeline construction right-of-way near MP 4.0 and is designated for domestic use by the Port of Pascagoula (Mississippi Automated Resource Information System, 2005; Caviness, 2005b).

| Table 4.3.1-1<br>**Water Supply Wells and Source Water Protection Areas** | | | |
|---|---|---|---|
| Facility | Feature | Approximate Milepost | Approximate Distance from Construction Right-of-Way |
| Sendout pipeline | Unused private well | 1.5 | 5 feet |
| Sendout pipeline | Source water protection area | 2.5 | Crossed |
| Sendout pipeline | Source water protection area | 3.0 | Crossed |
| Sendout pipeline | Source water protection area | 3.2 | Crossed |
| Sendout pipeline | Domestic private well | 4.0 | 150 feet |

Although the State of Mississippi has not implemented a wellhead protection program, it has identified source water protection areas, which must be designated for any PWS. However, no restrictions or protective measures have been established for source water protection areas. No source water protection areas or water supply wells are located within 150 feet of the proposed LNG terminal site. The proposed natural gas sendout pipeline would cross three source water protection areas (see table 4.3.1-1). Two of the source water protection areas were established for wells registered to Chevron near MPs 2.5 and 3.2, and the third source water protection area was established for a well registered to the Mississippi Phosphates Corporation near MP 3.0 (Caviness, 2005c; Smith, 2005).

Well data from installation of water wells associated with the source water protection areas indicate that they are screened in the Graham Ferry Formation at depths ranging from 275 to 363 feet below ground surface. Additionally, static water level measurements taken after installation show that the piezometric surface of that aquifer is lower than the water table in this area, indicating that hydraulic resistance likely exists between the aquifers. This conclusion is supported by well logs for two of the wells, which point to the presence of a confining clay layer above the screened sections (Smith, 2005).

#### 4.3.1.3 Groundwater Quality

Dissolved-solids concentrations in water of the Coastal Lowlands aquifer system are directly related to groundwater flow (Renken, 1998). In northern areas where the aquifers are recharged, concentrations of dissolved solids are low, but the water becomes increasingly saline as it moves toward the coast as a result of dissolution of aquifer minerals and mixing with seawater. Groundwater movement near the coast is sluggish and not sufficient to flush saltwater from the aquifer. In coastal areas such as southern Jackson County, Mississippi, the aquifer contains areas of water with dissolved-solids concentrations in excess of 1,000 milligrams per liter (mg/L), reaching the lower limits of dissolved-solids concentrations characteristic of brackish waters. At these levels, groundwater typically requires treatment in order to make it suitable for many industrial processes and residential use.

The southern limit of freshwater in the eastern part of Jackson County is at or near the coastline. In the western part of the county, the freshwater line extends several miles beyond the coast. Water in the Citronelle aquifer contains less than 100 mg/L of dissolved solids. The Miocene system is thinner near its northern edge at approximately 1,000 feet and thicker towards the southern end, reaching 4,000 feet. The concentration of dissolved solids in the Miocene system increases with depth. Wells less than 200 feet deep generally have concentrations of 100 mg/L of dissolved solids, except in areas contaminated by brine from oil wells (MDEQ, 2004b). For comparison, the EPA-recommended maximum concentration of dissolved solids in drinking water is 500 mg/L.

Only a limited amount of information on groundwater quality and yields is available for the surficial aquifers (alluvium and citronelle) in the immediate vicinity of the proposed project facilities; however, regionally, the groundwater within surficial aquifers along the coast is of poor quality. Much of

the water is saline due to saltwater intrusion. Locally, the water in the surficial aquifer contains high amounts of hydrogen sulfides and dissolved organic matter (Parsons Engineering Science, Inc., 2001). A review of USGS water quality data indicates that groundwater within the alluvium and Citronelle aquifers in Jackson County is slightly acidic (pH between 6 and 7 standard units) with filtered chloride measurements around 130 mg/L to 190 mg/L (USGS, 2005b). For comparison, the EPA's secondary drinking water standard (a non-enforceable guideline for aesthetic effects) for chloride is 250 mg/L.

According to the State of Mississippi Comprehensive Environmental Response, Compensation, and Liability Act/Uncontrolled Sites File list, the nearest known location of contaminated groundwater is on the Port of Pascagoula property located west of the proposed sendout pipeline route. The predominant contaminant at this location is listed as lead.

#### 4.3.1.4 Impact and Mitigation

In general, construction and operation of the proposed project would not significantly affect groundwater resources in the area. The project is located on the seaward edge of the Coastal Lowlands aquifer in a heavily industrialized area. Potential groundwater-related impacts that could occur include physical damage to wells, degradation of groundwater quality from disturbance of subsurface soils or spills of hazardous materials, and changes to groundwater flow from dewatering activities. These potential impacts would be avoided or minimized through appropriate construction and hazardous material handling practices as described below.

Based on currently available information, the wells identified in the project vicinity appear to be located outside of the pipeline construction right-of-way; however, the water supply wells located within 150 feet of the construction work area (construction right-of-way and temporary extra workspaces) could be susceptible to damage from construction activities. In addition, if the wells do not have adequate surface protection, they could be susceptible to impacts from spills of hazardous materials. To ensure that potential impacts on water supply wells are minimized during construction, Gulf LNG would identify and mark, as appropriate, any undocumented water wells and confirm the locations of existing, documented wells before construction. To further ensure that impacts on water supply wells are minimized, **we recommend that:**

- **<u>Before construction</u>, Gulf LNG conduct, with the well owner's permission, pre- and post-construction monitoring of well yield and water quality for in-use wells within 150 feet of the construction work area. <u>Within 30 days of placing the facilities in service</u>, Gulf LNG should file a report with the Secretary discussing whether any complaints were received concerning well yield or water quality and how each was resolved.**

- **Gulf LNG replace any potable water supply system that it damages during construction and cannot repair to its former capacity and quality. <u>Within 1 year of completion of construction</u>, Gulf LNG should file a report with the Secretary identifying all potable water supply systems damaged by construction and how they were repaired.**

As previously discussed, the source water protection areas crossed by the project are screened in the Graham Ferry Formation at depths ranging from 275 to 363 feet with the presence of a confining clay layer above the screened sections. As a result, trenching activities associated with construction of the sendout pipeline in the three source water protection areas would have no impact on the aquifer that supplies the water to these wells.

Some dewatering may occur during construction of the LNG terminal facility. However, relatively small volumes would be expected and effects on the overall groundwater system would be minor and temporary. Based on the relatively low volumes expected to be withdrawn, the likelihood of drawing off-site groundwater contaminants to the site through such dewatering activities is considered to be low. Groundwater would not be used during construction or operation of the proposed LNG terminal. Freshwater for construction (e.g., hydrostatic testing) and operation would be obtained from the Port of Pascagoula industrial water supply system.

Trench dewatering may also be necessary at limited areas along the natural gas sendout pipeline route where the water table is near the ground surface. Trench dewatering operations at a given location would be brief, typically lasting several days or less. Potential impacts on groundwater would include minor fluctuations in groundwater levels and/or increased turbidity within the aquifer adjacent to the activity. Most alluvial aquifers exhibit moderate to rapid recharge and groundwater movement; therefore, such effects would be short term. If there is adequate vegetation to function as a filter medium, discharge would be directed to the vegetated land surface to control erosion. Where adequate vegetation is absent or in the vicinity of waterbodies or wetlands, trench water would be pumped into a filter bag or settling basin constructed of hay bales or silt fence so that silt-laden water would be filtered before release from the construction right-of-way. These practices would minimize the impact on groundwater quality as the water removed from open trenches would be allowed to infiltrate back into the aquifer in the immediate vicinity of trenching activities. Trench dewatering would be conducted in accordance with applicable permits. As a result, impacts on groundwater associated with trench dewatering are not expected to be significant.

Shallow groundwater can affect the buoyancy of a pipeline by causing it to float. To mitigate potential buoyancy (floating) concerns and/or flexure of the pipe, Gulf LNG would install concrete-coated pipe in areas of shallow groundwater as necessary. Concrete coating activities would not be conducted within 100 feet of a waterbody in accordance with our Procedures.

Gulf LNG is proposing to use a portion of the Port of Pascagoula property located west of the proposed natural gas sendout pipeline route for a contractor yard and equipment staging area. Groundwater contamination, predominantly lead, is known to be present in this area. However, since no excavation would occur at this site, groundwater resources would not be affected, nor would the contaminated groundwater at this location affect the project. As previously indicated, no areas of groundwater contamination are known to be present at the proposed LNG terminal site or along the proposed sendout pipeline route. However, if areas of potential contamination are discovered during the course of construction, Gulf LNG would instruct the contractor to stop work at the discovery location to allow time to evaluate the potential contamination and to develop a plan for safe handling and disposal of the contaminated materials in accordance with all applicable local, state, and federal regulations. If the contaminated material is groundwater, Gulf LNG would contact personnel in the MDEQ Groundwater Assessment and Remediation Division and would follow the procedures contained in the MDEQ's document, *Brownfield Risk Evaluation Procedures.* Implementation of these procedures would mitigate impacts on human health (e.g., the construction workers) and the environment.

Hydraulically driven pilings would be used during construction of the marine facilities and the LNG storage and vaporization facilities. The use of deep pile foundations can increase the potential for contamination of aquifer layers through seepage from one layer to another. In addition, the deep pile foundations can act as a transport mechanism for surficial contamination into deep, previously uncontaminated water-bearing zones. Fugro (2005) estimates that the proposed pile driving for creation of a deep foundation for the LNG terminal structures could be at least 147 feet below final grade elevation. This depth is expected to stay within the permeable zone of the Citronelle aquifer. This would minimize the potential for cross-contamination with deeper aquifers because the pilings would not cross

multiple aquifer layers. Because the installation of the piles is not expected to increase the vertical transport of surface contaminants and no known groundwater contamination currently exists at the site, no adverse impacts on groundwater are anticipated as a result of pile driving.

Accidental spills or leaks of hazardous materials associated with equipment failures; the refueling or maintenance of vehicles; or the storage of fuel, oil, and other fluids during construction pose a risk to groundwater resources. Spills or leaks of hazardous liquids could contaminate groundwater and affect aquifers. If not cleaned up, contaminated soils could continue to leach and add pollutants to the groundwater long after a spill has occurred. Impacts associated with spills or leaks of hazardous liquids could be avoided or minimized by restricting the location of refueling and storage facilities and by requiring cleanup in the event of a spill or leak. Gulf LNG has developed an SPCC Plan (see Appendix C) that would minimize the likelihood and potential impact of a hazardous spill during construction of the onshore and offshore project facilities. The SPCC Plan describes preventative measures such as employee training, equipment inspection, and proper refueling procedures to minimize the likelihood of spills and leaks. The same practices would be employed at locations of hazardous material storage. The SPCC Plan also describes mitigative measures, such as containment and cleanup, to minimize impacts should a spill occur. Should this project be approved, Gulf LNG would develop a separate SPCC Plan after construction of the project to identify similar preventative measures that would be employed during operation of the LNG terminal and associated facilities. Through implementation of the SPCC Plans and other measures described above, the LNG Clean Energy Project would not have a significant impact on groundwater resources.

### 4.3.2 Surface Water

#### 4.3.2.1 Environmental Setting

The LNG Clean Energy Project would be located on the northern shoreline of the Mississippi Sound in the Port of Pascagoula, just southeast of the mouth of Bayou Casotte Harbor. Bayou Casotte is an estuary fed by two freshwater tributaries, the East Prong and West Prong, which drain the Bayou Casotte watershed (approximately 8.4 square miles in size). According to the National Weather Service Station in Mobile, Alabama, the harbor area's average annual rainfall is 69 inches. The upper portion of the watershed is characterized by rural agriculture, whereas the lower portion of the watershed has had extensive industrial, urban, and recreational development. Bayou Casotte Harbor is frequented by large ocean going vessels.

Based on MDEQ data collected between 1997 and 2001, background concentrations of TSS observed in Bayou Casotte range from 7 to 830 mg/L, with a mean of 55 mg/L and a median of 36 mg/L (Bayou Casotte Energy, 2005). According to the 2004 Mississippi Section 303(d) List of Impaired Water Bodies, Bayou Casotte is listed as impaired for Aquatic Life Support in an area north of the project site. Specifically, it is impaired because of elevated total toxins and unionized ammonia (MDEQ, 2004b). The waters in Bayou Casotte also have high levels of phosphorus and nitrogen due to fertilizer manufacturing plants that are located nearby (Gulf of Mexico Fishery Management Council (GMFMC), 1998). Water and sediment testing was conducted in September 2005 along the Mississippi Coast after Hurricane Katrina. Sampling stations within Bayou Casotte included both shallow water (1 foot) and deep water (22.75 feet) locations. The results of this testing showed low levels of most contaminants, although algal growth results for Bayou Casotte were "exceptionally high" (EPA and MDEQ, 2005). The EPA noted that nutrient enriched discharges from the Mississippi Phosphates facility to Bayou Casotte were the likely cause of the high algal growth (EPA and MDEQ, 2005). The sampling station nearest to the proposed LNG terminal, located within Bayou Casotte immediately west of Chevron's Pascagoula Refinery, showed a higher than average salinity level of 29.0 parts per thousand (ppt) and lower than average dissolved oxygen level of 4.61 mg/L (EPA and MDEQ, 2005).

The State of Mississippi has not established state fishery classifications for surface waters. Instead, the MDEQ classifies surface waters using the *Water Quality Criteria for Intrastate, Interstate, and Coastal Waters State of Mississippi* (MDEQ, 2003). Bayou Casotte's designated use is for fish and wildlife production. MDEQ's current assessment methodology indicates that Bayou Casotte is fully supporting for its designated use.

The Mississippi Sound extends approximately 100 miles from Lake Bourgne, Louisiana to Mobile Bay, Alabama, with a varying width of 7 to 15 miles. This long, shallow estuary is bordered on the north by small bays (St. Louis Bay, Biloxi Bay, Pascagoula Bay, and Grand Bay), marshes, bayous, rivers, and coastal beaches. To the south, the Barrier Islands, a series of narrow islands and sandbars, separate the sound from the Gulf of Mexico. The sound is primarily fed by the Escatawpa, Pascagoula, Tchoutacabouffa, Biloxi, Wolf, and Jourdan Rivers.

The Mississippi Sound provides diverse habitats for numerous fish, bird, mammal, and plant species and is listed as a marine fishery designated as "Recreation" (primary and secondary). Silty clay is the dominant sediment in the Mississippi Sound and the average depth at mean low water is about 6 feet. Wave action on the fine-grained sediments in the shallow sound creates a turbid environment. During peak river flow, the muddy waters may reach and extend beyond the barrier islands (GMFMC, 1998).

The MDEQ provided ambient turbidity and TSS data for water samples collected from the Mississippi Sound at locations in the Pascagoula area from 1997 through 2004 (MDEQ, 2005). Of 97 samples collected for turbidity, values ranged from 1.2 to 120 nephelometric turbidity units (NTU) with an average of 11.9 NTU. Of 86 samples collected for TSS, values ranged from 5 to 227 mg/L with an average of 42.9 mg/L.

In addition to Bayou Casotte and Mississippi Sound, other waterbodies in the proposed project area include two manmade canals and two ditches. The canals and ditches are not specifically listed under the MDEQ's water quality criteria, but do have a default classification of "Fish and Wildlife" (fishing; propagation of fish, aquatic life, and wildlife; and secondary recreational use), even though they are not listed as waterbodies sustaining fisheries. The canals would be crossed by the sendout pipeline and the drainage ditches are located within a proposed contractor yard and support area.

Table 4.3.2-1 provides a list of the waterbodies affected by the proposed project, including waterbody name, location, description, stream type, crossing width, water quality classification, fishery type, whether the waterbody is artificial or natural, and proposed crossing method.

#### 4.3.2.2 Impact and Mitigation

**Construction**

Activities associated with construction of the project, including construction of the marine facilities and associated dredging, dredged material placement, pipeline waterbody crossings, hydrostatic testing, stormwater runoff, and accidental spills or leaks of hazardous materials could affect surface water resources.

Table 4.3.2-1

**Waterbodies Affected by the LNG Clean Energy Project**

| Facility/Waterbody | Milepost | Description | Type | State Water Quality Classification[a] | Fishery Type | Artificial/ Natural | Crossing Width (feet) | Crossing Method |
|---|---|---|---|---|---|---|---|---|
| LNG Terminal Facilities | | | | | | | | |
| Mississippi Sound | NA | Estuary | NA | R | Marine | Natural | NA | NA |
| Pipeline Facilities | | | | | | | | |
| Pipeline Right-of-Way | | | | | | | | |
| Unnamed Canal | 1.6 - 2.9 | Canal | Perennial | FW [b] | None | Artificial | [c] | HDD |
| Unnamed Canal | 4.4 | Canal | Perennial | FW [b] | None | Artificial | 45 | Open-cut |
| Contractor Yards and Support Areas | | | | | | | | |
| Ditch | NA | Ditch | Intermittent | FW [b] | None | Artificial | NA | NA |
| Ditch | NA | Ditch | Intermittent | FW [b] | None | Artificial | NA | NA |

[a] FW = Fish and Wildlife – Defined as waters intended for fishing and propagation of fish, aquatic life, and wildlife. Waters meeting the Fish and Wildlife Criteria shall also be suitable for secondary contact recreation, which is defined as incidental contact with the water during activities such as wading, and boating that are not likely to result in full contact.
R = Recreation – Defined as waters suitable for recreational purposes, including such water contact activities as swimming and water skiing.

[b] Denotes state waters not specifically listed in the Water Quality Criteria for Intrastate, Interstate, and Coastal Waters (MDEQ, 2003), that are categorized as FW by default.

[c] The canal parallels the proposed sendout pipeline route and would be avoided/crossed by Gulf LNG's proposed horizontal directional drill (HDD) between MPs 1.6 and 2.9.

NA Not applicable.

Construction of the Marine Facilities and Associated Dredging and Dredged Material Placement

The primary impact of the project on water quality would result from the dredging of approximately 2.96 million $yd^3$ of material within and along the Mississippi Sound and the proposed placement of that material at the ODMDS located approximately 5 miles south of Horn Island. Details of Gulf LNG's proposed dredging are described in section 2.4.1.3. Dredging would result in a temporary increase in suspended solids in the water around the dredged area and the subsequent settling of the suspended particles, or sedimentation. The suspended sediment would temporarily reduce light penetration and could lower the rate of photosynthesis and aquatic productivity of the area. The introduction of sediment could also increase the amount of organic material and/or nutrients in the affected areas, which could lead to an increase in biological oxygen demand and could reduce dissolved oxygen levels or cause a release of chemical constituents, such as metals, PCBs, pesticides, or PAHs, if present in the sediments.

Because of the considerable distance between the dredging site and the ODMDS, the use of a clamshell mechanical dredge with bottom dumping barges or scows, is the only practical means of conducting the dredging. As discussed in section 4.2.2.1, studies by the COE indicate that clamshell dredging generally results in greater sediment resuspension than other forms of dredging (e.g., hydraulic cutterhead dredges) (COE, 1988a). While the amount of suspended sediment due to mechanical clamshell dredge operations varies with operating conditions, sediment type, and hydrodynamic conditions, typical plumes from mechanical clamshell dredges extend approximately 984 feet at the surface and approximately 1,640 feet at the bottom (Barnard, 1978; LaSalle, 1990). Maximum suspended sediment levels within the plume are typically less than 500 mg/L within approximately 328 feet of the dredging activity (Barnard, 1978; LaSalle, 1990), and decrease rapidly with distance from the dredging

operation due to settling and dilution. Use of the bottom dumping barges or scows minimizes resuspension of sediments at the placement site because dredged material placement occurs rapidly.

The sediment in the area to be dredged at the proposed LNG terminal site consists primarily of clays and silts (see section 4.2.2). Because of the high percentage of clays, dredging would cause an increase in turbidity; however, because of the relatively turbid conditions already present in the Mississippi Sound, the added TSS levels resulting from the proposed dredging would not likely have a significant impact on surrounding water quality or aquatic organisms. Bayou Casotte Energy modeled the potential for suspension of sediment associated with dredging of its proposed slip using the COE's DREDGE Model. The analysis indicated that maximum predicted levels of TSS would be 19.9 mg/L at a distance of approximately 30 feet from the dredging activity, with concentrations of TSS dropping at distances further away from the activity. These levels are similar to or below existing backgrounds levels for Bayou Casotte. In addition, as described in section 4.2.2.2, contaminants are unlikely to be released to the water column at significant concentrations during dredging or during dredged material placement.

To minimize impacts associated with dredging, Gulf LNG would implement the following construction practices:

- monitor dredging operations for adverse effects with established contingencies to reduce impacts should they be observed;
- suspend operations during severe weather; and
- avoid actively dewatering barges prior to overboard flow of excess water.

As part of ongoing agency consultations, Gulf LNG is discussing other specific turbidity reduction measures and the potential feasibility and effectiveness of various options. In addition, Gulf LNG would be required to conduct water quality monitoring as a condition of its section 401 Water Quality Certification. Based on the results of water quality monitoring, Gulf LNG could adjust the rate of dredging to reduce impacts resulting from elevated TSS levels. Based on the existing TSS levels and the implementation of Gulf LNG's mitigation measures, as well as those developed in consultation with the applicable agencies and included in its section 401 Water Quality Certification, we believe that potential impacts on water quality associated with the proposed dredging activities would be sufficiently minimized. Additional information on impacts associated with dredging activities on aquatic resources and special status species is provided in sections 4.6.2 and 4.7, respectively.

Waterbody Crossings Associated with the Pipeline Facilities

The 5.0-mile-long natural gas sendout pipeline would cross two minor waterbodies. There are no municipal water supplies or specially designated surface water protection areas downstream of the waterbody crossing locations. The first waterbody, a manmade canal, would be crossed as part of the proposed HDD between MPs 1.6 and 2.9. This canal would also be located adjacent to portions of the proposed pipeline route in this area. In general, use of the HDD method would avoid disturbance of the canal. However, an inadvertent release of drilling mud during the HDD operation could have an impact on the canal. Such a release could occur in the area of the mud pits or tanks, or along the path of the drill due to unfavorable ground conditions. Drilling mud is most often comprised of naturally occurring materials, such as bentonite, which in small quantities would not be detrimental to vegetation, fish, or wildlife. We have recommended that Gulf LNG prepare a HDD Plan to minimize impacts associated with an inadvertent release of drilling mud (see section 2.4.2.2).

The second waterbody, another manmade canal, would be crossed using the open-cut construction method (see section 2.4.2.2). The impacts of the open-cut construction method on the canal would be localized and short term. To minimize impacts on this waterbody, Gulf LNG would adhere to the measures contained in our Procedures. Our Procedures were developed in response to past concerns raised by federal, state, and local agencies and provide the minimum level of protection for surface waterbodies crossed during natural gas pipeline construction. Our Procedures include requirements for preconstruction planning, environmental inspection, specific construction methods, sediment and erosion control, restoration, and post-construction maintenance.

The proposed contractor yard and storage area located at the JCPA's General Cargo Terminal about 0.3 mile west of MP 2.0 contains two ditches. These ditches were delineated as wetlands and are discussed in greater detail in section 4.4.

Hydrostatic Testing

Before being placed into service, the proposed LNG storage tanks and the natural gas sendout pipeline would be hydrostatically tested to ensure structural integrity. Approximately 29 million gallons of test water would be obtained from the Port of Pascagoula industrial water supply to conduct these tests. The intake for the Port of Pascagoula industrial water supply is located on the Pascagoula River, approximately 15 miles north of the proposed LNG terminal site. Gulf LNG would not make any direct water withdrawals from the Pascagoula River.

The water would be transported to the LNG terminal site via the piping installed for the natural gas sendout pipeline. A temporary pipe would be installed to transport the water from the pig launcher at MP 0.0 to the LNG storage tank location. Before filling the tanks, the hydrostatic test water source would be chemically analyzed to ensure that the water would meet applicable code requirements. Before testing, the water would be stored to allow settling until the particulate matter content is 1 ppm, and caustic injection would be used to neutralize the water to a pH of 7.0. Upon successful completion of the hydrostatic testing of the LNG storage tanks, Gulf LNG proposes to discharge the test water into the Mississippi Sound in compliance with all applicable permits. If necessary, a number of discharge points could be accommodated to dissipate the test water over a large area and energy dissipation devices would be used as necessary to prevent scouring and erosion during discharge. Gulf LNG would sample and analyze the hydrostatic test water before discharge for compliance with all applicable requirements. No chemicals would be added to the hydrostatic test water before or after testing.

Gulf LNG would hydrostatically test the sendout pipeline in accordance with DOT regulations to ensure that the system is capable of operating at the design pressure. Gulf LNG estimates that 1.4 million gallons of water would be required to hydrostatically test the pipeline. Water used for testing the pipeline would be obtained from the water already used for the hydrostatic testing of the LNG storage tanks. The hydrostatic test water would contact only new pipe and no chemicals would be added. The test water would be discharged to the ground surface using energy dissipation devices to prevent scouring and erosion.

Gulf LNG would conduct the hydrostatic testing activities in accordance with our Procedures as well as all applicable permits, including NPDES discharge permits.

Stormwater Runoff

Stormwater runoff during construction of the project could affect water quality in the vicinity of construction activities. To minimize these potential affects, Gulf LNG would implement measures outlined in our Plan and would also develop a site-specific SWPPP as a requirement of the NPDES

general permit for construction stormwater discharges. The SWPPP would incorporate BMPs as specified in our Plan, as well as other guidance established in several documents developed for erosion control and stormwater management in the State of Mississippi. Additional information on the site-specific SWPPP that would be developed for construction of the LNG Clean Energy Project is provided in section 4.2.1.2.

Accidental Spills or Leaks of Hazardous Materials

Surface water quality could also be adversely affected by a spill, leak, or other releases of hazardous materials during construction activities. Gulf LNG would minimize potential impacts associated with spills or leaks of hazardous materials during construction by implementing its SPCC Plan (see section 4.3.1.4 and Appendix C).

**Operation**

During operation of the proposed project, impacts on water quality could result from maintenance dredging of the marine facilities, propeller wash from LNG ships and tugboats, routine discharge of condensate water from the SCVs, stormwater runoff, bank erosion, accidental spills or leaks of hazardous materials, or an LNG spill. Because the LNG ships would be fully loaded with LNG when transiting to and arriving at the proposed terminal, no ballast water would be discharged into the Mississippi Sound. However, as the LNG cargo is unloaded, ballast water would be taken on to maintain trim and stability. LNG ships would also take on water to cool engines during offloading. These activities could also have an impact on water quality as well as aquatic resources (see section 4.6.2.2).

As with any ship, water would also be used for cooling the LNG ships' boilers during transit. Typical cargo ships operating in the Gulf of Mexico draw and discharge water for cooling at a rate of 40,500 gallons per minute (gpm) and LNG ships would be expected to have similar usage rates. This use of water for the ships' cooling systems would not have an impact on water quality; however, the temperature of the discharged water would be raised slightly.

Maintenance Dredging of the Marine Facilities

Maintenance dredging of the ship berth and maneuvering area would be conducted on a 3-year cycle, and would remove between 115,000 and 180,000 $yd^3$ of material per cycle. To minimize disturbance, dredging would be timed to match the COE's dredging of Bayou Casotte. As currently proposed, dredged material would be placed in the BCDMMS, which is located immediately adjacent to the LNG Clean Energy Project site (see section 2.7.1).

As previously discussed, chemical analysis of the sediments in the area indicate that contaminants are unlikely to be released to the water column at significant concentrations during dredging or placement of the dredged material. Although the concentration of suspended solids would increase in the maintenance dredging area, the volume of dredged material would be much smaller than during the construction dredging and the area of disturbance would be smaller as well. Because the waters of the Mississippi Sound are naturally turbid, maintenance dredging would not have a significant adverse impact on surface water quality.

Propeller Wash from LNG Ships and Tugboats

During operation of the proposed LNG terminal, propeller wash from LNG ships and tugboats could temporarily increase suspended sediments and turbidity within the navigation channel and ship berth and maneuvering area. As a vessel navigates through a waterway, it generates hydraulic

disturbances in the form of waves and currents, mainly drawdown, return current, slope supply currents, wash waves, and jet wash (Wolter and Arlinghaus, 2003). These activities have the potential to resuspend, and subsequently redeposit, sediments, resulting in impacts similar to those for dredging. Impacts associated with propeller wash would occur more frequently than dredging because as many as 150 ships may berth at the terminal annually. Given the proposed location of the LNG terminal adjacent to a shipping channel that experiences regular vessel traffic, tidal flushing, and maintenance dredging, surface water resources would not be significantly affected.

Routine Discharge of Condensate Water from the SCVs

Water is produced as a by-product of combustion in the SCV process. In addition, industrial supply water would be injected into the SCVs to control $NO_x$ emissions. Under the proposed design, each SCV would generate up to 20 to 30 gpm of water depending on the source water used by the emission control system. The maximum water produced by SCVs during operation of the LNG Clean Energy Project would be 0.4 mgd. Gulf LNG proposes to discharge the SCV combustion and $NO_x$ emissions control water directly to the Mississippi Sound under an NPDES permit following pH adjustment. To minimize potential water quality impacts associated with the discharge to the Mississippi Sound, water from the SCV neutralization tank would be routed through a submerged high velocity outlet located within the ship berthing area. The outlet would be submerged to take advantage of the buoyancy of the discharge relative to that of the receiving water. Discharging at depth (i.e., 20 feet below the water surface) would enhance the natural mixing and dilution of the effluent as it rises through the water column. Depending on final design, the jet mixing zone would extend from about 5 to 20 feet from the point of discharge.

The pH of the water bath in an SCV is typically maintained at 5.6 standard units and the temperature of the bath is maintained between 55 °F and 65 °F. Prior to discharge, the pH of the SCV discharge water would be increased in a neutralization tank. An allowable discharge pH would be established during the NPDES permit review process. Gulf LNG anticipates that the pH of the discharge would range between 6.0 and 9.0 standard units. While the water baths would be maintained between 55 °F and 65 °F, because of the travel time through pumps and piping to the point of discharge, the SCV discharge water would be slightly heated to an estimated 60 °F to 70 °F. The typical range in ambient water temperature in Mississippi Sound is 48 °F to 89 °F, depending on the season. On average, the SCV discharge water would tend to be slightly cooler than the ambient water temperatures. Through proper management of excess SCV water, we believe that potential impacts on receiving waters would be minimized.

Stormwater Runoff

Project operation could cause pollution via stormwater runoff. Stormwater runoff at the LNG terminal site would be contained within the perimeter dike wall and the dike wall constructed between the LNG storage tanks and the processing area to encapsulate the LNG storage tank area. A single stormwater outfall would be installed to pump any stormwater that collects within the diked area to the Mississippi Sound through the LNG terminal's berthing area.

Gulf LNG would be required to obtain an Industrial Stormwater Permit from the MDEQ for operation of the facility. As a requirement of coverage under the Industrial Stormwater Permit, Gulf LNG would need to develop an Industrial SWPPP. The Industrial SWPPP would be submitted to the MDEQ, along with an application for coverage, at least 60 days before commencement of facility operations to allow for agency review. The Industrial SWPPP would identify potential sources of pollution at the facility that may reasonably be expected to affect the quality of stormwater discharged from the

operational facility and would describe BMPs to be implemented at the facility to reduce pollutants in stormwater discharges.

Bank Erosion

Bank erosion could reduce bank stability and result in increased turbidity and suspended sediments in the waters surrounding the proposed LNG terminal site. However, the location of the proposed marine facilities on the Mississippi Sound southeast of the mouth of Bayou Casotte Harbor would not result in significantly modified flow velocities or wave action that could promote increased erosion of the channel banks. Additionally, the movement of large vessels, such as LNG carriers or crude oil tankers, has the potential to result in bank erosion and associated turbidity through creation of waves or wakes caused by propeller wash. As discussed in section 2.4.1, the design of the marine facilities includes an area of rock or concrete units on the slope parallel to the shoreline to minimize scour/erosion potential within the berth area from LNG ship propeller wash. During the transit along the navigation channels, LNG ships would be operating at low speeds and would not create wakes that would increase the potential for shoreline erosion in the project area (see section 4.1.3.5). In addition, because the project is located at the southernmost end of the existing land mass, LNG ships calling at the terminal would not pass reaches of the Bayou Casotte shoreline subject to erosion. Given these factors, potential effects to water quality from bank erosion would be minimal.

Intake of Ballast Water and Cooling Water by LNG Ships

LNG ships would take on ballast water to maintain stability and would use water to cool engines during offloading of LNG at the proposed terminal. These activities have the potential to use large quantities of water from the Mississippi Sound. A single LNG ship could take on as much as 15 million gallons of ballast water during each offloading operation, and given that approximately 150 vessels may visit the proposed terminal each year, up to 2.3 billion gallons of ballast water could be withdrawn from the Mississippi Sound on an annual basis. Additionally, LNG ships use water to cool their engines during LNG offloading operations. Depending upon engine type, LNG ships could use between 15 and 42 million gallons of water for engine cooling while they are at the berth.

Given the location of the proposed LNG terminal site on the Mississippi Sound near the mouth of Bayou Casotte, sufficient water is available to provide the quantities necessary for ballast and engine cooling operations. Because the LNG ships would be fully loaded with LNG when transiting to and arriving at the proposed terminal, no ballast water would be discharged into the Mississippi Sound. Since ballast water would not be discharged into the Mississippi Sound, there is limited opportunity for the introduction of exotic species via this pathway. Additionally, the project area is an active port with existing commercial shipping and is already subject to withdrawals and discharges of vessel engine cooling water. Furthermore, heavy shipping traffic augments the mixing and circulation of water in the waterway, thus reducing impacts from ballast water and cooling water intake on water quality. Information on the effects of ballast water and cooling water intake on aquatic resources is presented in section 4.6.2.2. Additional information on the environmental impacts resulting from the transit of the LNG ships is provided in section 4.13.5.3.

Accidental Spills or Leaks of Hazardous Materials

Spills, leaks, or other releases of hazardous materials during operation of the proposed project could also adversely affect surface water quality. Should this project be approved, Gulf LNG would prepare an SPCC Plan for operation of the project that would include procedures to prevent and mitigate accidental releases of oil, gas, lubricants, or hazardous materials.

The LNG terminal was designed to account for an accidental spill of LNG during operation of the facility and to prevent any LNG from entering Bayou Casotte Harbor (see section 2.8.1.1). In the unlikely event that LNG is spilled into the water either from the LNG terminal itself or from a ship during transit to the LNG terminal, the cryogenic liquid would vaporize rapidly upon contact with the warm air and water. Being less dense than water, LNG would float on the surface prior to vaporizing. Because LNG is not soluble in water and would completely vaporize shortly after being spilled, the LNG could not mix with or contaminate the water.

## 4.4 WETLANDS

The proposed LNG Clean Energy Project would be constructed in areas that support numerous wetlands. Based on definitions developed by Cowardin, et al. (1979), wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. In the project area, two general classifications of wetlands occur: estuarine and palustrine.

Estuarine wetlands are defined as tidal wetlands that are usually semi-enclosed by land, but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from land (Cowardin, et al., 1979). Estuarine wetlands are further classified into subtidal and intertidal. Subtidal wetlands are those wetlands in which the substrate is continuously submerged, while intertidal wetlands have a substrate that is alternately flooded and exposed by tidal fluctuations. Salinity in these areas ranges from 0.5 to greater than 40 ppt, depending on the amount of freshwater and ocean water entering the system.

Palustrine wetlands are defined as non-tidal wetlands dominated by trees, shrubs, persistent emergent vegetation, emergent mosses, or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 ppt. Palustrine wetlands have traditionally been called marshes, swamps, bogs, fens, and prairies, and may include small shallow permanent and intermittent waterbodies referred to as ponds. The freshwater marsh community is characterized by erect, rooted herbaceous hydrophytes, excluding mosses and lichens (Cowardin, et al., 1979). Palustrine herbaceous wetlands often are characterized by inundated to seasonally inundated areas of grass, sedges, and rushes. Palustrine scrub-shrub wetland communities include wetlands dominated by woody vegetation less than 20 feet tall. Palustrine forested wetland communities include wetlands dominated by woody vegetation generally greater than 20 feet tall.

In June and July of 2005, Gulf LNG conducted field surveys of the proposed LNG terminal site, the proposed natural gas sendout pipeline right-of-way, temporary extra workspace, contractor yards and support areas, and aboveground facility locations to identify wetlands in the project area. These field surveys were conducted using the methods specified in the 1987 *COE Wetlands Delineation Manual*, which requires the identification of wetlands based on the presence of three parameters: hydrophytic vegetation, hydric soils, and wetland hydrology (Environmental Laboratory, 1987). Some of the common vegetation identified during the field surveys of the proposed LNG terminal site and sendout pipeline facilities is presented in table 4.4-1.

TABLE 4.4-1

**Common Wetland Species Identified in Delineations within the LNG Clean Energy Project Area**

| Coastal Brackish Marsh | Freshwater Emergent Wetlands | Scrub-shrub Wetlands | Forested Wetlands |
|---|---|---|---|
| saltwater false willow<br>*Baccharus angustifolia* | cogongrass<br>*Imperata cylindrica* | red maple<br>*Acer rubrum* | wax myrtle<br>*Morella cerifera* |
| needlegrass rush<br>*Juncus roemerianus* | forked rush<br>*Juncus dichotomus* | Chinese privet<br>*Ligustrum sinense* | slash pine<br>*Pinus elliottii* |
| common three-square grass<br>*Schoenoplectus pungens* | manyhead rush<br>*Juncus polycephalus* | wax myrtle<br>*Morella cerifera* | black willow<br>*Salix nigra* |
| saltmeadow cordgrass<br>*Spartina patens* | torpedo grass<br>*Panicum repens* | small tallowtree<br>*Triadica sebifera* | bald cypress<br>*Taxodium distichum* |
| smooth cordgrass<br>*Spartina alterniflora* | Vasey's grass<br>*Paspalum urvillei* | | small tallowtree<br>*Triadica sebifera* |
| broadleaf cattail<br>*Typha latifolia* | | | |

Hurricane Katrina is likely to have had a short-term impact on freshwater wetlands in the project area. Salt stress associated with the storm surge may result in temporary die-off of some plant species in these wetlands but not to the extent that vegetation identifications made before the hurricane are invalid. It is expected that as rains provide freshwater and help to remove salt from inland wetland areas, plant regrowth will continue and/or new shoots will become established.

Although not always considered wetlands, submerged aquatic vegetation or seagrass occurs in relatively shallow coastal waters of the Mississippi Sound. No submerged aquatic vegetation was identified in the immediate project area. The nearest seagrass beds to the proposed LNG terminal are located approximately 4 miles east just outside Point aux Chenes Bay (State of Mississippi and NMFS, 1995). However, LNG ships would transit confined areas between the barrier islands and the mainland where submerged aquatic vegetation could be present (see section 4.5.1.1).

### 4.4.1 Affected Wetlands

Table 4.4.1-1 lists specific wetlands that would be affected by the project, including the wetland type and the anticipated impacts during construction and operation of the project. Gulf LNG has indicated that the COE has approved its wetland delineations conducted for the project. At the request of the COE, Gulf LNG conducted a hydrogeomorphic (HGM) assessment of wetland functions for all the coastal brackish marsh wetlands that would be permanently affected by the project. Additional details on the HGM assessment are presented in section 4.4.3.

#### 4.4.1.1 LNG Terminal Facilities

Gulf LNG identified one medium to high quality emergent wetland (coastal brackish marsh) within the proposed LNG terminal location. Construction of the LNG terminal would affect 3.3 acres of this wetland, all of which would be permanently converted to commercial/industrial uses. An additional 1.6 acres of the coastal brackish marsh would be permanently affected by the construction of a new road that would be maintained for access to the terminal. Additional wetland impacts could occur as a result of construction and operation of the nonjurisdictional facilities associated with the LNG terminal (i.e., electric transmission facilities and water supply pipeline); however, the final route for these facilities has not been determined (see section 2.2).

The LNG terminal would be located in the Tenneco/Chevron Management Unit within the Bayou Casotte-Bangs Lake Planning Area. Planning and management goals for this area include the protection of a 25-acre wetland located to the south and east of the proposed LNG terminal site. Gulf LNG is coordinating with the MDMR and the COE regarding the specific limits of the protection area and any potential mitigation measures required. Additional information on this management and planning area is provided in section 4.8.3.

TABLE 4.4.1-1

**Wetlands Affected by Construction and Operation of the Proposed LNG Clean Energy Project**

| Facility/ Beginning Milepost | Wetland ID | Wetland Classification [a] | Crossing Length Workspace (feet) [b] | Crossing Length Centerline (feet) [c] | Temporary Construction Impact (acres) [d] | Permanent Operational Impact (acres) [e] |
|---|---|---|---|---|---|---|
| LNG Terminal Facilities | | | | | | |
| LNG Terminal Site | | | | | | |
| NA | 28 | E2EM | NA | NA | 3.30 | 3.30 |
| Access Road | | | | | | |
| NA | 28 | E2EM | 1,670 | 1,690 | 2.53 | 1.58 |
| NA | 24 | PEM | 700 | 111 | 0.00 [f] | 0.00 [f] |
| NA | 23 | PEM | 240 | 181 | 0.00 [f] | 0.00 [f] |
| NA | 22 | E2EM/PEM | 1,625 | 1,632 | 0.00/0.00 [f] | 0.00/0.00 [f] |
| LNG Terminal Facilities Subtotal | | | | | 5.83 | 4.88 |
| Pipeline Facilities | | | | | | |
| Pipeline Right-of-Way | | | | | | |
| 0.00 | 28 | E2EM | 1,670 | 1,690 | 0.00 [g] | 0.00 [g] |
| 0.45 | 24 | PEM | 700 | 111 | 0.00 [g] | 0.00 [g] |
| 0.69 | 23 | PEM | 240 | 181 | 0.00 [g] | 0.00 [g] |
| 0.78 | 22 | E2EM/PEM | 1,625 | 1,632 | 0.00 [g] | 0.00 [g] |
| 1.10 | 21 | E2EM | 2,375 | 2,424 | 3.51 | 0.00 |
| 1.61 | 20 | PEM | 550 | 57 | 0.00 [h] | 0.00 |
| 1.75 | 19 | PEM | 200 | 3 | 0.00 [h] | 0.00 |
| 1.88 | 18 | PEM | 350 | 67 | 0.00 [h] | 0.00 |
| 2.38 | 17 | PEM | 15 | unknown | 0.00 [h] | 0.00 |
| 2.41 | 16 | PEM | 15 | 15 | 0.00 [h] | 0.00 |
| 2.95 | 15 | PEM | 525 | 60 | 0.10 | 0.00 |
| 3.04 | 14 | PEM/PFO | 1,775 | 1,785 | 2.24/1.18 | 0.00/1.12 |
| 3.46 | 13 | PEM/PFO | 3,100 | 3,096 | 3.26/2.06 | 0.00/1.24 |
| 4.35 | 25 | PFO | 15 | 16 | 0.03 | 0.02 |
| 4.39 | 8 | PEM | 70 | 62 | 0.11 | 0.00 |
| 4.42 | 0 | PFO | 170 | 165 | 0.23 | 0.17 |
| 4.65 | 1 | PEM/PFO | 85 | 75 | 0.11/0.06 | 0.00/0.00 |
| 4.77 | 2 | PEM/PFO | 90 | 70 | 0.10/0.03 | 0.00/0.00 |
| 4.82 | 3 | PEM | 50 | 51 | 0.08 | 0.00 |
| 4.83 | 4 | PEM | 15 | 15 | 0.03 | 0.00 |
| 4.84 | 5 | PEM | 15 | 15 | 0.03 | 0.00 |
| 4.87 | 6 | PEM/PFO | 565 | 562 | 0.61/0.19 | 0.00/0.00 |
| 4.99 | 7 | PEM | 130 | 79 | 0.17 | 0.00 |
| Temporary Extra Workspace | | | | | | |
| 0.00 | 28 | E2EM | NA | NA | 0.00 [i] | 0.00 |
| 1.10 | 21 | E2EM | NA | NA | 0.00 [i] | 0.00 |
| Contractor Yards and Support Areas | | | | | | |
| NA | 29 | PEM | NA | NA | 0.00 | 0.00 |
| NA | 30 | PEM | NA | NA | 0.00 | 0.00 |
| NA | 31 | PEM | NA | NA | 0.00 | 0.00 |
| NA | 32 | PSS | NA | NA | 0.00 | 0.00 |
| Pipeline Facilities Subtotal | | | | | 14.13 | 2.55 |
| Project Total | | | | | 19.96 | 7.43 |

TABLE 4.4.1-1 (cont'd)

**Wetlands Affected by Construction and Operation of the Proposed LNG Clean Energy Project**

| Facility/ Beginning Milepost | Wetland ID | Wetland Classification [a] | Crossing Length Workspace (feet) [b] | Crossing Length Centerline (feet) [c] | Temporary Construction Impact (acres) [d] | Permanent Operational Impact (acres) [e] |
|---|---|---|---|---|---|---|

[a] Cowardin Classification System:

E2EM = Estuarine intertidal emergent wetland (coastal brackish marsh)
PEM = Palustrine emergent wetland
PSS = Palustrine scrub-shrub wetland
PFO = Palustrine forested wetland

[b] Represents a measurement of any portion of the workspace that goes through the wetland.

[c] Represents the crossing length along the centerline of the pipeline.

[d] Temporary construction impacts consist of that portion of the LNG terminal site, pipeline construction right-of-way, and temporary extra workspaces that would be allowed to naturally revegetate following construction.

[e] Permanent operational impacts for the LNG terminal include the permanent loss of wetland within the footprint of the facility and the access road. Permanent operational impacts for the pipeline are based on the conversion of forested wetlands to emergent wetlands within the permanently maintained right-of-way. Lands used for temporary extra workspaces would be allowed to revert to prior condition following completion of construction.

[f] Wetland impacts previously accounted for in the U.S. Army Corps of Engineers mitigation plan for the Port of Pascagoula Special Management Area.

[g] The pipeline in this area would be constructed adjacent to the proposed permanent access road associated with the LNG terminal. The acres of wetlands affected by the proposed pipeline are included in the acreage calculations for the LNG terminal facilities.

[h] Significant ground disturbing activities would be avoided at these wetlands by use of the horizontal directional drill crossing method.

[i] Our Procedures require that temporary extra workspaces be located at least 50 feet from wetland boundaries; however, Gulf LNG is proposing to locate these temporary extra workspaces within wetlands and has requested variances from our Procedures to do so (see section 4.4.2). The acreage of wetlands affected by these temporary extra workspaces is included in the acreage calculations for the LNG terminal facilities (0.39 acre associated with wetland 28) and the pipeline facilities (0.43 acre associated with wetland 21).

NA Not applicable

#### 4.4.1.2 Pipeline and Associated Aboveground Facilities

Gulf LNG identified 23 wetlands along the natural gas sendout pipeline route, including 16 emergent wetlands (primarily freshwater herbaceous), 5 combination forested and emergent wetlands, and 2 forested wetlands. A large portion of these wetlands constitute low to medium quality habitat based on the presence of exotic species and evidence of previous human activity. Previous disturbance to these wetlands includes fire suppression activities and mowing as well as altering of the hydrology due to the construction of drainage ditches. Construction of the proposed pipeline facilities would have a temporary impact on 14.1 acres of wetlands, including 10.3 acres of emergent wetlands and 3.8 acres of forested wetlands. Of these, about 2.6 acres would be permanently affected by operation of the pipeline facilities. This would include the permanent conversion of 2.6 acres of forested wetlands to emergent wetlands within the permanently maintained right-of-way. All of the emergent wetlands would be allowed to revert to preconstruction conditions following construction.

**Temporary Extra Workspace**

Although our Procedures require that temporary extra workspaces be located at least 50 feet from wetland boundaries, Gulf LNG has identified two locations where temporary extra workspace is proposed to be located within wetlands. The use of these proposed temporary extra workspaces during construction would temporarily affect 0.8 acre of emergent wetlands (coastal brackish marsh). The wetland impacts resulting from these workspaces are included in the acreage presented in table 4.4.1-1 and do not represent additional impacts. See section 4.4.2 for a discussion of Gulf LNG's requested variances from our Procedures.

**Aboveground Facilities**

The aboveground facilities associated with the beginning of the natural gas sendout pipeline (i.e., pig launcher) would be located in a wetland area within the boundaries of the LNG terminal site. The acreage of disturbance associated with these facilities is included in the 3.3 acres of wetland impacts identified for the LNG terminal facility (see section 4.4.1.1). None of the other aboveground facilities associated with the proposed sendout pipeline would be located in wetland areas.

**Contractor Yards and Support Areas and Access Roads**

The proposed contractor yard and staging area at about MP 0.3 of the sendout pipeline route would be located adjacent to a coastal brackish marsh (wetland ID 28); however, only upland areas would be used in this location and Gulf LNG would maintain a 50-foot setback from the wetland. The proposed contractor yard and staging area located at the JCPA's General Cargo Terminal about 0.3 mile west of MP 2.0 is crossed by an existing railroad spur line where two ditches, one on either side of the railroad, are located. The area contains one scrub-shrub wetland and three emergent wetlands within its boundary. Gulf LNG has indicated that these wetlands are currently mowed and/or have been significantly altered by previous human activities. Gulf LNG has also indicated that these wetlands would not be directly affected during construction activities at the site. No wetlands would be affected by the contractor yard and staging area located at about MP 5.1 of the sendout pipeline route.

Temporary access roads to be used during construction of the proposed sendout pipeline would not affect any wetland areas.

### 4.4.2 Impact and Mitigation

Construction of the LNG Clean Energy Project would affect a total of about 20.0 acres of wetlands. Construction of the LNG terminal facilities would result in temporary impacts on 5.8 acres of wetlands. Permanent wetland impacts associated with the LNG terminal facilities would include the permanent loss of about 4.9 acres of emergent wetlands (coastal brackish marsh). Construction of the pipeline facilities would temporarily affect 14.1 acres of wetlands. Operation of the proposed pipeline facilities would result in the permanent conversion of about 2.6 acres of forested wetlands to emergent wetlands.

The impacts of project-related construction and operation activities on wetlands would vary depending on the timing of construction, construction techniques used, the sensitivity of the resources disturbed, and the length of time required for wetlands to be restored. Soil disturbance and removal of wetland vegetation within the project area could temporarily affect the capacity of wetlands to buffer flood flows and could increase the potential for erosion. Removal of wetland vegetation could also deprive wildlife of a valuable habitat component and encourage the recruitment of less desirable invasive species. Failure to properly segregate topsoil over the pipeline trench could result in the mixing of topsoil with subsoil, which could affect the success of post-construction reestablishment and natural recruitment of native wetland vegetation. Rutting of soils from construction equipment could result in soil mixing and a disruption of surface water flow, which could also affect the success of post-construction right-of-way restoration. Uncontrolled surface runoff from adjacent disturbed upland areas could transfer sediment into off-right-of-way wetlands. Construction equipment fuel and lubricant leaks and spills could also result in wetland contamination and some loss of wetland values/functions as wildlife habitat could be diminished during pipeline construction.

**General Wetland Construction and Mitigation Procedures**

In general, wetland impacts would be minimized by avoidance, mitigation of impacts, and compensation in accordance with federal, state, and local regulations.

Gulf LNG attempted to avoid and minimize impacts on wetlands during the siting and design of the proposed project facilities. As discussed in section 3.4.1, Gulf LNG evaluated different site configurations to avoid and minimize impacts on wetlands to the maximum extent possible. By utilizing an open-cell vertical dike wall design and modifying the initial terminal layout by shifting the terminal footprint to the west, Gulf LNG was able to reduce the total area of wetlands impacted by the LNG terminal site itself from 11 acres to 3.3 acres. As it leaves the LNG terminal site, the sendout pipeline would be located within the proposed LNG terminal access road right-of-way to minimize additional disturbance of wetlands. In addition, Gulf LNG would further avoid wetland impacts by limiting the width of the pipeline construction right-of-way to 75 feet in wetlands and locating temporary extra workspaces at least 50 feet back from most wetland boundaries, consistent with our Procedures.

Typical wetland construction methods are described in section 2.4.2.2. Gulf LNG would mitigate construction-related impacts by implementing our Procedures as discussed below and by complying with the MDMR/COE's section 404 and MDEQ's section 401 permit conditions. In order for the COE to determine whether practicable alternatives have been taken, Gulf LNG is required to avoid wetland impacts to the maximum extent possible. Gulf LNG must also demonstrate that it has taken appropriate and practicable steps to minimize wetland impacts in compliance with the COE's section 404(b)(1) guidelines that restrict discharges of dredged or fill material where a less environmentally damaging alternative exists. When unavoidable wetland impacts are proposed, the COE, MDMR, and MDEQ would require that all practicable actions be taken to mitigate those impacts. This is consistent with the

CEQ's *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act* (40 CFR Part 1508.20), which defines mitigation to include the following criteria:

- avoiding the impact altogether by not taking a certain action or parts of an action;
- minimizing impacts by limiting the degree or magnitude of the action and its implementation;
- rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
- reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and
- compensating for the impact by replacing or providing substitute resources or environments.

**FERC Staff's Wetland and Waterbody Construction and Mitigation Procedures**

To avoid or minimize impacts on wetlands, Gulf LNG would implement the wetland construction and restoration measures contained in our Procedures except where a site-specific variance has been requested and approved by the FERC (see discussion below). Among other measures these Procedures include the following requirements:

- Limit the width of the construction right-of-way to 75 feet, unless a wider right-of-way is requested on a site-specific basis and a variance is issued by the FERC.
- Locate temporary extra workspaces at least 50 feet back from wetland boundaries unless a reduced setback is requested on a site-specific basis and a variance is issued by the FERC.
- Construction equipment operating within the right-of-way would be limited to that equipment necessary for clearing, excavation, pipe installation, backfilling, and restoration activities. All nonessential equipment would use upland access roads to the maximum extent practicable.
- Equipment operating within saturated wetlands would be low-ground-weight equipment or would operate from prefabricated construction mats.
- Temporary erosion and sedimentation control measures would be installed immediately after the initial disturbance of wetland soils and would be inspected and maintained regularly until final stabilization.
- Sedimentation controls would be installed across the construction right-of-way, as needed, within wetlands to contain trench spoil.
- In unsaturated wetlands, the uppermost 12 inches of topsoil along the pipeline trench would be segregated from the underlying subsoil.
- Project-specific restoration plans would be developed based on consultations with appropriate land management or state agencies. The wetland restoration plan should include measures for re-establishing herbaceous and/or woody species, controlling the invasion and spread of undesirable exotic species, and measures for monitoring the success of the revegetation and weed control efforts.

**Requested Variances to the FERC Staff's Procedures**

In accordance with our Procedures, Gulf LNG submitted two requests for areas where locating temporary extra workspaces in wetlands would be necessary based on site-specific conditions. Table 4.4.2-1 summarizes the requests and FERC's evaluation of and recommendations for each request.

TABLE 4.4.2-1

**Variances Requested for Temporary Extra Workspaces Located Within Wetlands**

| Milepost | Wetland ID | Wetland Classification | Wetland Affected (acres) | Reason for Request | Approved or Denied |
|---|---|---|---|---|---|
| 0.0 | 28 | E2EM1P | 0.39 | Gulf LNG stated that the installation of pipeline facilities in this area requires temporary use of the wetland area for staging and movement of delivery trucks. | Approved [a] |
| 1.5 | 21 | E2EM1P | 0.43 | Gulf LNG is proposing a HDD in this area in order to minimize impacts on existing utilities and Chevron operations. A portion of the HDD entry point would be located in the wetland. | Approved [a] |

[a] Approval of these additional temporary workspaces does not relieve Gulf LNG from complying with other requirements of our Procedures. Erosion and sedimentation control devices should be monitored and maintained in these areas more frequently than the minimum time intervals required by our Procedures until final grading and revegetation has been completed.

As discussed in section 4.4.1.2, the proposed contractor yard and staging area located at the JCPA's General Cargo Terminal about 0.3 mile west of MP 2.0 contains one scrub-shrub wetland and three emergent wetlands within its boundary. Gulf LNG has indicated that these wetlands would not be directly affected during construction activities at the site. However, Gulf LNG has not provided a site-specific map or plan depicting the location of the proposed facility in relation to the wetlands. In addition, Gulf LNG has not committed to maintaining at least a 50-foot setback from the wetlands or, if a 50-foot setback cannot be maintained, has not requested a variance from our Procedures for activities within 50 feet of the wetland boundaries. Therefore, **we recommend that:**

- **Gulf LNG file a site-specific plan depicting the location of the proposed contractor yard and staging area located 0.3 mile west of MP 2.0 in relation to the wetlands located within the boundaries of the site. The site-specific plan should show how Gulf LNG would maintain a 50-foot setback from the wetlands or, if a 50-foot setback cannot be maintained, should include a request with justification for a variance from section VI.B.1.a of our Procedures. The site-specific plan should be filed with the Secretary for the review and written approval of the Director of OEP <u>before construction</u>.**

### 4.4.3 Compensatory Mitigation

The COE has a policy of "no net loss" of wetlands in the United States. This means that every wetland impact must be offset by the creation, restoration, enhancement, or preservation of at least an equal amount of wetlands, which is referred to as compensatory mitigation. Compensatory mitigation is considered once the regulatory agencies have evidence that the following steps have been carried out: 1) avoidance; 2) minimization; 3) rectification; and 4) reduction. Residual wetland impacts that are not or cannot be mitigated within the project area are accounted for using compensatory mitigation to ensure that there is a full replacement of both wetland area and functions.

Permanent impacts on about 2.6 acres of forested wetlands would occur as a result of vegetation removal during construction of the sendout pipeline and ongoing vegetation maintenance practices during operation of the pipeline. Gulf LNG would mitigate for these impacts through compensation using the Old Fort Bayou Mitigation Bank. The Old Fort Mitigation Bank consists of approximately 1,700 acres and is located about 20 miles northwest of the project site in Jackson County, Mississippi. According to the director of the mitigation bank, Gulf LNG would be able to buy credits to mitigate for impacts on forested wetlands at various ratios depending on the quality of the wetlands affected. Gulf LNG has indicated that because the mitigation site is located relatively far from the proposed project site and may not represent an exact replication of the project area vegetation, wildlife, water quality, and other features, it proposes to purchase mitigation credits for permanent impacts on forested wetlands at a 2:1 ratio.

Construction and operation of the LNG terminal and associated access road would result in the permanent conversion of 4.9 acres of emergent wetland (coastal brackish marsh) to an industrial use. According to Gulf LNG, impacts on wetlands 22, 23, and 24 were previously accounted for by the COE during development of the Port of Pascagoula Special Management Area (SMA). In addition, development of the SMA included necessary mitigation for the loss of these three wetlands. The mitigation for the loss of these three wetlands has already been completed. For these reasons, these wetlands are not included in the overall acreage of wetlands affected by the project and Gulf LNG is not proposing any specific mitigation for construction of the access road and sendout pipeline through these wetlands.

Final mitigation measures to ensure that there is no net loss of wetlands would be established under the terms of the Joint MDMR/COE section 404/10 permit. The mitigation ratio for permanent impacts on coastal marsh resources would be finalized based on the quality of the wetlands that would be affected by the project. As previously discussed, Gulf LNG conducted an HGM assessment of coastal brackish marsh wetlands affected by the project using a newly developed tidal wetlands HGM model for the north-central Gulf of Mexico. In general, the HGM approach determines the quality and impact of the affected wetlands and generates a number that quantifies the loss of function of the affected wetland. This functional loss number can then be used in the design of the mitigation plan to ensure that the functional loss is replaced. The details and results of the HGM assessment are included in Gulf LNG's draft Mitigation Plan (see Appendix F).

Gulf LNG developed its draft Mitigation Plan in consultation with the COE, MDMR, NMFS, and other applicable agencies. The plan includes details of Gulf LNG's proposal to convert an area of existing upland to coastal brackish marsh to compensate for permanent wetland impacts associated with the development of the LNG terminal and access road. The upland site consists of about 7.6 acres that are suitable for restoration. Details on how Gulf LNG proposes to convert this area are provided in Appendix F. Restoration of this new coastal wetland would also serve to mitigate for loss of the existing coastal brackish marsh's function as EFH (see section 4.6.4).

In the draft Mitigation Plan, Gulf LNG has also identified criteria that would be used to determine the success of the restoration effort (see Appendix F). Gulf LNG proposes to monitor the converted area at 1-year intervals for 5 years after completion of the restoration or until the success criteria are met, whichever occurs first. In the event that establishment of the created marsh is unsuccessful based on the proposed criteria, Gulf LNG would implement appropriate action to correct the deficiencies. Gulf LNG has indicated that it would prepare an annual report presenting data on the wetland restoration area for up to 5 years following completion of the restoration, or until the success criteria are met; however, Gulf LNG did not identify the specific agencies that would receive the annual report. Because Gulf LNG's draft Mitigation Plan has not been finalized and does not specify which agencies would receive the annual reports, **we recommend that:**

- **Gulf LNG continue to consult with the COE, MDMR, NMFS, and other applicable agencies to finalize its Mitigation Plan. The final Mitigation Plan should also specify that the annual report presenting data on the wetland restoration area be filed with the FERC, COE, MDMR, and NMFS. Gulf LNG should file the final Mitigation Plan with the Secretary <u>before construction</u>.**

## 4.5 VEGETATION

### 4.5.1 Habitat/Community Types

The LNG Clean Energy Project is located in a coastal setting where there are a variety of vegetation communities that transition from the marine environment of the Mississippi Sound through shoreline and estuarine areas along the coast to upland communities farther inland. Hurricane Katrina is likely to have had a short-term impact on upland vegetation communities in the project area. Salt stress associated with the storm surge may result in temporary die-off of some plant species but not to the extent that the communities mapped and characterized before the hurricane are invalid. For example, some of the woody species at the LNG terminal site exhibited yellowing and dead leaves in the weeks following Hurricane Katrina, but not entire loss from the site. It is expected that as rains provide freshwater and help to remove salt from the soil, plant regrowth will continue and/or new shoots will become established.

Analysis of the project area vegetation before the hurricane indicated the presence of three distinct upland vegetation community types. These community types include open, scrub-shrub, and forested uplands. As discussed in section 4.4, no submerged aquatic vegetation was identified in the immediate project area. The nearest seagrass beds to the proposed LNG terminal are located approximately 4 miles east just outside Point aux Chenes Bay. However, LNG ships would transit confined areas between the barrier islands and the mainland where submerged aquatic vegetation could be present. Beach dunes also exist on Petit Bois and Horn Islands along the LNG ship transit route. There were three wetland types identified within the project area: emergent (including coastal brackish marsh and freshwater), scrub-shrub, and forested wetlands. The wetland communities affected by the project are discussed in section 4.4. Intertidal mudflats also occur in the area of the proposed LNG terminal site; however, these mudflats are sparsely or non-vegetated.

Open uplands within the project area are primarily composed of herbaceous plant species and generally include existing utility rights-of-way and other former and active industrial lands. Open areas associated with the proposed project occur along the sendout pipeline route and consist of grasses such as dandelion (*Taraxacum officinale)*, goldenrod (*Solidago* spp.), ragweed (*Ambrosia artemisiifolia)*, and other hardy and disturbance-tolerant species.

Scrub-shrub uplands within the project area are generally characterized by cut-over woodlands or other areas altered by development. Dominant plant species in these areas include: wax myrtle (*Myrica cerifera)*, Chinese privet (*Ligustrum sinense)*, coastal pepper bush (*Clethra alnifolia),* immature slash pine (*Pinus elliottii),* Chinese tallow (*Tridica sebifera)*, cogongrass (*Imperata cylindrical)*, and groundsel tree (*Baccharis halimifolia).* Other vegetative species in these areas include spiny sowthistle (*Sonchus aster),* poisonbean (*Sesbania drummondii),* Carolina geranium (*Geranium carolinianum),* Hercule's club (*Zanthoxylum clava-herculis),* and Canada germander (*Teucrium canadense).*

Forested uplands within the project area are characterized by slash pine, loblolly pine (*P. taeda),* water oak (*Quercus nigra),* Chinese tallow tree, Chinese privet, wax myrtle, and cogongrass. A large portion of the forested uplands in the project area have been affected by road construction, industrial development, gas pipelines, and related activities that have occurred for over 50 years.

Submerged aquatic vegetation, or seagrass, occurs in relatively shallow coastal waters of the Mississippi Sound as a result of depth-limited penetration of sunlight associated with the relatively turbid waters of the coast. Seagrass occurs off the western shore of Petit Bois Island in open waters from 1 to 9 feet deep, typically in a sandy substrate with various amounts of shells and shell fragments (MDMR, 1998a). Seagrass beds commonly consist of turtle grass (*Thalassia testudinum*), shoal grass (*Halodule wrightii*), and manatee grass (*Syringodium filiforme*). Submerged vegetation near the mainland is

dominated by two species, widgeon grass (*Ruppia maritime*) and to a lesser extent tape grass (*Vallisneria americana*).

The beach dune community on both Petit Bois and Horn Islands consist of two distinct plant associations. The hardy pioneer plants colonize the foredune and are dominated by sea oats, which are able to survive both partial burial by sand and exposure of the root system when sand is blown away. The extensive root system of this plant aids in dune stabilization. On the protected lee side of the dune a large variety of plants occur, including beach grass, bunch grass, prickly-pear cactus, and golden aster (National Park Service, 2006).

#### 4.5.1.1 LNG Terminal Facilities

Construction of the proposed LNG terminal facilities would affect about 42.6 acres of vegetation. Specifically, construction would affect about 33.3 acres of land for the LNG terminal and about 9.3 acres of land for the permanent access road to the terminal. The vegetative communities present on the LNG terminal site can be characterized as scrub-shrub uplands and intertidal mudflats (30.0 acres total). Also present on the LNG terminal site are about 3.3 acres of coastal brackish marsh. Of the 9.3 acres of land that would be required for the permanent access road, 2.7 acres consist of scrub-shrub uplands and 6.6 acres consist of coastal brackish marsh. Of the 6.6 acres of wetlands affected by the proposed access road, Gulf LNG states that about 4.1 acres were previously accounted for in the COE's Mitigation Plan for the Port of Pascagoula SMA (see section 4.4.3).

Following construction, the entire 42.6 acres of land would be permanently converted to industrial use for operation of the LNG terminal facilities. Although operation of the LNG terminal facilities would permanently remove native vegetation, these impacts are not expected to be significant on a regional scale because areas with similar vegetation characteristics are found on surrounding lands. Wetland vegetation-related impacts and mitigation are discussed in sections 4.4.2 and 4.4.3. Additional information on the environmental impacts resulting from the transit of the LNG ships is provided in section 4.13.5.3.

Additional impacts on vegetation could occur as a result of construction and operation of the nonjurisdictional facilities associated with the LNG terminal (i.e., electric transmission facilities and water supply pipeline); however, the final route for these facilities has not been determined (see section 2.2).

#### 4.5.1.2 Pipeline and Associated Aboveground Facilities

Construction of the pipeline and associated aboveground facilities would affect about 82.4 acres of land. Of the 82.4 acres of land affected, about 68.3 acres would consist of upland vegetation and 14.1 acres would consist of wetland vegetation. Wetland vegetation-related impacts and mitigation are discussed in section 4.4.2. Of the 68.3 acres of upland vegetation, about 53.0 acres would consist of open uplands and/or industrial uses, 9.9 acres would consist of scrub-shrub uplands, and 5.4 acres would consist of forested uplands. Operation of the proposed pipeline facilities would require about 26.1 acres of vegetation be converted to permanently maintained pipeline right-of-way (24.9 acres) and aboveground facilities (1.2 acres).

During construction, existing vegetation including herbaceous, shrub, and tree species would be temporarily removed from within the pipeline construction right-of-way and other workspaces as necessary. In addition, trees would be permanently prevented from growing on the operational right-of-way. The impacts of clearing vegetation generally include the loss of habitat, habitat fragmentation, increased absorption of solar radiation into affected soils, and a greater potential for surface water

movement/erosion. Typically, impacts would be greatest in forest lands because they are more structurally complex than other vegetation types and generally take longer to become reestablished following construction.

To minimize impacts on vegetation, Gulf LNG has routed the proposed natural gas sendout pipeline so that it would be collocated with existing facilities to the maximum extent possible. Approximately 72 percent of the proposed sendout pipeline would parallel existing pipeline or road rights-of-way. In addition, Gulf LNG would restore the construction right-of-way in accordance with our Plan and Procedures. Implementation of the measures provided in our Plan and Procedures would minimize potential long-term impacts on vegetation by allowing annual maintenance of only a 10-foot-wide strip centered over the pipeline. Additionally, routine vegetation maintenance across the entire permanent right-of-way could occur only once every 3 years in uplands and would be restricted in wetlands to the periodic clearing of trees greater than 15 feet in height that are within 15 feet of the pipeline centerline. Therefore, we believe that impacts resulting from construction and operation of the proposed pipeline and aboveground facilities would not significantly affect vegetative resources.

### 4.5.2 Invasive Plant Species

Many locations throughout the proposed project area are known to contain exotic and invasive plant species (e.g., Chinese tallow). These species are defined as any species, including its seeds, spores, or other biological material capable of propagating that species, that is not native to the ecosystem and whose introduction does or is likely to cause economic or environmental harm. These species often take advantage of disturbed soil areas and can potentially out-compete native species, causing a permanent change in habitat type.

In accordance with our Procedures, Gulf LNG would be required to conduct post-construction monitoring for the first and second growing seasons in upland areas to evaluate the success of revegetation. As part of this monitoring program, Gulf LNG would be required to examine the right-of-way for the presence of invasive species. In non-agricultural upland areas, revegetation would be considered successful if the density and cover of non-nuisance species within the areas disturbed during construction are similar to the density and cover in adjacent undisturbed areas. Gulf LNG's stated adherence to our Plan and Procedures would significantly minimize the potential effects from invasive plant species associated with the proposed project.

## 4.6 WILDLIFE AND AQUATIC RESOURCES

### 4.6.1 Terrestrial Wildlife

The LNG Clean Energy Project is located in the Southern Coastal Plain region of the United States (EPA, 2005b). This biogeographic region encompasses much of the Gulf Coast and consists primarily of flat plains with numerous swamps, marshes, and lakes. The region supports numerous wildlife communities and can generally be divided into six terrestrial, wetland, and open water habitats in the project area. These habitats include open uplands, scrub-shrub and forested uplands, scrub-shrub and forested wetlands, emergent wetlands (including freshwater and coastal brackish marsh), intertidal mudflats, and open water. LNG ships would also transit confined areas between the barrier islands and the mainland where submerged aquatic vegetation and beach dunes could be present. The wildlife and aquatic resources associated with submerged aquatic vegetation is discussed in section 4.6.2.1. Additional information on the environmental impacts resulting from the transit of the LNG ships is provided in section 4.13.5.3.

**Open Uplands**

Open areas within the project area provide relatively limited cover and foraging habitat. These areas tend to have relatively low species diversity but they are occasionally used by wildlife such as rock dove (*Columba livia*), mourning dove (*Zenaida macroura*), house sparrow (*Passer domesticus*), Norway rat (*Rattus norvegicus*), raccoon (*Procyon lotor*), and opossum (*Didelphis marsupialis*).

**Scrub-shrub and Forested Uplands**

Scrub-shrub and forested uplands within the project area typically consist of mixed pine-hardwoods forests and harvested woodlands, or habitats altered by development. Reptilian and amphibian species that are likely to be found in this community include tree frogs (*Hyla* spp.), southern toad (*Bufo terrestris*), various salamanders (*Ambystoma* spp.), black racer (*Coluber constrictor*), gray rat snake (*Elaphe obsoleta*), eastern diamondback rattlesnake (*Crotalus adamanteus*), ground skink (*Scincella laterale*), and eastern box turtle (*Terrapene carolina*).

Birds that likely occur in forested and harvested woodlands within the project area include the house sparrow, mockingbird (*Mimus polyglottus*), cardinal (*Cardinalis cardinalis*), brown thrasher (*Toxostoma rufum*), vireos (*Vireo* spp.), Carolina wren (*Thryothorus lucovicianus*), bob-white quail (*Colinus virginianus*), and blue jay (*Cyanocitta cristata*). Mammals present include the white-tailed deer (*Odocoileus virginianus*), bobcat (*Lynx rufus*), raccoon, cotton rat (*Sigmodon hispidus*), harvest mouse (*Reithrodontomys humulis*), cottontail rabbit (*Sylvilagus floridanu*), opossum, and gray fox (*Urocyon cinereoargenteus*).

**Scrub-shrub and Forested Wetlands**

Several small, low- to medium-quality palustrine scrub-shrub and forested wetlands occur in the project area (see section 4.4.1). The natural hydrology of these communities has been altered by the construction of drainage canals. Fire suppression practices have also altered the vegetative structure and vegetative composition of these wetlands. These wetlands provide habitat for species of reptiles and amphibians such as the water moccasin (*Agkistrodon piscivorus*), water snake (*Nerodia* spp.), green anole (*Anolis carolinensis*), skink (*Eumeces* spp.), leopard frog (*Rana pipens*), and amphiuma (*Amphiuma means*). Bird species present include swamp sparrow (*Melospiza georgiana*), yellow-throat (*Geothlypis trichas*), prothonotary warbler (*Protonotaria citrea*), and eastern towhee (*Pipilo erythrophthalmus*). Mammal species present in scrub-shrub and forested wetland habitats within the project area include raccoon, swamp rabbit (*Sylvilagus aquaticus*), gray squirrel (*Sciurus carolinensis*), opossum, and bobcat.

**Emergent Wetlands**

Emergent wetlands in the project area consist of fresh, intermediate, and brackish marsh. Salinity is the primary factor in determining the species composition of emergent wetland communities, with species diversity decreasing with an increase in salinity. Salt concentrations are dependent on rainfall, river discharge, and tidal flows. Amphibians and reptiles are relatively abundant in emergent wetlands and may include the green tree frog (*Hyla cinerea*), southern leopard frog (*Rana sphenocephala*), bullfrog (*Rana catesbiana*), Mississippi diamond-back terrapin (*Malaclemys terrapin pileata*), American alligator (*Alligator mississippiensis*), Gulf salt marsh snake (*Nerodia clarkii clarkii*), and the water moccasin.

Bird species found in emergent wetlands in the project area may include the great blue heron (*Ardea herodias*), great egret (*Ardea alba*), tricolored heron (*Egretta tricolor*), black-crowned night heron (*Nycticorax nycticorax*), clapper rail (*Rallus longirostris*), purple gallinule (*Porphyrula martinica*), belted kingfisher (*Megaceryle alcyon*), marsh hawk (*Circus cyaneus*), and a variety of wintering ducks. Mammals present may include the muskrat (*Ondatra zibethicus*), mink (*Mustela vison*), raccoon, opossum, cotton rat, and the non-native nutria (*Myocastor coypus*).

**Intertidal Mudflats**

Intertidal mudflats are the predominant habitat in the area of the proposed LNG terminal site. These mudflats are sparsely or non-vegetated, inhabited by a wide variety of invertebrates, and adjacent to high quality marsh habitat. These characteristics provide foraging and resting habitats that are used by various migratory and resident species of birds throughout the year. A survey conducted by Gulf LNG in March 2005 identified over 50 bird species along the intertidal mudflats in the project area, including terns (*Sterna* spp.), sandpipers (*Calidris* spp.), herons, ducks, raptors, and a variety of songbirds (Barry A. Vittor and Associates, Inc., 2005a).

**Open Water**

Open water habitats associated with the LNG Clean Energy Project include the waters of the Bayou Casotte Channel bordering the site on the west and the Mississippi Sound. These waters provide habitat during the summer breeding season to many species of gulls and terns. Open waters of the Mississippi Sound and Bayou Casotte provide wintering habitat for a wide variety of bird species, including the federally endangered brown pelican (*Pelecanus occidentalis*), American white pelican (*Pelecanus erythrorhynchos*), loons (*Gavia* spp.), grebes (*Podiceps* spp.), and ducks. Bottlenose dolphins (*Tursiops truncatus*) and Atlantic spotted dolphins (*Stenella frontalis*) may also occasionally occur in the project area and along the proposed LNG ship route (see section 4.7.2).

**Beach Dunes**

Beach dunes occur on Petit Bois and Horn Islands along the LNG ship transit route associated with the proposed project. Beach dunes provide foraging and resting habitats for various migratory and resident species of birds throughout the year, including great blue heron, gulls, terns, and osprey (*Pandion haliaetus*). In addition, marsh rabbit (*Sylvilagus palustrus*), cottontail rabbit, Norway rat, black rat (*Rattus rattus*), river otter (*Lutra canadensis*), and raccoon occur in beach dune habitat.

#### 4.6.1.1 Unique or Sensitive Wildlife Habitats

The Grand Bay Reserve, which contains at least 12 natural communities and 57 species listed as rare or imperiled by the Mississippi Natural Heritage Program (MNHP), is located in the vicinity of the proposed project (see section 4.8.3). The Grand Bay Reserve provides habitat to a variety of reptiles, including one of the largest known populations of the Gulf marsh snake (MDMR, 1998b; MDMR,

2005a). In addition, the reserve supports a diverse array of birds, including overwintering grounds for waterfowl, marsh birds, wading birds, and shorebirds; foraging grounds for the brown pelican; and nesting habitat for osprey. Mammals inhabiting the Grand Bay Reserve include the river otter and muskrat.

The LNG terminal site is located about 0.5 mile west of the Grand Bay Reserve. The sendout pipeline route would pass through about 0.5 mile of the reserve between MPs 1.1 and 1.6. The portion of the Grand Bay Reserve that the pipeline would cross is owned by Jackson County and is within an existing Mississippi Department of Transportation (MDOT) utility right-of-way (Clark, 2005). Although direct impacts on lands managed by the Grand Bay Reserve are not expected, the FWS expressed concern over potential project impacts on unique, rare, and imperiled species known to occur within the reserve. Gulf LNG has not proposed any specific measures to account for potential impacts on these species. Therefore, in order to avoid or minimize potential impacts on rare species within the Grand Bay Reserve, **we recommend that:**

- **Gulf LNG consult with the Grand Bay Reserve biologist to determine the need for developing site-specific measures that would avoid or minimize impacts on unique, rare, and imperiled species within the reserve. Additionally, Gulf LNG should consult with the biologist to assess the potential for hazards or conflicts between construction activities and scheduled seasonal burns on the reserve. Results of consultations should be filed with the Secretary <u>before beginning construction of the pipeline within the reserve</u>.**

The LNG terminal would also be located in the Tenneco/Chevron Management Unit within the Bayou Casotte-Bangs Lake Planning Area. Planning and management goals for this area include the protection of a 25-acre wetland that is located to the south and east of the proposed LNG terminal site. Gulf LNG is coordinating with the MDMR and the COE regarding the specific limits of the protection area and any potential mitigation measures required. Additional information on this management and planning area is presented in section 4.8.3.

#### 4.6.1.2 Potential Project Impacts on Terrestrial Wildlife

The impact of construction and operation of the proposed project on terrestrial wildlife and wildlife habitats would vary depending on the timing of construction and types of construction techniques used, as well as on the requirements of each species and the habitat present where various project components would be constructed. Some smaller, less mobile wildlife, such as small mammals, amphibians and reptiles, could be stressed, injured, or killed by construction activities. Other wildlife, such as birds and larger mammals, would likely leave the immediate area when construction activities approach and move to similar habitats nearby. These moves may increase competition for limited resources between individuals in nearby habitats for a short period after construction. In general, impacts on terrestrial wildlife would be short term and minimal because much of the area affected by construction would be allowed to revert to the preconstruction habitat type following construction. Wildlife habitat would be permanently altered due to construction of the LNG terminal.

**LNG Terminal Facilities**

Construction and operation of the LNG terminal facilities would affect 42.6 acres of terrestrial wildlife habitat, including 33.3 acres for the LNG terminal and 9.3 acres for the permanent access road to the terminal. Construction of the LNG terminal would affect about 30.0 acres of scrub-shrub uplands and intertidal mudflats. The LNG terminal site also consists of approximately 3.3 acres of emergent wetland (coastal brackish marsh). Of the 9.3 acres of land required for the permanent access road, 2.7 acres

consists of scrub-shrub uplands and 6.6 acres consists of emergent wetland (coastal brackish marsh). Additional impacts on wildlife habitat could occur as a result of construction and operation of the nonjurisdictional facilities associated with the LNG terminal (i.e., electric transmission facilities and water supply pipeline); however, the final route for these facilities has not been determined (see section 2.2).

Habitat within the 42.6-acre footprint of the LNG terminal would be permanently lost to wildlife. Some smaller, less mobile wildlife, such as small mammals, amphibians, and reptiles, would likely experience direct mortality during clearing and grading activities. Other wildlife, such as birds and larger mammals, would likely leave the immediate construction area when construction activities approach, perhaps relocating to the Grand Bay Reserve, which would provide similar and ample habitat to the east of the project area. Gulf LNG would mitigate for the permanent loss of coastal brackish marsh associated with the LNG terminal facilities through compensatory replacement of habitat at a ratio established under the Joint MDMR/COE section 404/10 permit (see section 4.4.3).

Operation of the project would increase the overall large-vessel traffic in Bayou Casotte and involve frequent berthing of large ships at the LNG terminal. Shore and wading birds can be startled by the noise of large or rapidly approaching ships and boats. However, such activities are already common in the vicinity of the project; therefore, a significant impact due solely to the proposed project is not expected. Additional information on the environmental impacts resulting from the transit of the LNG ships is provided in section 4.13.5.3.

The proposed LNG terminal site is located along a route that is followed by various migratory birds as they move between northern breeding grounds and southern wintering grounds. As such, migrating birds could encounter the LNG terminal immediately before or just after crossing the Gulf of Mexico. Many of the birds that cross the Gulf of Mexico are nocturnal migrants. In some cases, these species can be disoriented and fly off course because of the bright lights on buildings, towers, lighthouses, and boats (Evans and Rosenberg, 1999). During an interagency scoping meeting for the project, the FWS expressed concerns that migratory birds could be adversely impacted by lighting at the LNG terminal. To address this issue, Gulf LNG committed to coordinate with the appropriate state agencies to discuss lighting design options and diversion techniques. Based on further consultations with the FWS, **we recommend that:**

- **Gulf LNG develop a lighting plan consistent with the lighting guidelines developed by the FWS for siting, construction, operation, and decommissioning of communication towers, to the extent that those guidelines are consistent with applicable safety regulations and requirements. Gulf LNG should file the lighting plan with the Secretary for the review and written approval of the Director of OEP <u>before construction</u>.**

**Pipeline and Associated Aboveground Facilities**

Construction of the proposed pipeline facilities, including temporary extra workspaces, contractor yards and support areas, and aboveground facilities, would affect about 82.4 acres of upland and wetland vegetation habitats. Following construction, temporary work areas and non-forested portions of the permanent pipeline right-of-way would be allowed to revert to preconstruction conditions. Portions of the permanent right-of-way in upland forests and forested wetlands would be maintained in an herbaceous state in accordance with our Plan and Procedures to facilitate leak surveys. Because most of the pipeline construction areas would revert to preconstruction conditions, impacts on most wildlife habitat would be temporary and short term. Long-term impacts would be limited to upland forests and forested wetlands, which, even where not maintained as herbaceous, would take many years to become re-established.

To minimize impacts on wildlife, the affected areas would be revegetated and maintained according to our Plan and Procedures. Our Plan does not allow routine vegetative maintenance to occur more frequently than every 3 years, except along a 10-foot-wide herbaceous corridor centered on the pipeline that can be maintained annually. The Plan also prohibits vegetative clearing between April 15th and August 1st along the permanent easement, which prevents disturbance of ground-nesting birds. Impacts on wildlife habitat would be further minimized by the collocation of approximately 72 percent of the proposed route within existing pipeline or road rights-of-way.

As previously discussed, the sendout pipeline would be located within the Grand Bay Reserve between about MPs 1.1 and 1.6; however, the land in this area is owned by Jackson County and is within an existing MDOT right-of-way. Nonetheless, we have recommended that Gulf LNG consult with the Grand Bay Reserve biologist to determine the need for developing site-specific measures that would avoid or minimize impacts on unique, rare, and imperiled species within the reserve (see section 4.6.1.1).

### 4.6.2 Estuarine/Marine Resources

The proposed LNG Clean Energy Project is located near the mouth of Bayou Casotte on the Mississippi Sound. Separated from the Gulf of Mexico by a line of barrier islands, the Mississippi Sound acts as a mixing basin for freshwater discharge from rivers and seawater entering through barrier island passes (GMFMC, 1998). Salinity within the sound fluctuates seasonally, but positive salinity gradients generally exist from the mainland seaward and from the water surface to the bottom (GMFMC, 1998). Fish communities occupying these nearshore areas consist of species found in both estuarine and offshore marine habitats. Distribution and abundance of fish species and communities within these habitats vary greatly with time and place, depending on factors such as temperature, salinity, and predictable cycles directly related to reproduction.

Life histories of many fish species in the Gulf of Mexico can be characterized as estuarine-dependent. These species typically spawn in the Gulf, allowing their larvae to be carried inshore by currents. Juvenile fish generally remain in these estuarine nurseries for about a year, taking advantage of the greater availability of food and protection that estuarine habitats afford. Upon reaching maturity, estuarine fish either remain in the estuary, migrate to sea to spawn (returning to the estuary between spawnings), or migrate from the shallow estuaries to spend the rest of their lives in deeper offshore waters. Non-estuarine fish, including coastal pelagic marine fish and freshwater fish, will also forage in estuaries when conditions are favorable.

#### 4.6.2.1 Existing Conditions

The following sections discuss the biological resources associated with estuarine/marine habitats, fisheries of special concern, and existing commercial and recreational fisheries.

**Estuarine/Marine Habitats**

The portion of the Mississippi Sound in the vicinity of the LNG Clean Energy Project and along the LNG ship transit route currently supports six nearshore habitats: marine water column, estuarine water column, softbottom communities, submerged aquatic vegetation, oyster reefs, and coastal marshes.

Marine Water Column

The north-central Gulf of Mexico includes waters offshore of Mississippi over the Mississippi-Alabama shelf, immediately seaward of the barrier islands, including Horn Island and Petit Bois Island south of the proposed project area. Water depths range from less than 100 feet in nearshore areas to

nearly 11,000 feet in the central Gulf of Mexico. Marine species inhabiting the water column occasionally enter the estuarine waters of the project area to forage. Common marine species off the coast of Mississippi include Spanish mackerel (*Scomberomorus maculatus*), red snapper (*Lutjanus campechanus*), silver seatrout (*Cynoscion nothus*), harvestfish (*Peprilus alepidotus*), butterfish (*Peprilus bui),* bluefish (*Pomatomus saltatrix*), cobia (*Rachycentron canadum*), groupers (*Epinephelus itajara* and *E. morio*), lane snapper (*Lutjanus syangris*), striped mullet (*Mugil cephalus*), scalloped hammerhead shark (*Sphyrna lewini*), blacktip shark (*Carcharhinus limbatus*), tiger shark (*Galeocerdo cuvieri*), bonnethead shark (*Sphyrna tiburo*), and Atlantic sharpnose shark (*Rhizoprionodon terraenovae*).

Estuarine Water Column

The proposed LNG terminal site is located on the Mississippi Sound, an area that is separated from the open waters of the Gulf of Mexico by a series of narrow islands and sandbars. With an average depth of 6 feet during mean low water, the shallow water column of the Mississippi Sound provides a variety of aquatic species with habitat for spawning, breeding, feeding, growth, and shelter. Common Mississippi Sound fish species that spend their entire lives in estuaries (true-estuarine species) include the killifishes (*Fundulus* spp. and *Cyprinodon* spp.) and livebearers (*Gambusia affinis* and *Poecilia latipinna*). True-estuarine species with lower occurrence include silversides (such as *Menidia beryllina*), striped mullet (*Mugil cephalus*), and ladyfish (*Elops saurus*). Larger fish species known to utilize estuarine habitat to forage on the above species include the southern flounder (*Paralichthys lethostigma*), spotted seatrout (*Cynoscion nebulosus*), sand seatrout (*C. arenarius*), and red drum (*Sciaenops ocellatus*). Pelagic estuarine fish species include the bay anchovy (*Anchoa mitchilli*), menhaden (*Brevooritia patronus*), striped anchovy (*Anchoa hepasetus*), butterfish (*Peprilus burti*), threadfin fish (*Dorosoma petenense*), bumper (*Chloroscombrus chrysurus*), mackerel (*Scomberomorus maculates*), and bluefish (*Pomatomus saltatrix*).

Softbottom Communities

Softbottom communities associated with the LNG terminal site include unvegetated submerged (subtidal) areas and intertidal mudflats. Benthic invertebrates are typically divided into three classes based on increasing size: microbenthos, meiobenthos, and macrobenthos. Microbenthos include bacteria, yeasts, fungi, microalgae (diatoms and flagellates), and protozoans. Microbenthos are largely decomposers and one of the most important components of the benthic community of the Mississippi Sound because they form a major link between primary producers and higher trophic level consumers. The meiobenthic community typically consists of permanent residents, such as nematodes, harpacticoid copepods, gastrotrichs, and kinorhynchs. Macrobenthic species includes adult stages of clams, polychaete worms, snails, and crabs. Submerged softbottom communities that occur throughout the Mississippi Sound undergo and are adapted to frequent disturbance due to shipping traffic, storms, trawling, and dredging operations. Recolonization by benthic species is rapid.

Fish species associated with submerged softbottom communities include the Atlantic croaker (*Micropogonias undulates),* spot (*Leiostomus xanthurus*), sand seatrout, sea catfish (*Arius felis*), silver perch (*Bairdiella chrysura*), hogchoker (*Trinectes maculatus*), and puffer (*Sphoeroides parvus).*

Intertidal mudflats in the vicinity of the LNG terminal are composed of unconsolidated organic and mud deposits that are controlled by currents, wave action, and tides. The top few centimeters of mudflats support an enormous macrobenthic population dominated by polychaetes, mollusks, and crustaceans. In addition, substrates include large numbers of microbenthic and meiobenthic communities, including bacteria, diatoms, nematodes, copepods, and amphipods.

In February and May 2005, a benthic habitat and macroinfaunal assemblage characterization study was performed for Gulf LNG (Barry A. Vittor and Associates, Inc. and TRC Environmental Corporation, 2005). A series of petite ponar grab samples was taken in the vicinity of the LNG terminal in waters less than 8 feet deep. The dominant taxa collected was composed of opportunistic burrowing deposit feeders such as the polychaetes *Mediomastus* (LPIL) and *Hetermastus filiformus*, the bivalve *Gemma gemma*, and the gastropod *Acteocina conaliculata.* The study indicated that species composition in the vicinity of the LNG terminal is similar to other shallow water areas of the Mississippi Sound.

Submerged Aquatic Vegetation

Submerged aquatic vegetation occurs in the relatively shallow coastal waters of the Mississippi Sound. Areas of submerged and emergent vegetation are an integral part of the estuarine system. Typical motile benthic species utilizing seagrass habitat includes gastropods such as the convex slippershell (*Crepidula convexa*). Submerged and emergent vegetation serve as nursery grounds for larvae, postlarvae, and juvenile estuarine-dependent species. In addition to providing habitat for juvenile fish, aquatic vegetation and its associated epiphytic and benthic fauna and flora provide shelter and food for small residents, such as bay scallops (*Argopecten irradians*), gray snapper (*Lutjanus griseus*), black drum (*Pogonias cromis*), and code goby (*Gobiosoma robustum*) (Nelson, 1992). Due to this concentration of forage fish and invertebrates, areas of submerged aquatic vegetation also serve as important feeding grounds for larger predatory species. Such predatory species include the spotted seatrout, red drum, southern flounder, spot, and various sharks and rays. In addition, green sea turtles (*Chelonia mydas*) and Kemp's ridley sea turtles (*Lepidochelys kempii*) are known to occur in seagrass beds. As discussed in section 4.4, the nearest seagrass beds to the proposed LNG terminal are located about 4 miles east of the project area just outside Point aux Chenes. However, submerged aquatic vegetation occurs in the shallow waters off of Petit Bois Island along the LNG ship transit route.

Oyster Reefs

Oyster reefs are located in the nearshore waters of the Mississippi Sound. These reefs provide habitat for a variety of invertebrate and fish species, and play an important role in water filtration of the Mississippi Sound. The nearest oyster reefs to the proposed project are located 1.8 miles to the northeast in Bangs Lake. An additional oyster reef is located in the mouth of the Pascagoula River about 5.4 miles west of the project area. The dominant species within nearby oyster reefs is the American oyster (*Crassostera virginica*). Other species found in the oyster reefs of the Mississippi Sound include at least six species of crab, black drum, Gulf toadfish (*Opsanus beta*), balanoid barnacles (*Balanus* spp.), mussels (*Brachidontes* spp.), burrowing clams (*Diplothrya smithii*), and polychates.

Coastal Marshes

Coastal marsh habitats form a band of vegetation that line the fringe of the proposed project area. Coastal marshes are tidally influenced and typically have salinities that range from 2 to 15 ppt, while freshwater marshes rarely exceed salinities of 1 ppt. Coastal wetland soils are typically saturated and are composed of fine to medium grained sediment, overlain with a layer of organic detritus or peat. Within the Mississippi Sound, coastal marsh is most abundant in the Pascagoula area, covering about 13,340 acres (GMFMC, 1998).

Benthic substrates within coastal marshes provide important foraging habitats for fish and larger benthic species. Benthic meiofauna known to inhabit these marshes include nematodes, harpacticoid copepods, kinorhynchs, ostracods, small polychaetes, and some insect larvae. Macroepifauna include bivalve species such as the ribbed mussel (*Modiolus demissus)*, American oyster, hooked mussel (*Branchidontes recurvus*), Gray-common rangia *(Rangia cuneata)*, and little surf clam (*Mulinia lateralis*).

Typical gastropods include the river snail (*Neritina reclivata)*, marsh periwinkle (*Littorina irrorata*), and salt marsh snail (*Melampus bidentata)*. Crustaceans include mysid shrimp (*Mysidopsis almyra*), mud crab (*Panopeus herbstii)*, Harris mud crab (*Rithropanopeus harrisii)*, heavy marsh crab (*Sesarma reticulatum*), stone crab, and lesser blue crab (*Callinectes similis*).

Fish species commonly found in tidal marshes include the striped mullet, menhaden, sheepshead minnow (*Cyprinodon variegatus*), bay anchovy, bayou killifish (*Fundulus pulverous*), inland silverside (*Menidia beryllina*), chain pipefish (*Syngnathus louisianae*), spotted seatrout, black drum, red drum, and code goby (*Gobiosoma robustum*).

**Fisheries of Special Concern**

Fish species of special concern that occur in the vicinity of the proposed project include state and federally listed threatened and endangered species, those with EFH designations in the Mississippi Sound estuary, and those of commercial and recreational value. Threatened and endangered fish species are discussed in section 4.7.1.4. Species having EFH designations are discussed in section 4.6.4. Commercial and recreational fish species are discussed below.

**Commercial and Recreational Fisheries**

The fishery resources found within the project area can be classified as warmwater marine, warmwater estuarine, and warmwater fresh (freshwater areas are limited to the sendout pipeline route) (see section 4.6.3). The commercial and recreational fishery industries of coastal Mississippi reflect the economic, aesthetic, and recreational value of the estuarine and nearby Gulf of Mexico waters. Most of the commercially and recreationally important species of the northern Gulf of Mexico depend, to some extent, on estuarine habitats and tend to dominate these habitats in terms of numbers and biomass. Table 4.6.2-1 provides a list of representative commercial and recreational fish and shellfish species known to occur in coastal Mississippi waters.

TABLE 4.6.2-1

**Representative Recreational and Commercial Fish and Shellfish Species Known to Occur in Coastal Mississippi Waters**

| Common Name | Scientific Name | Fishery Classification |
|---|---|---|
| Brown shrimp | *Farfantepenaeus aztecus* | Warmwater marine/estuarine |
| Pink shrimp | *Farfantepenaeus duorarum* | Warmwater marine/estuarine |
| White shrimp | *Litopenaeus setiferus* | Warmwater marine/estuarine |
| American oyster | *Crassostrea virginica* | Warmwater marine/estuarine |
| Blue crab | *Callinectes sapidus* | Warmwater estuarine |
| Atlantic croaker | *Micropogonias undulatus* | Warmwater marine/estuarine |
| Black drum | *Pogonias cromis* | Warmwater marine/estuarine |
| Bluefish | *Pomatomus saltatrix* | Warmwater marine/estuarine |
| Gulf menhaden | *Brevoortia patronus* | Warmwater marine/estuarine |
| Sand seatrout | *Cynoscion arenarius* | Warmwater estuarine |
| Southern flounder | *Paralichthys lethostigma* | Warmwater marine/estuarine |
| Southern kingfish | *Menticirrhus americanus* | Warmwater marine/estuarine |
| Spanish mackerel | *Scomberomorus maculatus* | Warmwater marine |
| Spotted seatrout | *Cynoscion nebulosus* | Warmwater estuarine |
| Spot | *Leiostomus xanthurus* | Warmwater marine/estuarine |
| Striped mullet | *Mugil cephalus* | Warmwater marine |
| Red drum | *Sciaenops ocellatus* | Warmwater marine/estuarine |

The major fisheries in Mississippi include brown shrimp, white shrimp, pink shrimp, blue crab, American oyster, and finfish. The project site includes suitable habitat for all of the above-mentioned species. The brown shrimp and white shrimp have designated EFH in the project area. Additional information on species with designated EFH in the project area is provided in section 4.6.4.

#### 4.6.2.2 Impact and Mitigation

Construction and operation of the proposed project would have both short-term and permanent impacts on the estuarine/marine habitats present in areas disturbed by project activities.

**Construction**

Activities associated with construction of the project facilities, including dredging, pile installation, and accidental spills or leaks of hazardous materials could directly and indirectly impact estuarine/marine organisms. Potential impacts on these organisms include habitat alteration, increased turbidity, resuspension of contaminated sediments into the water column, accidental takes, and increased noise.

Dredging

As discussed in section 2.4.1.3, dredging associated with the construction of the proposed ship berth and maneuvering area would temporarily impact about 61.3 acres of open water habitat. This area would be dredged to and maintained at -42 feet MLLW to match the depth of the adjacent Bayou Casotte Channel and would include an additional 2 feet for advance maintenance dredging and up to 2 feet of potential overdredge allowance. Dredging would be conducted 24 hours a day, 7 days per week and would require about 9 months to complete.

*Habitat Alteration* - Dredging of the ship berth and maneuvering area would result in the permanent conversion of 61.3 acres of shallow softbottom habitats (primarily sandy sediments) to deeper softbottom habitats (primarily silty-sand sediments). Many of the aquatic species that currently inhabit shallow water habitat in the project area also inhabit the deeper water of the adjacent Bayou Casotte Channel. Although dredging activity would take the current benthic population of organisms living within the sediments, these species recolonize relatively quickly, and are not likely to be negatively affected by the alteration in habitat. Aquatic species that prefer the shallow water habitat would experience a loss of habitat due to dredging; however, the large amount of similar habitat in the vicinity of the project area would provide ample habitat for individuals displaced by construction activities. To further assess project impacts, the MDMR requested that Gulf LNG conduct trawl and benthic sampling before and after dredging activities.

The benthic community in the ship berth and maneuvering area is dominated by macroinfuanal species that are known colonizers (e.g., the polychaete *Mediomastus* spp. and the bivalve *Gemma gemma*). These opportunistic species are highly dominant in number, comprising over 60 percent of all benthic macroinfauna. Soft bottom benthic communities experience obvious changes following dredging activities. Within the first few days following completion of dredging operations, the benthic community can be as much as 80 percent reduced in species richness and up to 90 percent reduced in species abundance and biomass (Desprez, 2000). However, these effects are not long lasting, as polychaetes, oligochaetes, and other similar species begin to quickly recolonize the disturbed area. Through natural processes and their rapid population growth, these opportunistic species take advantage of the unoccupied space created in the newly exposed sediments, paving the way for later succession species.

The Minerals Management Service (MMS) has performed a number of studies of dredging effects and recolonization, some associated with offshore sand mining operations. In one of the studies, species abundance, biomass, and richness declined immediately after dredging but recovered quickly, and by the following spring (within 9 to 12 months of the end of dredging), no detectable differences were found between the dredged and undisturbed areas (Hammer et al., 2005). Abundance also recovered quickly after a second dredging operation, although biomass and richness remained reduced the next spring.

In addition to infauna, dredging can affect epifauna, and in one study using trawls off Duval County Florida, the number of taxa and individuals greatly exceeded control areas 4 months after dredging and remained higher for up to 7 to 13 months (Applied Biology, Inc., 1979). In another study, no differences in pre- and post-dredging epifaunal communities were observed at 8 and 16 months post-dredging at a borrow site off Egmont Key in Florida (Blake et al., 1996).

Although the findings of individual studies of the recolonization of benthic communities following dredging vary, substantial recovery generally occurred in less than 1 year and complete recovery occurred within time frames shorter than 3 years. The studies referenced above found that initial recolonization of dredged areas would commence in a matter of days or weeks, and that these areas would become functional benthic communities similar to pre-dredge conditions or to adjacent reference locations in approximately 12 to 18 months. However, later successional stages of benthic recolonization would be more gradual. Based on our review of these studies, it is likely that these processes would also occur in the Pascagoula area of the Mississippi Sound following dredging.

Gulf LNG has developed a Mitigation Plan and a Monitoring Plan, in consultation with the NMFS, MDMR, NMFS, and other applicable agencies to address habitat alteration associated with dredging and dredge material placement activities (see Appendices F and E, respectively). Gulf LNG proposes to conduct beach seine and trawling studies and a Gulf sturgeon habitat assessment survey as part of its Monitoring Plan (see Appendix E). Beach seine and trawling studies would be conducted in the berthing area and at reference stations both before construction and quarterly for a 1-year period following construction to evaluate fishery resources in the project area. In addition, Gulf LNG would conduct a quantitative evaluation of bottom sediments, water quality, and the community composition of benthic invertebrates as part of the 3-year post-construction habitat assessment survey. This information would be compared to the pre-construction Gulf sturgeon habitat assessment survey in order to provide information on the benthic community recovery both as it relates to the Gulf sturgeon and to the general biota of this portion of the Mississippi Sound.

In its Monitoring Plan, Gulf LNG also indicated that annual reports would be prepared presenting the results of monitoring efforts and that these reports would be provided to the COE, EPA, MDMR, and NMFS; however, Gulf LNG did not specify that these annual reports would be provided to the FERC. Gulf LNG has agreed to revise its Monitoring Plan to specify that the annual reports presenting the results of the monitoring efforts be filed with the FERC. Gulf LNG has committed to filing the revised Monitoring Plan with the Secretary before construction.

*Increased Sedimentation and Turbidity* - Increased turbidity from dredging activities could have a range of physiological and behavioral effects on fish. Physiological effects include gill trauma, failure to osmoregulate, and hindrance of reproduction and growth (Clark and Wilber, 2000). For example, high levels of turbidity can clog gills or result in the abrasion of sensitive epithelial tissue. Behavioral effects can also be triggered by an increase in suspended sediments, such as avoidance of the area, territoriality, and altered predation and foraging habits. Alternately, the reduced visibility of predatory fish could lower the risk of prey species being taken.

Benthic organisms in the project area could be covered by down-current deposition of sediments following dredging. This settling may cause immediate mortality to sessile benthic organisms in and around the dredging footprint. Although these organisms tend to recolonize relatively quickly, there would be a short-term effect (e.g., on finfish and shellfish) because these benthic organisms are an important food source for larger aquatic organisms in the area.

The suspension of organic materials and sediments could cause an increase in biological and chemical use of oxygen, resulting in a decrease of dissolved oxygen concentrations in the affected area. Lower dissolved oxygen concentrations could cause a temporary displacement of mobile organisms and may stress or kill sessile benthic organisms within the affected area.

Based on the physical characteristics of the project site, increased sedimentation and turbidity due to dredging activities would be temporary, and suspended sediments would likely return to background levels a short time after and a short distance from the point of disturbance. Additional information on the anticipated sediment plume and mitigation measures to reduce turbidity is provided in section 4.3.2.2.

*Resuspension of Contaminated Sediments into the Water Column* - Another potential impact of dredging is the mobilization of contaminated sediments. Contaminants generally adhere to fine-grained particles, which when resuspended, can be ingested by organisms and have potentially toxic effects. Sediment samples were collected in the proposed project area in the spring of 2005. Testing of the sediments, including elutriate testing, revealed that sediments in the project area have either no or very low levels of chemical contaminants (Barry A. Vittor and Associates, Inc., 2005b). Therefore, adverse impacts on organisms due to the resuspension of contaminated sediments are not anticipated.

*Increased Noise* - While dredging is occurring, there would be a variety of sounds produced by vessel engines and pump motors, as well as incidental sound when equipment is moved. Sound has been documented to affect schooling behavior, growth rates, fat stores, and reproduction in fish (Meier and Horseman, 1977; Banner and Hyatt, 1973 in Nightingale and Simenstad, 2001). The duration, level of sound, and presence of sensitive species are key factors determining the impacts of dredging noise. Based on the sound levels typically generated during dredging operations, dredging would be unlikely to physically harm fish in the project area. However, dredging would produce noise levels high enough to cause fish and mobile invertebrates to relocate to an area where the noise level is no longer stressful for the duration of dredging activities.

*Dredged Material Placement* - Gulf LNG is proposing to place the dredged material at the ODMDS south of Horn Island, which is an approved dredged material placement location. Given the proposed offshore placement of the dredged material, the sediment would be removed using a mechanical clamshell dredge and bottom dumping barges or scows to transport dredged material. Use of the bottom dumping barges or scows minimizes resuspension of sediments at the placement site because dredged material placement occurs rapidly. In general, the primary effects of placing the dredged material at the ODMDS are an increase in the concentrations of suspended solids in the water column and burial of aquatic organisms with sediments; however, near the boundaries of the site, impacts are expected to be minimal (EPA, 1991). Except for changes in bathymetry, resources impacted by offshore dredged material placement generally recover over time.

During dredged material placement, a plume would be created containing elevated levels of suspended sediments, which could affect aesthetics, light penetration, feeding by benthic organisms and fish, and, at very high levels, could destroy or injure fish and benthic organisms. Sediment losses during placement would be minimal because the sediment falls to the bottom and dilutes rapidly. Research has shown that placement losses typically range from 1 to 5 percent of the amount placed (Truitt, 1986).

Recent laboratory studies with material in the size range of fine silt (0.01 mm) to medium sand (0.5 mm) estimated a loss of less than 1 percent of material (Ruggaber and Adams, 2000).

Direct impacts on the benthic community at the dredged material placement site would result from burial. Impacts on benthic organisms in adjacent areas through increased siltation and burial during the placement process would be minimal (EPA, 1991). It is expected that any newly deposited dredged material at the ODMDS would be rapidly recolonized by a pioneering assemblage of benthic organisms. Over time, it is expected that the dredged material would experience a natural advancement of successional stages. The initial recolonization by pioneering species would gradually advance to a more stable, head down deposit-feeding community in the sediments.

Fisheries resources may be indirectly impacted by offshore dredged material placement due to a temporary loss of benthic food organisms. The impact is greatest to demersal (bottom) fish, although pelagic (open water) fish may also be affected by temporary increases in TSS in the water column. Fish, due to their high mobility, are not expected to be directly impacted by dredged material placement because they can avoid the area (EPA, 1991). There are no areas of shellfish culture in the vicinity of the ODMDS; therefore, no impacts would result from dredged material placement. Overall, there would be no significant adverse impacts on the marine ecosystem from the use of the ODMDS (EPA, 1991).

Pile Installation

As discussed in section 2.4.1.3, steel pipe piles would be installed as part of the construction of the marine facilities (i.e., for breasting/mooring dolphins and jetty/unloading platforms and trestles). Gulf LNG estimates that pile driving for the LNG terminal would occur over 10-hour shifts, 6 days per week, for a period of about 37 weeks. In some cases, driving steel piles can generate intense underwater sound pressure waves that can adversely affect nearby marine organisms. Although the effects of pile driving are poorly studied and there appears to be substantial variation in a species' response to sound, intense sound pressure waves can change fish behavior or injure/kill fish through rupturing swim bladders or causing internal hemorrhaging. The degree to which an individual fish exposed to sound waves would be affected is dependent upon variables such as the peak sound pressure level and frequency as well as the species, size, and condition of a fish (e.g., small fish are more prone to injury by intense sound waves than are larger fish of the same species). In some cases, sound pressure levels greater than 155 decibels at a reference pressure of 1 micropascal (re: 1 μPa) can illicit avoidance behaviors or stun small fish (NMFS, 2003). Sounds greater than 190 decibels (re: 1 μPa) are thought to physically injure some fish (Hastings, 2002). The presence of predators can also influence how a fish might be affected by pile driving (e.g., fish stunned by pile-driving activities may be more susceptible to predators).

The intensity of the sound pressure levels produced during pile driving depends on a variety of factors including, but not limited to, the type and size of the pile, the firmness of the substrate into which the pile is being driven, the depth of water, and the type and size of the pile-driving hammer. For example, driving hollow steel piles with impact hammers produces intense, sharp spikes of sound that can injure fish. In some cases, fish may be startled by the first few strikes of an impact hammer. However, this response can wane and the fish may remain in the area (NMFS, 2001). As such, the potential effect on fish from impact hammers could be magnified because fish would not only be exposed to intense sound waves but may not avoid pile-driving activities, which would prolong their exposure to the potentially harmful sounds and increase their risk of injury or death. In a review of studies documenting fish kills associated with pile driving, the NMFS (2003) reported that all have occurred during use of an impact hammer on hollow steel piles. On the other hand, the rapid repetitions of vibratory hammers produce relatively low intensity sound waves. Evidence also suggests that fish consistently display an avoidance response to sound from a vibratory hammer, even after repeated exposure (Dolat, 1997; Knudsen et al., 1997).

Driving steel pipe piles with an impact hammer in similar settings has been shown to generate sound levels from 192 to 194 decibels (re: 1 μPa), above the level that is thought to injure some fish. Depending on the specific conditions at the site, these sounds can have a transmission loss rate of 0.021 to 0.046 decibels (re: 1 μPa) per foot (Nedwell and Edwards, 2002; Nedwell et al., 2003). Based on these values, the use of an impact hammer at the proposed LNG terminal could generate underwater sound levels great enough to injure, stun, or illicit avoidance responses (i.e., 155 decibels (re: 1 μPa)) in fish in the vicinity of the pile driving activities. Although the sound waves of the greatest intensity would be limited to the immediate vicinity of the piles within the unloading slip, sound levels of 155 decibels (re: 1 μPa) could extend over 1,800 feet from a steel pile while piles for some of the mooring dolphins are being driven. Because dredging and other construction activities would be occurring both before and during pile installation, it seems likely many fish would avoid the area where the most intense sound levels would be generated. Nevertheless, Gulf LNG would implement measures to minimize the effects of pile driving activities and associated noise on aquatic species, including the use of a bubble curtain to distribute air bubbles around 100 percent of the perimeter of a pile over the full depth of the water column while it is being driven. The bubble curtain components would include a high-volume air compressor, primary feed line, and a distribution manifold. During pile driving activities, the bubble curtain would be checked and maintained for effectiveness.

Accidental Spills or Leaks of Hazardous Materials

Spills, leaks, or accidental releases of fuels, lubricants, or other hazardous substances could potentially occur during construction of the proposed project. Gulf LNG would minimize potential impacts associated with spills or leaks of hazardous materials during construction by implementing its SPCC Plan (see section 4.3.1.4 and Appendix C).

**Operation**

During operation of the proposed project, impacts on estuarine/marine organisms could result from maintenance dredging of the marine facilities, changes in water quality due to ballast water intake, propeller wash from LNG ships and tugboats, LNG ship cooling water intake and discharge, introduction of exotic or invasive species, and routine discharge of condensate water from the SCVs. Increased noise levels and accidental spills or leaks of hazardous materials could also affect estuarine/marine organisms.

Maintenance Dredging of the Marine Facilities

Maintenance dredging of the ship berth and maneuvering area would be conducted on a 3-year cycle, and would remove between 115,000 and 180,000 $yd^3$ of sediment per cycle. To minimize disturbance, dredging would be timed to match the COE's dredging of Bayou Casotte. As currently proposed, dredged material would be placed in the BCDMMS, which is located immediately adjacent to the LNG Clean Energy Project site. Potential impacts on estuarine/marine organisms from maintenance dredging include habitat alteration, loss of the benthic community, increased sedimentation and turbidity, and increased noise. These impacts would be similar to those described above for dredging during construction of the project; however, impacts would be shorter in duration than those described above. As previously discussed, substantial recovery of benthic communities following dredging generally occurs in less than 1 year and complete recovery occurs within time frames shorter than Gulf LNG's proposed 3-year maintenance dredging cycle.

Water Quality

*Ballast Water Discharge and Intake* - To maintain trim and stability, LNG ships calling on the LNG terminal (ranging from 88,000 to 150,000 $m^3$ in LNG carrying capacity) would take on as much as 15 million gallons of water for ballast during LNG cargo unloading. Gulf LNG anticipates that ship

masters would minimize the amount of water taken on while in the project area due to the naturally high turbidity of water in the Mississippi Sound. This water would be taken on through openings in the side of the vessel at a rate of about 1.3 million to 1.6 million gallons per hour over an 8 to 10 hour period. Gulf LNG estimates that about 2.3 billion gallons would be withdrawn annually during operation of the proposed project.

Ballast water discharges have been identified as a major pathway for the introduction and spread of exotic species. Because ships calling on an LNG import terminal would arrive fully loaded and not discharge ballast water, there is limited opportunity for the introduction of exotic species via this pathway. Although the intakes are typically covered with a strainer plate or grate (with 1-inch-wide by 10- to 12-inch-long slots) to prevent debris and large fish from entering the ship with the ballast water, demersal and pelagic fish of various life stages would be at some risk of being pulled into the ballast tanks given the relatively high velocity of the water at the intake structures (i.e., 2.5 feet per second). It is difficult to accurately quantify the numbers of adult, juvenile, and larval fish or fish eggs that could be entrained during ballasting operations. In part, this is due to the dynamic nature of estuarine systems where species assemblages are continually changing in time and space. This seems particularly true in the Mississippi Sound where strong seasonal and regional gradients in water temperature, dissolved oxygen, and salinity correlate strongly with changes in the distribution and abundances of fish eggs and larvae (Rakocinski et al., 1996). While difficult to quantify specific impacts, we are not aware of any studies that would suggest that ballast water uptake could result in significant long-term adverse impacts on fish populations or other local marine biota.

*Propeller Wash from LNG Ships and Tugboats* - During operation of the proposed LNG terminal, propeller wash from LNG ships and tugboats could temporarily increase suspended sediments and turbidity within the navigation channel and ship berth and maneuvering area, affecting open bay habitat as well as benthic communities. As a vessel navigates through a waterway, it generates hydraulic disturbances in the form of waves and currents, mainly drawdown, return current, slope supply currents, wash waves, and jet wash (Wolter and Arlinghaus, 2003). These activities have the potential to resuspend, and subsequently redeposit, sediments resulting in impacts similar to those for dredging. Impacts associated with propeller wash would occur more frequently than dredging because as many as 150 ships may berth at the terminal annually.

Propeller wash could affect the substrate within and adjacent to the navigation channel and could limit the recolonization of benthic species in those areas. Potential indirect effects of vessel movement through the waterway could include disturbances preventing fish from nest-guarding (Mueller, 1980; cited in Wolter and Arlinghaus, 2003) or feeding (Barrett et al., 1992; cited in Wolter and Arlinghaus, 2003), and dislodgement and redistribution of eggs and larvae in less suitable habitats (Jude et al., 1998; cited in Wolter and Arlinghaus, 2003). Obstructing nest-guarding behavior and dislodgement and redistribution of eggs into less suitable habitats could lower the reproductive success of affected fish species. Given the proposed location of the LNG terminal adjacent to a shipping channel that experiences regular vessel traffic, tidal flushing, and maintenance dredging, it seems likely the biological communities along the ship channel that would be disturbed by propeller wash from LNG ships and tugboats are adapted to and tolerant of this dynamic environment.

*LNG Ship Cooling Water Intake and Discharge* - All ships use water to cool their boilers. The cooling water would be withdrawn from the Mississippi Sound at the project location. Depending upon engine type, LNG ships could use between 15 and 42 million gallons of water for engine cooling while they are at the berth. Water used for engine cooling would be quickly discharged, and the resulting increase in water temperature is expected to be minor. Intake of water can also result in the entrainment of aquatic resources. Early life stages of blue crab; white, brown, and pink shrimp; stone crab; croaker;

bay anchovy; black drum; red drum; and seatrout are all dependent on the estuary for nursery habitat and would be most susceptible to entrainment (NMFS, 2006).

Gulf LNG reviewed several studies of larval fish and decapods in Mississippi Sound to determine estimates of the densities of each species in the estuary (Swingle, 1971; Christmas, 1973; GeoMarine, Inc., 1977; Shipp, 1979; Rakocinski et al., 1996; and NMFS, 2004a). These studies were supplemented by life history information compiled by the EPA in regard to the Section 316(b) Phase II Final Rule survey for the Gulf of Mexico (EPA, 2006b). Gulf LNG used this data to determine estimated impacts on the species listed above. A detailed description of the review and analysis conducted by Gulf LNG is included in Attachment A of the EFH Assessment (see Appendix G).

Overall, the majority of species identified by the NMFS occur in low densities in the project area. In contrast, blue crab and penaeid shrimp occur in high densities in the project area; however, they exhibit naturally high mortality rates. Based on Gulf LNG's calculations, these combined effects account for the negligible impact on these species. The resulting low numbers removed from these species populations would be expected to have a negligible impact on ecology in the project area and the surrounding Mississippi Sound, including food chain relationships. However, as previously discussed, Gulf LNG has prepared a draft Mitigation Plan to describe the measures it would implement to reduce impacts associated with the project. We have recommended that Gulf LNG continue to consult with the NMFS and other applicable agencies to finalize its Mitigation Plan (see section 4.4.3).

*Introduction of Exotic or Invasive Species* - As discussed above, ships calling on the LNG import terminal would arrive fully loaded and would not discharge ballast water; therefore, there is limited opportunity for the introduction of exotic species via this pathway. However, it might be possible for exotic species to be imported on the hulls and exterior equipment of LNG vessels. To address this issue, the Coast Guard has developed responses to exotic/invasive organisms associated with foreign vessels. The Coast Guard Office of Operating and Environmental Standards developed *Mandatory Practices For All Vessels with Ballast Tanks on All Waters of the United States*. The mandatory practices include requirements to rinse anchors and anchor chains during retrieval to remove organisms and sediments at their place of origin and remove fouling organisms from hull, piping, and tanks on a regular basis and dispose of any removed substances in accordance with local, state, and federal regulations. By following these practices, LNG vessels would not likely introduce exotic or invasive species to the area.

*Routine Discharge of Condensate Water from the SCVs and $NO_x$ Emissions Control Water from the SCVs* - As discussed in section 4.3.2.2, each SCV would generate up to 20 to 30 gpm of water, depending on the source water used by the emission control system. Maximum wastewater produced by SCVs during operation of the LNG Clean Energy Project would be 0.4 mgd. The relatively small volume of water discharged into the water column would have negligible impacts on fish and benthic organisms.

Noise

Vessel traffic associated with operation of the project would generate underwater sounds. Although vessel sounds would not generally be of the intensity produced from construction of the project, project vessels (e.g., LNG carrier ships and tugs) operating in Bayou Casotte could produce sounds that may illicit responses in fish. Most research suggests that fish exhibit avoidance behavior in response to engine noise (International Council for the Exploration of the Sea, 1995). At the same time, research conclusions tend to suggest that because the effects are transient (i.e., once the ship passes, behavior returns to normal), the long-term effects on populations would be negligible (Stocker, 2001).

Accidental Spills or Leaks of Hazardous Materials

Spills, leaks, or other releases of hazardous materials during operation of the proposed project could also adversely affect estuarine/marine organisms. Should this project be approved, Gulf LNG would prepare an SPCC Plan for operation of the project that would include procedures to be implemented for the prevention and mitigation of releases of oil, gas, lubricants, or hazardous materials during operation of the terminal facility and associated facilities.

### 4.6.3 Freshwater Resources

Potential habitat for freshwater fisheries in the vicinity of the LNG Clean Energy Project includes several emergent wetlands, two canals, and two ditches, all of which are associated with the proposed sendout pipeline and related facilities. The vegetation within the emergent wetlands that would be affected in the project area is discussed in section 4.4. Surface water is generally only present for brief periods during the growing season in these wetlands and the water table usually lies well below the soil surface. Therefore, emergent wetlands in the project area are not anticipated to support freshwater fisheries.

The proposed sendout pipeline would cross two canals (see table 4.3.2-1). The two canals contain water year-round; however, Gulf LNG reported that there are no fisheries associated with these waterbodies. Gulf LNG would implement our Procedures to minimize construction-related impacts on these waterbodies. The two ditches associated with the project are located within a proposed contractor yard and support area. These ditches contain water only intermittently and are also not likely to sustain fish populations. Gulf LNG has indicated that these ditches would not be directly affected during construction activities at the site. As a result, no adverse impacts on aquatic resources associated with these waterbodies are anticipated.

### 4.6.4 Essential Fish Habitat

Recognizing that many marine fisheries are dependent on nearshore and estuarine environments for at least part of their life cycles, new habitat conservation provisions to the MSA (Public Law 94-265, as amended in 1996 and Public Law 104-297 as amended in 1998) were added, along with other goals, to promote more effective habitat management and protection of marine fisheries. The protection of the marine environments important to marine fisheries, referred to as EFH, is required in the review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 USC 1802(10)). All estuaries and estuarine habitats in the northern Gulf of Mexico are considered EFH (GMFMC, 1998).

Federal agencies that authorize, fund, or undertake activities that may adversely impact EFH must consult with the NMFS. Although absolute criteria have not been established for conducting EFH consultations, the NMFS recommends consolidated EFH consultations with interagency coordination procedures required by other statutes, such as the NEPA and ESA, in order to reduce duplication and improve efficiency. Generally, the EFH consultation process includes the following steps:

1) **Notification** – The action agency should clearly state the process being used for EFH consultations (e.g., incorporating EFH consultation into the EIS or Rivers and Harbors Act section 10 permit).

2) **EFH Assessment** – The action agency should prepare an EFH Assessment that includes both identification of affected EFH and an assessment of impacts. Specifically, the EFH Assessment

should include: 1) a description of the proposed action; 2) an analysis of the effects (including cumulative effects) of the proposed action on EFH, the managed fish species, and major prey species; 3) the federal agency's views regarding the effects of the action on EFH; and 4) proposed mitigation, if applicable.

3) **EFH Conservation Recommendations** – After reviewing the EFH Assessment, the NMFS would provide recommendations to the action agency regarding measures that can be taken by that agency to conserve EFH.

4) **Agency Response** – The action agency must respond to the NMFS within 30 days of receiving the NMFS' recommendations or the action agency may notify the NMFS that a full response to the conservation recommendations will be provided by a specified completion date agreeable to all parties. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH.

We incorporated EFH consultations for the LNG Clean Energy Project with the interagency coordination procedures required under NEPA. For purposes of reviewing this project under NEPA, the FERC is the lead federal agency. As such, the FERC requests that the NMFS consider the draft EIS as notification of initiation of EFH consultation. Gulf LNG retained TRC Environmental Corporation, Inc. to conduct various field investigations and to provide baseline data on existing resources that occur within the proposed project area. The EFH Assessment for the LNG Clean Energy Project is included as Appendix G. An analysis of the cumulative impacts of the project on aquatic resources (including EFH) is presented in section 4.14.4. Our views regarding the potential effects of the LNG Clean Energy Project on EFH are included below.

**Conclusions of the EFH Assessment**

The current project design and implementation of proposed mitigation would serve to offset impacts on EFH. The proposed project would impact three habitat types that function as EFH: estuarine water column, intertidal wetlands, and unvegetated substrates. Species with EFH designated in the Mississippi Sound could potentially be impacted by loss/alteration of habitat, dredging, permanent loss of about 4.9 acres of intertidal wetland, entrainment of benthic invertebrates, and the temporary resuspension of sediments into the water column during construction. In addition, an accidental spill or leak of hazardous materials into estuarine waters during construction and operation of the proposed project could potentially affect EFH. Gulf LNG has developed Mitigation and Monitoring Plans, in consultation with the COE, MDMR, NMFS, and other applicable agencies to address impacts on EFH. Gulf LNG's Mitigation and Monitoring plans are provided in Appendices F and E, respectively. We have recommended that Gulf LNG continue to consult with the COE, MDMR, NMFS, and other applicable agencies to finalize its Mitigation Plan (see section 4.4.3). Gulf LNG has also developed an SPCC Plan (see Appendix C) that would minimize the likelihood and potential impact of a hazardous spill during construction of the onshore and offshore project facilities. Gulf LNG would develop a separate SPCC Plan after construction of the project to identify similar preventative measures that would be employed during operation of the LNG terminal and associated facilities.

Although there would be permanent impacts on EFH as the result of construction of the LNG Clean Energy Project, Gulf LNG proposes to mitigate for losses of EFH by restoring an area of existing upland to coastal brackish marsh to provide replacement of juvenile nursery, foraging habitat, and prey production for a number of important EFH species, including brown and white shrimp, red drum, and Spanish mackerel (see Appendix F). With this mitigation, we do not believe impacts on EFH associated with construction or operation of the project would have a substantial adverse effect on managed fisheries in the area.

## 4.7 THREATENED, ENDANGERED, AND OTHER SPECIAL STATUS SPECIES

Federal and state regulations protect a number of species that potentially occur in the vicinity of the LNG Clean Energy Project and along the LNG ship transit route. With assistance from Gulf LNG, we consulted with the FWS, NMFS, and MNHP to analyzed impacts on special status species. The species identified during these consultations are discussed in detail below.

### 4.7.1 Federally Listed Threatened and Endangered Species

As described in section 1.3, section 7 of the ESA requires that the FERC (in consultation with the FWS and NMFS) ensure that its actions do not "jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined...to be critical" (16 USC 1536(a)(2)). In compliance with section 7 of the ESA, the FERC staff submitted to the FWS and NMFS on March 27, 2006 a Biological Assessment for the LNG Clean Energy Project with a request for concurrence on its determinations of effect. The Biological Assessment described in detail environmental baselines for federally listed species and critical habitat; direct, indirect, interdependent and interrelated, and cumulative effects to those species; proposed conservation measures; and determinations of effect. Information included in the Biological Assessment is summarized in this EIS.

To determine whether any federally listed or proposed endangered or threatened species or their designated critical habitat occur in the area and might be affected by the proposed project, Gulf LNG has been assisting the FERC with meeting its obligations under the ESA by consulting with the FWS and NMFS and conducting surveys of the project area. The FWS and NMFS identified 15 federally listed endangered or threatened species that potentially occur in the vicinity of the LNG Clean Energy Project or along the LNG ship transit route within the waters of the Gulf of Mexico. The 15 species include six mammals (sperm whale, blue whale, sei whale, fin whale, humpback whale, and North Atlantic right whale), two birds (bald eagle, brown pelican), five reptiles (hawksbill sea turtle, green sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, and loggerhead sea turtle), and two fish (smalltooth sawfish and Gulf sturgeon). Table 4.7.1-1 identifies the federally listed species potentially occurring in the project area and summarizes our determination of effect for each listed species. Species-specific impacts and conservation/mitigation measures are discussed in the following sections. Additional information regarding LNG shipping incidents and their potential impacts along the transit corridor is provided in section 4.13.5.3.

#### 4.7.1.1 Mammals

**Whales**

Six whales are federally listed as endangered and could possibly occur in the waters of the Gulf of Mexico. These whales include the sperm, blue, sei, fin, humpback, and North Atlantic right whale.

The sperm whale is the largest of the toothed whales, or odontocetes (Waring et al., 2006). Sperm whales occur widely throughout the world's oceans. Males are generally found in higher latitudes, either alone or in groups, migrating towards lower latitudes. Only the largest males appear to enter breeding grounds near the equator. Females, calves, and juveniles are non-migratory, remaining in tropical and subtropical waters throughout the year (American Cetacean Society, 2005). Sperm whales dive up to 1,640 feet to feed, primarily preying on medium-sized deep water squid, but they also feed on species of smaller squid, octopus, skate, and fish (American Cetacean Society, 2005). Unlike many other whale species, sperm whales feed year-round. Historical declines in sperm whale populations have been due to over-harvest by commercial whaling operations, which peaked at about 29,000 whales per year in the mid-1960s (NatureServe, 2005).

TABLE 4.7.1-1

**Federally Listed Endangered or Threatened Species Potentially Occurring in the Project Area**

| Species | Status [a] | Preferred Habitat | Determination |
|---|---|---|---|
| **Mammals** | | | |
| Sperm whale<br>*Physeter macrocephalus* | E | Abyssal and pelagic; prefers deep water (>600 feet), and is sometimes found around islands or in shallow shelf waters. | Not likely to adversely affect |
| Blue whale<br>*Balaenoptera musculus* | E | Pelagic; generally prefers cold waters and open seas, but young are born in warmer waters of lower latitudes. | Not likely to adversely affect |
| Sei whale<br>*Balaenoptera borealis* | E | Pelagic; generally in deep water along the edge of continental shelf and in open ocean. | Not likely to adversely affect |
| Fin whale<br>*Balaenoptera physalus* | E | Pelagic; often seen 25 miles or more from shore. In the western Atlantic, occurs mainly over continental shelf in summer and in depths of 300 to 600 feet. | Not likely to adversely affect |
| Humpback whale<br>*Megaptera novaeangliae* | E | Pelagic and coastal waters; sometimes frequenting inshore areas such as bays. | Not likely to adversely affect |
| North Atlantic right whale<br>*Eubalaena glacialis* | E | Pelagic and coastal waters, winters in the western Atlantic where calving occurs. | Not likely to adversely affect |
| **Birds** | | | |
| Bald eagle<br>*Haliaeetus leucocephalus* | T | Coastal areas, rivers, and large bodies of water. | Not likely to adversely affect |
| Brown pelican<br>*Pelecanus occidentalis* | E | Coastal areas and waters within 20 miles of the shoreline and in depths up to 80 feet. | Not likely to adversely affect |
| **Reptiles** | | | |
| Hawksbill sea turtle<br>*Eretmochelys imbricate* | E | Coastal reefs, bays, rocky areas, estuaries, lagoons at depths of 70 feet or less, and open sea. | Not likely to adversely affect |
| Green sea turtle<br>*Chelonia mydas* | T | Lagoons, bays, shoals, and estuaries, as well as coral reefs, rocky outcrops, and high-energy beaches. | Not likely to adversely affect |
| Kemp's ridley sea turtle<br>*Lepidochelys kempii* | E | Shallow coastal and estuarine waters over sand or mud bottoms. | Not likely to adversely affect |
| Leatherback sea turtle<br>*Dermochelys coriacea* | E | Open sea, coastal waters, and sandy beaches with a deep water approach. | Not likely to adversely affect |
| Loggerhead sea turtle<br>*Caretta caretta* | T | Open seas over the continental shelf, bays, estuaries, lagoons, creeks, and mouths of rivers. | Not likely to adversely affect |
| **Fish** | | | |
| Smalltooth sawfish<br>*Pristis pecinata* | E | Project is within the historic but not current range of this species. | No effect |
| Gulf sturgeon<br>*Acipenser oxyrinchus desotoi* | T [b] | Range includes Gulf of Mexico east of the Mississippi River. | Not likely to adversely affect |

[a] Federal Status:
E = Endangered
T = Threatened

[b] Critical habitat designated in the project area.

Sperm whales are the most abundant large cetacean in the Gulf of Mexico and are present throughout the year (NatureServe, 2005). Aerial surveys have shown that sperm whales are present in the northern Gulf of Mexico in all seasons. Although sperm whales are occasionally found around islands or in shallow (130 to 230 feet) shelf waters, sightings are most commonly aggregated along the continental slope, the 3,300-foot isobath near the Mississippi River delta, and near cyclonic (cold-core) eddies (Davis et al., 2000; Biggs et al., 2000; Davis et al., 2002). This is an area that has been recognized for high densities of sperm whales and represents a habitat where they can be predictably found (Baumgartner et al., 2001; Davis et al., 2002). Recent research supports distinct stock status for the Gulf of Mexico population of sperm whales (Waring et al., 2006). The best estimate of abundance for sperm whales in oceanic waters of the northern Gulf of Mexico is 1,315, and is pooled from data collected between 1996 and 2001 (NMFS, 2006).

The blue whale is the largest living animal on earth. Blue whales are migratory, moving toward the poles in the spring for feeding and returning to the subtropics in the fall to mate (NMFS, 1998a). The blue whale was historically over-harvested; however, continued decline of the species may be due to alterations in the food-chain from commercial fishing and whaling (NatureServe, 2005). Several records of blue whale strandings (pre-1970) suggest that blue whales have occasionally strayed into the waters of the Gulf of Mexico.

Sei and fin whales are widely distributed with populations centering in the temperate zones of both the northern and southern hemispheres. The similarity of the sei and fin whales has caused confusion as to the whales' actual distribution and frequency of occurrence. The sei whale is considered uncommon in the Atlantic waters off of the United States and tends to avoid semi-enclosed waterbodies such as the Gulf of Mexico (NMFS, 1998b). In waters off of the United States, the fin whale is generally found along the 330-foot isobath over the continental shelf (NMFS, 1998b). Although it is considered uncommon, the fin whale is known to occur in the Gulf of Mexico. Historical declines in both sei and fin whale populations have been attributed to whaling.

Humpback whales are found in all oceans of the world, generally occurring in waters over continental shelves, along their edges, and around some oceanic islands (NMFS, 1991a); however, this species rarely occurs in the Gulf of Mexico. Humpback whale populations were historically depleted by over-harvesting and continue to be threatened by marine pollution, disturbance by vessel traffic, and entanglement in fishing gear (NatureServe, 2005). There are only three historical sitings recorded of humpbacks in the Gulf of Mexico. Two of these sitings were near Tampa Bay, Florida; and the third location was not specified (NMFS, 1991a).

The North Atlantic right whale is a large-sized baleen whale that is frequently found in coastal and shelf waters (NMFS, 2005a). The North Atlantic right whale is among the rarest of the world's whales, due historically to commercial whaling. However, in recent years, the greatest known cause of North Atlantic right whale mortality is collision with ships (NMFS, 2005a). For most of the year, North Atlantic right whale distribution is strongly correlated with that of their primary prey, copepods. Five "high use" areas were identified along the east coast of North America in the initial Recovery Plan for the North Atlantic right whale (NMFS, 1991b). Still considered to be key habitat areas, the most southerly of these areas is located within 15 miles of the Atlantic coast of Florida and Georgia (Sebastian Inlet, Florida to the Altamaha River, Georgia). While many of the remaining North Atlantic right whales gather along the coast of Florida/Georgia for the calving period between December and March, limited data suggests that a few individuals might also winter in other areas that include the waters near Bermuda and in the Gulf of Mexico (Reeves, 2001).

Potential Whale Impacts

As described above, six species of federally listed whales have been recorded within the Gulf of Mexico. However, the NMFS (2005b) indicated that observations of five of those species (blue, sei, fin, humpback, and North Atlantic right whales) have likely been juveniles straying from the normal range of these stocks, or are only occasional transients. The NMFS does not believe that there are resident stocks of these five whale species in the Gulf of Mexico and has stated that the potential for interaction between any of the proposed project's activities and these whale species is extremely low (NMFS, 2005b).

Activities associated with construction and operation of the project, including dredged material placement, accidental spills, and increases in noise and vessel traffic could potentially affect federally listed whales in the project area. These potential impacts are discussed below.

*Dredged Material Placement* - Gulf LNG is proposing to place construction-related dredged material at the ODMDS south of Horn Island, which is an approved dredged material placement location. The primary impact on whales from the placement of dredged material at this site would be a temporary increase in suspended solids in the water column; however, whales in the vicinity of the ODMDS would likely avoid the area while placement is occurring. The EPA (1991) found that dredged material placement at this site would not result in adverse impacts on any endangered whales, or their critical habitat. During operation of the project, dredged material would be placed at an upland disposal site and would not have an impact on whales. Additional information on the impacts of dredged material placement on aquatic resources is presented in section 4.6.2.2.

*Accidental Spills or Leaks of Hazardous Materials* - Spills, leaks, or accidental releases of fuels, lubricants, or other hazardous substances could potentially occur during construction and operation of the proposed project. The inadvertent release of fuels, lubricants, or other hazardous materials during construction or operation of the proposed LNG terminal could have an adverse impact on water quality, which could subsequently have an impact on whales. Similarly, inadvertent releases of hazardous materials from LNG ships in transit to the proposed LNG terminal could also affect water quality and therefore, whales. Depending on the size of the release, whales could experience direct stress and/or injury. Additional information regarding LNG shipping incidents and their potential impacts along the transit corridor is provided in section 4.13.5.3. Gulf LNG would minimize potential impacts associated with spills or leaks of hazardous materials during construction by implementing its SPCC Plan (see section 4.3.1.4 and Appendix C). In addition, each vessel would maintain a Shipboard Oil Pollution Emergency Plan (SOPEP) as required by international convention. The SOPEP complies with MARPOL 73/78 Consolidated Edition 2002 Annex 1 Regulation 26 requiring every oil tanker of 150 tons gross and above, and every ship of 400 tons gross and above, to carry an approved SOPEP.

*Noise* - Whales may be affected by periodic increases in underwater noise levels that would occur during ship transits associated with the project. Most whales depend on sound as they hunt for food, detect predators, find mates, and maintain their awareness in the sea; vessel noise can impact whales by elevating ambient noise levels to the point of interfering with biologically important signals (Richardson, et al., 1995). Conversely, sounds emitted by whales for communication and identification can be masked and go unheard due to the increased noise in the marine environment.

Noise in the aquatic environment is defined as sound from an array of sources that does not convey biologically significant information. The marine environment contains many natural and anthropogenic sources of noise. Natural noise includes surf, wind, earthquakes, and biological activity. Anthropogenic sources include noise generated to locate submerged objects, measure environmental features, and conduct industrial activities. Noise can be neutral background acoustical clutter, or can impede acoustic communication or other biological functions (NMFS, 2003).

LNG ships are in the category of cargo and tanker vessels, which are increasing in numbers world wide. Cargo vessels are known to emit high levels of low frequency sound (6.8 to 7.7 hertz at 181 to 190 decibels (re: 1 μPa)) capable of traveling long distances (Richardson, et al., 1995). Noise generated by LNG ships is generally omni-directional, emitting from all sides of the vessel (Whale and Dolphin Conservation Society, 2004). However, noise levels are greatest on the sides of the ship and weakest on the front and rear of the ship. This noise distribution may be the reason that whales do not always avoid oncoming ships and are thus struck and either injured or killed.

Whales tend to either react strongly or not at all to the noise generated by oncoming ships. These reactions often occur in response to changes in engine and propeller speed (Richardson, et al., 1995). It is anticipated that whales would generally avoid areas with high noise levels during construction and operation of the proposed project.

*Vessel Traffic* - Construction and operation of the LNG Clean Energy Project would result in an increase in LNG marine traffic through the Gulf of Mexico. While there are no prescribed routes for ships transiting open waters of the Gulf of Mexico, entrance into the Gulf is through the Straits of Florida, south of the Florida Keys and Florida reefs. From there, a merchant vessel would cross the Gulf by the most direct, safest route to its destination port. A system of shipping safety fairways and fairway anchorages has been established for the Gulf of Mexico and is shown on some, but not all, navigation charts. These fairways are near port entrances and along coastal trade routes, but do not extend across the Gulf of Mexico or into the deep waters of the open Gulf. LNG ships moving to and from the proposed LNG import terminal would follow somewhat different routes depending on the various potential points of origin (i.e., Middle East and Mediterranean Region, the West Coast of Africa, and the Eastern Caribbean and Northeast Coast of South America). The following lists provide information on where LNG ships would most likely enter and transit through waters within the U.S. Exclusive Economic Zone (EEZ) and summarizes the potential LNG ship routes to the proposed LNG import terminal in Jackson County, Mississippi.

<u>Middle East and Mediterranean Region</u>

- Depart the Mediterranean Sea at the Straits of Gibraltar to enter the Atlantic Ocean.
- Transit west across the Atlantic Ocean.
- Enter the EEZ in one of the following two locations and turn south to follow the east coast of Florida.
    - North of the Little Bahama Bank (roughly at latitude 27.5° North).
    - Through the Northwest Providence Channel (roughly at latitude 26.0° North).

    Note: These locations are approximately 150 miles and 240 miles, respectively, south of the Southeastern Right Whale Reporting Boundary, which is located at latitude 30.0° North (33 CFR Part 169).
- Transit south then west through the Straits of Florida.
- Turn to the northwest after passing the Dry Tortugas (located approximately 70 miles west of Key West) to enter the Gulf of Mexico.
- Transit northwest across the Gulf of Mexico to the Port of Pascagoula.

West Coast of Africa

- Transit west across the Atlantic Ocean to the Old Bahama Channel (located between the Bahamas and the north coast of Cuba).

  Note: The LNG ship would likely transit through the EEZ as it passes north of Puerto Rico.

- Transit west-northwest through the Old Bahama Channel and exit into the Straits of Florida.

- Enter the EEZ in the Straits of Florida south of Key West.

- Turn to the northwest after passing the Dry Tortugas (located approximately 70 miles west of Key West) to enter the Gulf of Mexico.

- Transit northwest across the Gulf of Mexico to the Port of Pascagoula.

Eastern Caribbean and Northeast Coast of South America

- Transit northwest across the Caribbean Sea to the Mona Pass (located between Puerto Rico and the Dominican Republic).

  Note: The LNG ship would likely transit through the EEZ as it passes west of Puerto Rico.

- After passing through the Mona Pass, transit west-northwest through the Old Bahama Channel and exit into the Straits of Florida.

- Enter the EEZ in the Straits of Florida south of Key West.

- Turn to the northwest after passing the Dry Tortugas (located approximately 70 miles west of Key West) to enter the Gulf of Mexico.

- Transit northwest across the Gulf of Mexico to the Port of Pascagoula.

Based on this summary of potential LNG ship routes to the proposed LNG terminal, the following general regions of the EEZ may be transited by LNG ships:

- east Coast of Florida, south of latitude 27.5º North;

- Straits of Florida, south of the Florida Keys;

- waters north and west of Puerto Rico; and

- waters of the Gulf of Mexico (each LNG ship would transit these waters).

LNG ships associated with the proposed project would normally travel west in the Gulf of Mexico to the Horn Island Pass Sea Buoy, where they would enter the Horn Island Pass Channel. From the Horn Island Pass Channel, the vessels would transit the Lower Pascagoula and Bayou Casotte Channels to the proposed LNG terminal.

Although whales would not likely occur in the immediate vicinity of the LNG terminal, they could be affected by increased vessel traffic associated with the project in the Gulf of Mexico and open seas. Collisions between boats and/or ships and toothed whales are uncommon; however, whales have been struck and killed by ships (Slijper, 1962). The literature suggests that vessel injuries and mortalities from strikes are reduced at 12 knots and are significantly reduced at 10 knots (NMFS, 2006). In the presence of vessels, whales exhibit behaviors that increase their susceptibility to collision such as startle responses, more erratic surface movements, reduced surface time, fewer blows per surfacing, shorter intervals between successive blows, and increased frequency of dives without raised flukes (Whitehead et al., 1990; Cawthorn, 1992; Gordon et al., 1992). Although the majority of injurious vessel strikes are thought to be caused by small vessels that have planing hulls, some larger vessels are associated with mortalities. To provide protection against these types of injuries, the NMFS has developed measures that must be implemented to reduce the risk associated with vessel strikes or disturbance of these protected species to discountable levels. These measures are known as the *Vessel Strike Avoidance Measures and Injured or Dead Protected Species Reporting Procedures (revised May 5, 2006)* (Strike Avoidance Procedures). The procedures that vessel operators should implement include:

- use of an Atlantic and Gulf of Mexico reference guide that helps identify the species of marine mammals and sea turtles that might be encountered in Atlantic waters off the United States, including the Caribbean and Gulf of Mexico. Additional training should be provided regarding information and resources available regarding federal laws and regulations for protected species, ship strike information, critical habitat, migratory routes and seasonal abundance, and recent sightings of protected species;

- maintain a vigilant watch for marine mammals and sea turtles and slow down or stop the vessel to avoid striking protected species;

- maintain a distance of 300 feet or greater between the vessel and whales;

- attempt to maintain a distance of 150 feet or greater between the vessel and sea turtles or small cetaceans;

- attempt to remain parallel to the animal's course and avoid excessive speed or abrupt changes in direction when protected species are sighted in the area;

- reduce vessel speed to 10 knots or less when mother/calf pairs, pods, or large assemblages of cetaceans are observed near an underway vessel. The vessel should attempt to route around the animals, maintaining a minimum distance of 300 feet whenever possible;

- reduce speed and shift the engine to neutral when protected species are sighted in the vessel's path or in close proximity to a moving vessel. Do not engage the engines until the animals are clear of the area;

- if a sighted whale is believed to be a North Atlantic right whale, federal regulation requires a minimum distance of 1,500 feet be maintained from the animal;

- report into the Mandatory Ship Reporting System upon entering North Atlantic right whale critical habitat;

- check with various communication media for general information regarding avoiding ship strikes and specific information regarding North Atlantic right whale sighting locations; and

- report sightings of any injured or dead protected species (marine mammals and sea turtles) immediately, to the Marine Mammal and Sea Turtle Stranding Hotline or the Marine Mammal Stranding Network.

Gulf LNG has committed to provide LNG ship captains with the Strike Avoidance Procedures, which outline collision avoidance measures. Gulf LNG would instruct vessel operators and crews to follow the guidelines listed in the Strike Avoidance Procedures when operating their ships within the EEZ, which includes maintaining a vigilant watch for marine protected species and slowing down or altering their course to avoid striking protected species.

Based on their life history and probability of occurrence along the LNG ship transit route or at the LNG terminal, our consultations with the NMFS, and Gulf LNG's implementation of the Strike Avoidance Procedures, we have determined that whales would *not likely be adversely affected* by the project.

#### 4.7.1.2 Birds

**Bald Eagle**

The bald eagle, federally listed as threatened, is predominantly a winter migrant in the southeast. However, increasing occurrences of nesting have been observed in the region and there is potential nesting habitat in Jackson County (FWS, 2005a). Bald eagles nest in Mississippi from September through January, with fledging generally occurring by midsummer. Bald eagles will often return to the same nest for a number of years; however, they may also use alternate nests in the vicinity. Throughout their range this species selects large, super-canopy roost trees that are open and accessible for nest sites (FWS, 2005b). Bald eagles primarily feed on fish, but are opportunistic and will eat a variety of mammals, amphibians, crustaceans, and birds.

Bald eagles are most vulnerable to disturbance during courtship, nest building, egg laying, incubation, and brooding (roughly the first 12 weeks of the nesting cycle). Disturbance during this critical period may lead to nest abandonment, cracked and chilled eggs, and exposure of small young to the elements (FWS, 2005b). Project activities near a nest late in the nesting cycle may also cause flightless young birds to prematurely leave nests, thus reducing their chance of survival.

Gulf LNG conducted field investigations of the project area during June and July 2005 (Barry A. Vittor and Associates, Inc. and TRC Environmental Corporation, 2005). These surveys were conducted at the proposed LNG terminal and along the pipeline route. Suitable nesting habitat is not present on site, and no eagle nests were observed in the project area during these surveys. However, because the waters of the Mississippi Sound may provide foraging habitat for bald eagles, we have recommended that Gulf LNG consult with the FWS and conduct additional surveys, as necessary, if construction has not begun within 1 year from the date of issuance of the FERC approval (see section 4.7.4.3).

Although bald eagles would not be directly affected by the proposed project, activities associated with construction and operation could have an impact on bald eagles. Specifically, dredging and dredged material placement, and increases in noise, traffic, and lighting levels could temporarily affect bald eagle foraging habits, potentially increasing stress to this species. However, because foraging habitat for bald

eagle occurs throughout the region, impacts would not be expected to result in population level changes to bald eagles in the project area.

Based on their life history and limited potential for project-related impacts, we have determined that bald eagles would *not likely be adversely affected* by the project. In a letter to the FERC staff dated April 28, 2006, the FWS concurred with this determination.

**Brown Pelican**

In Mississippi, brown pelicans are generally found along the coast of the Gulf of Mexico and on the Barrier Islands. However, the specific size of the brown pelican population in the region is not known (FWS, 2005c). Brown pelicans typically nest in colonies, often on small coastal islands that provide protection from mammalian predators. Most foraging occurs in shallow estuarine waters, and sand spits and offshore sand bars are used for loafing and nocturnal roost areas. Brown pelicans seldom venture more than 20 miles out to sea (FWS, 2005c). The Grand Bay National Estuarine Research Reserve (part of the Grand Bay Reserve discussed in section 4.6.1.1), located 1.5 miles east of the site, has been described as supporting foraging grounds for the brown pelican (MDMR, 1998b).

Gulf LNG reported that brown pelicans have been observed near the proposed LNG terminal and that the species is common in estuarine waters around Bayou Casotte (Barry A. Vittor and Associates, Inc. and TRC Environmental Corporation, 2005). The field surveys found that the project area does not contain suitable habitat for nesting, but may contain potential loafing habitat onshore and foraging habitat offshore. Because the project area may contain loafing and foraging habitat, we have recommended that Gulf LNG consult with the FWS and conduct additional surveys, as necessary, if construction has not begun within 1 year from the date of issuance of the FERC approval (see section 4.7.4.3).

Although construction activities, including dredging, may have a temporary impact on loafing and foraging habitat, the brown pelican is highly mobile and suitable habitat within the Grand Bay National Estuarine Research Reserve would provide ample habitat for any displaced individuals. Operation of the proposed project would result in an increase in marine traffic; however, because of the existing levels of marine traffic within the port, no impacts on brown pelicans are anticipated.

Based on the life history of brown pelicans, their familiarization with commercial ship traffic, and the availability of suitable habitat adjacent to the project site, we have determined that the brown pelican would *not likely be adversely affected* by the project. In a letter to the FERC staff dated April 28, 2006, the FWS concurred with this determination.

#### 4.7.1.3 Reptiles

**Sea Turtles**

Five species of sea turtles are federally listed as threatened or endangered and have been documented in the Gulf of Mexico. These include the hawksbill, green, Kemp's ridley, leatherback, and loggerhead sea turtles. All five sea turtles have been known to occur along the continental shelf and coastal areas in the Gulf of Mexico. Sea turtles nesting on beaches in the United States are under the jurisdiction of the FWS; sea turtles occurring in United States waters are the responsibility of the NMFS, Protected Resources Division.

The hawksbill is a small to medium-sized sea turtle that inhabits the tropical and subtropical seas of the Atlantic, Pacific, and Indian Oceans. Although it has been recorded in the coastal waters of Mississippi, it is considered rare (NMFS and FWS, 1993). Nesting occurs on undisturbed, deep-sand

beaches, from high-energy ocean beaches to tiny pocket beaches several meters wide bounded by crevices of cliff walls; most typically beaches used by nesting turtles are low-energy, with woody vegetation near the waterline. In the continental United States, nesting sites are restricted to Florida where nesting is sporadic (NMFS and FWS, 1993).

It is thought that weedlines in the Gulf of Mexico serve as foraging habitat for posthatchling hawksbills, whereas juvenile and adult hawksbill sea turtles inhabit coral reefs where they feed on sponges (NMFS and FWS, 1993). Hawksbills are also known to inhabit mangrove-fringed bays and estuaries, particularly along the eastern shore of continents where coral reefs are absent. Due to the lack of suitable foraging and nesting habitats, there is a low probability of this species occurring within the project area.

The green sea turtle inhabits three different habitat types during its life cycle: high-energy oceanic beaches with deep sand and little organic content (nesting), convergence zones in pelagic habitat (juvenile foraging), and benthic feeding grounds in relatively shallow, protected waters (adult foraging). Juvenile green sea turtles are assumed to be omnivorous, while adults are generally herbivorous, preferring to forage in pastures of seagrass and/or algae (NMFS and FWS, 1991a). In the United States, the principal green turtle nesting beaches are located in eastern Florida, with additional nesting known to occur in the Virgin Islands and Puerto Rico (NMFS and FWS, 1991a). Nesting at the LNG terminal site is highly unlikely, as green sea turtles prefer to nest on high-energy beaches with deep sand and little organic content. Further, the MMS describes reports of green sea turtles nesting in the northern Gulf of Mexico as "isolated and infrequent" (MMS, 1997).

According to the FWS and NMFS (1992), the Kemp's ridley sea turtle is the smallest of all living sea turtles and is considered the most endangered species of sea turtle. Adult and juvenile Kemp's ridley sea turtles are primarily restricted to the Gulf of Mexico, although juveniles have been recorded throughout the Atlantic Ocean. Nesting for this species is essentially limited to an 11-mile stretch of coastline near Rancho Nuevo, Tamaulipas, Mexico.

Juvenile Kemp's ridley sea turtles typically feed on *Sargassum* spp. and associated infauna. Adults forage in shallow-water benthic communities, specializing in portunid crabs. Other food items include shrimp, snails, bivalves, sea urchins, jellyfish, sea stars, fish, and occasionally marine plants. During the non-breeding season, Kemp's ridley sea turtles prefer warm bays, shallow coastal waters, tidal rivers, estuaries, and seagrass beds with substrates of sand and mud. No Kemp's ridley sea turtle nesting habitat occurs near the project site (i.e., sandy beaches), and nesting has not been known to occur in the area. However, open water areas of the Mississippi Sound may provide foraging habitat for Kemp's ridley sea turtles.

The leatherback sea turtle is the largest sea turtle, weighing up to nearly 1 ton. Leatherback sea turtles are the most pelagic of the sea turtles, seldom approaching land except for nesting. The largest known concentration of leatherback sea turtle nests is located on the western coast of Mexico. In the eastern United States, nesting is known to occur occasionally on high energy beaches on the northeastern shores of the Gulf of Mexico and in southeastern Florida.

Adult leatherbacks forage on a wide variety of invertebrates, including gastropods, mollusks, and crustaceans (NMFS and FWS, 1992). Leatherbacks are abundant in the northern Gulf of Mexico, but primarily in deep waters of the continental slope and beyond (Hansen et al., 1996; Mullin and Hoggard, 1998); however, they also occur on the continental shelf in smaller numbers. This species has been reported as occurring in shallow coastal waters but not usually near shore (Lee and Socci, 1989). Due to the lack of suitable foraging and nesting habitats, there is a low probability of the leatherback sea turtle occurring within the project area.

The loggerhead sea turtle is the most abundant sea turtle in the Gulf of Mexico (Dodd, 1988). Loggerhead sea turtles inhabit nearshore continental shelves and estuarine portions of temperate and tropical waters worldwide. The NMFS and FWS estimate (1991b) that 35 to 40 percent of total loggerhead nesting worldwide occurs in the southeastern United States, of which 80 percent occurs in Florida. The loggerhead has been known to occasionally nest on Mississippi's barrier islands, about 12 miles south of the project site (MDMR, 2005b).

After hatching, loggerhead sea turtle hatchlings swim directly offshore and become associated with *Sargassum* in pelagic drift lines where they remain for a number of years. Subadults are known to enter estuaries where they remain until they achieve maturity. Adult loggerheads inhabit diverse nearshore habitats, including turbid bays. Loggerheads will eat a wide variety of foods, such as aquatic plants, crustaceans, mollusks, jellyfish, squid, sea urchins, and fish (NMFS and FWS, 1991b).

Potential Sea Turtle Impacts

The green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtle require sandy beaches for nesting. The shoreline of the LNG Clean Energy Project would not provide suitable nesting habitat for sea turtles, as it is predominantly intertidal mudflats. Therefore, the project would have *no effect* on nesting sea turtles.

Sea turtle occurrence is expected throughout the estuarine and marine environments of the project area. Activities such as dredging and dredged material placement, increases in noise and vessel traffic, and potential spills could potentially affect sea turtles in the project area. These potential impacts are discussed below.

*Dredging/Dredged Material Placement* - Gulf LNG proposes to dredge the ship berth and maneuvering area using a mechanical clamshell dredge. Because the project area does not support foraging habitat for leatherback and hawksbill sea turtles, impacts on these species are unlikely. It is possible that dredging activities could directly destroy or degrade benthic foraging habitats that could be used by other sea turtle species. However, the relatively slow dredging motion of clamshell dredges has been reported to present minimal risk of directly injuring or killing sea turtles (Dickerson, et al., 2004).

Dredging and dredged material placement would create a sediment plume, which can affect aesthetics, light penetration, feeding, and, at very high levels, could injure sea turtles. Sediment plumes generated by dredging and dredged material placement could temporarily disrupt the feeding activity of sea turtles in the project area and at the dredged material placement site. Physical impacts on Kemp's ridley and loggerhead sea turtles are expected to be minimal as these species are known to forage in highly turbid waters. However, Kemp's ridley, green, and loggerhead sea turtles would be expected to relocate to similar habitat during dredging and dredged material placement. To minimize the potential impacts associated with dredging, Gulf LNG would implement the following construction practices:

- monitor dredging operations for adverse effects with established contingencies to reduce impacts if they are observed. If a sea turtle is observed in the active dredging area, operations would be suspended until the turtle leaves the active dredging area of its own volition;

- suspend operations during severe weather, which would reduce the extent of dredging-related sediment transport and siltation, thereby reducing potential alteration of benthic habitats; and

- avoid actively dewatering barges prior to overboard flow of excess, sediment-laden water in the work area. This reduction would reduce the potential alteration of benthic habitats in the vicinity of dredging activities.

In addition to these practices, Gulf LNG is proposing to place construction-related dredged material at the ODMDS south of Horn Island, which is an approved dredged material placement location. Given the proposed offshore placement of construction-related dredged material, the sediment would likely be removed using a mechanical clamshell dredge and bottom dumping barges or scows would be used to transport dredged material to the ODMDS. The use of the bottom dumping barges or scows minimizes resuspension of sediments at the placement site because dredged material placement occurs rapidly. In general, the primary effects of dredged material placement in offshore areas are an increase in the concentrations of suspended solids in the water column and burial of aquatic organisms. Except for changes in bathymetry, resources affected by offshore placement of dredged material generally recover over time. Sea turtles in the vicinity of the ODMDS would likely avoid the area while placement is occurring. The EPA (1991) found that dredged material placement at this site would not result in adverse impacts on any endangered or threatened sea turtles or their critical habitat. Additional information on the impacts of dredged material placement on aquatic resources is presented in section 4.6.2.2.

Maintenance dredging of the ship berth and maneuvering area during operation of the proposed project would be conducted on a 3-year cycle, and would remove between 115,000 and 180,000 $yd^3$ of sediment per cycle. To minimize disturbance, dredging would be timed to match the COE's dredging of Bayou Casotte. As currently proposed, dredged material would be placed in the BCDMMS, which is located immediately adjacent to the LNG Clean Energy Project site (see section 2.7.1). Therefore, no impacts on sea turtles from the placement of maintenance dredged material are anticipated.

*Noise* - Sea turtles may be impacted by increased noise from pile driving activities and ship noise. Studies have shown that the sound waves from pile driving may result in injury or trauma to fish, sea turtles, or animals with gas-filled cavities, such as swim bladders, lungs, sinuses, and hearing structures (Abbott and Sawyer, 2002). The use of impact hammers for pile driving would result in greater acoustic energy in the surrounding aquatic environment compared with the use of vibratory hammers. Potential impacts on sea turtles due to increased noise from pile installation are discussed in section 4.6.2.2.

Because dredging and other construction activities would occur before and during pile installation, sea turtles would likely avoid the area where the most intense sound levels would be generated. Nevertheless, given the potential for sea turtles to occur in the area, Gulf LNG has agreed to implement the following measures recommended by the NMFS to mitigate the effects of pile driving activities and associated noise on protected species.

- Establish a 500-meter safety zone that would be monitored for the presence of sea turtles (and other protected species such as dolphins) prior to beginning any pile driving in estuarine environments. In enclosed areas with structures limiting propagation (e.g., sea walls or channel banks), observations would focus on those aquatic areas most affected from the activity.

- Following the initial observations, conduct intermittent observations at least once an hour to monitor for sea turtles (and dolphins) in the area. Intermittent observations would be conducted during daylight hours for at least 5 minutes to maintain watch for animals in the area, and ensure the bubble curtains are functioning properly. If, at any time, animals are observed to be injured or harassed in the safety zone during pile driving, the pile driving activity would cease until the animal has left the area of its own volition.

- Avoid pile driving during nighttime hours when visual clearance of the zone cannot be conducted.

- Use a bubble curtain during pile driving operations to distribute air bubbles around 100 percent of the perimeter of a pile over the full depth of the water column while it is being driven. The bubble curtain components would include a high-volume air compressor, primary feed line, and a distribution manifold. The bubble curtains would be checked and maintained for effectiveness.

- Maintain records of all sea turtle (and marine mammal) sightings in the area, including date and time, weather conditions, species identification, approximate distance from the pile, direction and heading in relation to the pile driving, and behavioral observations. If animals are observed in the safety zone, additional information such as corrective actions taken (e.g., shutdown of the pile driver and duration of the shut-down), behavior of the animal, and time spent in the safety zone would be recorded.

Noise from the engines of construction vessels or LNG ships would also result in increased underwater noise in the project area. However, because sea turtles are mobile, it is anticipated that they would avoid areas with high noise levels during construction and operation of the proposed project.

*Vessel Traffic* - the NMFS expressed concern that LNG marine traffic associated with operation of the LNG terminal could potentially affect sea turtles in the open Gulf of Mexico (NMFS, 2005b). Vulnerability to collision with an LNG ship would be greatest while sea turtles feed, swim, and rest near the surface of the water. In areas of intense ship traffic, sea turtles can experience propeller or collision injuries; however, most of these injuries are caused by small, fast moving vessels (NMFS, 2004b). In contrast, LNG ships push a considerable bow wave because of their design and large displacement tonnage. This wave pushes water, flotsam, and other small objects (like sea turtles) away from the vessel. In addition, ships traveling to the LNG terminal would use established and well-traveled shipping lanes, thus further reducing the potential for collisions as the existing vessel traffic likely deters sea turtles from occupying these areas.

*Accidental Spills or Leaks of Hazardous Materials* - If the occurrence of a sea turtle were to overlap with the rare incidence of a spill, leak, or accidental release of fuels, lubricants, or other hazardous substance, a turtle would be at risk due to impacts on respiratory, skin, blood chemistry, and salt gland function (NMFS, 2004b). Sea turtles are susceptible to the effects of spills either by direct encounter or ingestion of contaminated prey. Fuel spills from construction vessels or LNG ships could potentially occur during both construction and operation of the project. If a spill were to occur, sea turtles would likely move away from the most concentrated areas. The presence of the vessels involved in spill control and clean-up would discourage the presence of sea turtles. The low likelihood and limited volume of fuel spills coupled with the overall rarity of sea turtles in the project area minimizes the potential for impacts on this species. In addition, Gulf LNG would minimize potential impacts associated with spills or leaks of hazardous materials during construction by implementing its SPPC Plan (see section 4.3.1.4 and Appendix C).

For LNG ship operation in the open Gulf of Mexico there is a possibility that fuel used for vessel propulsion or auxiliary/emergency generators could spill or leak. Fuel (e.g., diesel) on each ship is protected by the vessel's double hull. Each vessel would maintain a SOPEP as discussed in section 4.7.1.1. In addition, should this project be approved, Gulf LNG would prepare an SPCC Plan for operation of the project that would include procedures to prevent and mitigate accidental releases of oil, gas, lubricants, or hazardous materials (see sections 4.2.1.7 and 4.3.1.4). Additional information regarding LNG shipping incidents and their potential impacts along the transit corridor is provided in

section 4.13.5.3. With the implementation of these measures, the low likelihood and limited volume of fuel spills in the vicinity of the transit route, coupled with the overall rarity of sea turtles, minimizes the potential for impacts on sea turtles.

Sea Turtle Conclusions

Overall, we have determined that, with the implementation of Gulf LNG's SPCC Plan, the Strike Avoidance Procedures, and the proposed mitigation measures related to pile driving, sea turtles would *not likely be adversely affected* by construction and operation of the proposed project. In a letter to the FERC staff dated April 28, 2006, the FWS concurred that the project is not likely to adversely affect any of the five species of sea turtles under the FWS' jurisdiction.

#### 4.7.1.4 Fish

**Smalltooth Sawfish**

The smalltooth sawfish is listed as endangered in the Gulf of Mexico. Sawfish species inhabit shallow coastal waters of tropical seas and estuaries throughout the world where they are generally found in shallow waters very close to shore over muddy and sandy bottoms (NMFS, 2005b). They are often found in sheltered bays, on shallow banks, and in estuaries or river mouths. Historically, the smalltooth sawfish was common throughout the Gulf of Mexico from Texas to Florida. However, the current range of this species is confined mainly to peninsular Florida. The decline in smalltooth sawfish abundance has been caused primarily by bycatch in various fisheries, likely compounded by habitat degradation. Due to the fact that abundances are low and there are no known breeding or juvenile habitats in the project area, the risk of harm to smalltooth sawfish associated with the LNG Clean Energy Project is so low as to be considered discountable (NMFS, 2005b). Consequently, we have determined that the project would have *no effect* on the smalltooth sawfish.

**Gulf Sturgeon**

The Gulf sturgeon is a distinct sub-species of Atlantic sturgeon, historically distributed from Charlotte Harbor to the Mississippi River (Ross, 2001). The Gulf sturgeon is an anadromous fish that migrates from saltwater into large coastal rivers in the spring between February and April. Reproductive fish move from the mouths of coastal rivers upriver to spawn. At present, the only known spawning locations in Mississippi are at Bouie Creek (about 160 miles north-northwest of the proposed project area) and at the Pearl River (about 75 miles to the west of the proposed project area). However, spawning may also occur in the Chickasawhay River about 225 miles north of the project location (FWS and Gulf States Marine Fisheries Commission (GSMFC), 1995).

In late October through early November, adult sturgeon move downstream and forage in the estuaries adjacent to the mouth of rivers (Fox et al., 2000, 2002; Harris et al., 2005). They remain in the estuaries until winter temperatures drop whereby they return to saltwater for the coldest 3 to 4 months of the winter (FWS and GSMFC, 1995). Adult Gulf sturgeons do not appear to feed during summer months when they reside in rivers (Wooley and Crateau, 1985; Gu et al., 2001).

When in estuary habitats, the diet of Gulf sturgeon appears to be comprised of benthic organisms and varies locally. In the Suwannee River estuary in Florida, where diet information is perhaps best understood, the diet is dominated by brachiopods (*Glottidia pyrimidata*); however, amphipods (*Ampelisca* spp.), brittle stars (*Ophiactis abyssicola*), and lancelets (*Amphioxus* spp.) are also included (Huff, 1975; Mason and Clugston, 1993). In Choctawhatchee Bay, also in Florida, a major diet component is ghost shrimp (*Lepidophthalmus louisianensis*) as well as amphipods (Fox et al., 2002).

Analysis of sediments associated with prey species observed in the Suwannee River estuary and Choctawhatchee Bay indicated that prey items were generally associated with sand environments (Harris et al., 2005). Tracking of Gulf sturgeon throughout the winter indicated that they generally were located in water depths ranging from 8 to 12 feet (Fox et al., 2002) in Choctawhatchee Bay and 3 to 12 feet in the Suwannee River Estuary (Harris et al., 2005).

Critical Habitat

The LNG Clean Energy Project is located on the Mississippi Sound about 4 miles southeast of the mouth of the Pascagoula River. The area to be dredged for the marine facilities is located between the federal navigation channel and the shoreline, with water depths ranging from 0 to 8 feet. Sediments are a mixture of sand, silt, and clay. This portion of the Mississippi Sound has been designated as critical habitat for the Gulf sturgeon. Mississippi Sound critical habitat includes open bays, including Pascagoula Bay, Point aux Chenes Bay, Grand Bay, and Sandy Bay. The northern boundary of the Mississippi Sound critical habitat is mainland shorelines between Heron Bay Point, Mississippi and Point aux Pins, Alabama (FWS and GSMFC, 1995). The southern boundary of the Mississippi Sound critical habitat is 1.2 miles offshore of the barrier islands and offshore of the 72 COLREGS lines at barrier island passes (defined at 33 CFR Part 80.815). There are seven Primary Constituent Elements (PCEs) associated with the designated critical habitat for Gulf sturgeon. The designation of PCEs helps to focus conservation efforts and impact minimization measures on those critical elements of the habitat that are essential to the conservation of the species. However, based on consultation with the NMFS in July 2005, only four of the PCEs apply to the LNG terminal site; the other three PCEs are associated with the riverine component of Gulf sturgeon habitat. The four applicable PCEs include abundant food items, water quality, sediment quality, and safe and unobstructed migratory pathways.

In the project area, the Gulf sturgeon and its designated critical habitat are under the jurisdiction of the NMFS. Representatives of Gulf LNG initiated consultation with the NMFS, Protected Resources Division staff in November 2004. Gulf LNG developed a habitat characterization plan to compare the proposed LNG Clean Energy site to two known Gulf sturgeon feeding sites at the mouth of the Pascagoula River. The plan was approved by the NMFS and field work was conducted in the spring of 2005. The resulting report was submitted to the NMFS in June 2005. Information collected during the study resulted in the following determinations:

- the organic component of the sediments at the proposed LNG terminal was about half the level observed at the Pascagoula River sample sites;
- the clam *Gemma gemma*, previously observed in the stomach contents of Gulf sturgeon, was abundant at the proposed project site;
- the surficial sediments at the proposed project site and both of the Pascagoula River sites were dominated by sand;
- the proportion of inorganic sediment components (sand, silt, and clay) differed significantly between the proposed project site and the two Pascagoula River sites;
- blue crabs were being actively fished at both of the Pascagoula River sites, but not near the proposed project site, indicating a lower freshwater input at the project site;
- invertebrate density at the proposed project site was lower than has been observed in other regions for Gulf sturgeon; and
- species composition taken from the proposed project site clustered separately from those of the two Pascagoula River sites.

Potential Gulf Sturgeon Impacts

The proposed project area is located in a section of the Mississippi Sound that the NMFS and FWS have designated as critical habitat for the Gulf sturgeon. Adult Gulf sturgeon pass through the area at the mouth of the Pascagoula River on their outward migration to, and subsequent return from, the offshore barrier islands during the winter feeding period. Therefore, adult fish may be expected to occur in this area during the 4 to 5 coolest months of the year (November to March). Construction and operation activities associated with the proposed LNG Clean Energy Project have the potential to impact the Gulf sturgeon and its designated critical habitat. Activities such as dredging and dredged material placement, increases in noise, the discharge of water from the SCVs, LNG ship cooling water intake and discharge, and spills or leaks of hazardous materials could potentially affect Gulf sturgeon in the proposed project area. In addition, construction and operation of the proposed LNG Clean Energy Project have the potential to affect PCEs associated with the critical habitat of the Gulf sturgeon. These potential impacts are discussed below.

*Dredging and Dredged Material Placement* - Dredging associated with the construction of the proposed berthing and maneuvering area is expected to take approximately 8 to 9 months and would temporarily impact about 61.3 acres of open water habitat. Dredging activities could increase sedimentation and turbidity in the immediate vicinity of the dredging operations, potentially resulting in a short-term impact on fish and other biological resources in the area (see section 4.6.2.2). Turbidity resulting from dredging activities is not in itself a problem for Gulf sturgeon, which naturally feed in some of the most turbid and stained environments in the Gulf of Mexico, including the Choctawhatchee Bay, Apalachicola Bay, and the Suwannee River estuary in Florida. However, increases in biological oxygen demand associated with turbidity resulting from disruption of reduced or anoxic sediments during dredging may cause sturgeon, if present, to avoid the area until dissolved oxygen levels increase above 2 ppt. Based on the physical characteristics of the project site, increased sedimentation and turbidity due to dredging activities would be temporary, and suspended sediments would likely return to background levels a short time after and a short distance from the point of disturbance. Nevertheless, dredging would be kept to a minimum and would be conducted in accordance with permit requirements. Additional information on the impacts of dredged material placement on aquatic resources is presented in section 4.6.2.2.

To minimize potential impacts associated with dredging, Gulf LNG would implement the following construction practices:

- monitor dredging operations for adverse effects with established contingencies to reduce impacts if they are observed;
- suspend operations during severe weather; and
- avoid actively dewatering barges prior to overboard flow of excess water.

When completed, dredging associated with construction of the proposed ship berth and maneuvering area would have an impact on approximately 61.3 acres of open water habitat. Much of the proposed dredging area is shallower than the preferred water depths measured in other known feeding areas. For example, tracking of Gulf sturgeon throughout the winter indicated that they generally were located in water depths ranging from 8 to 12 feet (Fox et al., 2002) in Choctawhatchee Bay and 3 to 12 feet in the Suwannee River Estuary (Harris et al., 2005). The area to be dredged for the marine facilities is located between the federal navigation channel and the shoreline where the depths range from 0 to 8 feet. However, a majority of the area to be dredged is currently at depths that are less than 4 feet. The ship berth and associated maneuvering area would be dredged to an elevation of -42 feet MLLW, with an

additional 2 feet for advance maintenance and up to 2 feet of potential overdredge allowance. Because the sides of the ship berth and maneuvering area would be contoured at a 5:1 slope, much of the dredged area would be shallower than -42 feet MLLW (see figure 2.1.1-1).

Additionally, information collected through field surveys has reported that invertebrate prey, sediment characteristics, and water quality in the immediate vicinity of the proposed project are different from characteristics observed at other known Gulf sturgeon feeding sites. Therefore, the conversion of about 61.3 acres of shallow subtidal non-vegetated estuarine open water habitat to a roughly equivalent acreage of deeper subtidal estuarine habitat is not likely to have a significant impact on the Gulf sturgeon and represents a negligible alteration of designated critical habitat (see PCE impact evaluation below). As discussed in detail in section 4.6.2.2, benthic organisms removed by dredging activities in soft sediments typically have rapid re-colonization rates (within 12 to 18 months of the cessation of relevant construction impacts), preventing long-term impacts on the biota of these areas (Applied Biology, Inc, 1979; Blake et al., 1996; Desprez, 2000; and Hammer et al., 2005). The ship berth and maneuvering area would be adjacent to the existing Bayou Casotte Channel. Although some shallow open water habitat at this location may be altered for forage use by the Gulf sturgeon, adjacent undisturbed areas in the Mississippi Sound are present. Also, foraging may continue once the berth is constructed and the project is in operation, since subtidal benthos would become reestablished in the dredged area. A significant loss of Gulf sturgeon critical habitat and potential feeding area for this species due to construction of the proposed ship berth and maneuvering area is not anticipated.

Gulf LNG is proposing to place the dredged material at the ODMDS about 5 miles south of Horn Island. This placement area is outside of the area designated as critical habitat for Gulf sturgeon. Sediments would be removed using mechanical dredging equipment and transported to the ODMDS using bottom dumping barges or scows. Use of bottom dumping barges or scows minimizes resuspension of sediments because dredged material placement occurs rapidly. Thus, any secondary impacts on the nearest designated Gulf sturgeon critical habitat, which is 1.2 miles seaward of Horn Island, are unlikely.

As previously described, maintenance dredging of the berth area would be conducted on a 3-year cycle. Maintenance dredging would occur over approximately 2 weeks, and would temporarily increase turbidity resulting in impacts similar to those described during construction. This would result in a direct, short-term impact on benthic macroinfaunal communities due to the removal of between 115,000 and 180,000 $yd^3$ of sediment per cycle. To minimize impacts on the Gulf sturgeon and its critical habitat, dredging would be timed to match the COE dredging of Bayou Casotte. As currently proposed, dredged material would be placed in the BCDMMS, which is located immediately adjacent to the LNG Clean Energy Project site (see section 2.7.1).

*Noise* - Noise from construction activities of the proposed marine facilities (e.g., dredging and pile driving) may have a temporary impact on the Gulf sturgeon or their habitat. As discussed in section 4.12.2.3, Gulf LNG estimates that pile driving for the LNG terminal would occur over 10-hour shifts, 6 days per week, for a period of about 37 weeks. Pile driving has the potential to create repetitive noise that may be harmful to any Gulf sturgeon located in close proximity. However, other engine noises, small work boats, and general activity associated with pile driving are likely to elicit an avoidance response from the Gulf sturgeon that would keep them away from the construction area. Section 4.6.2.2 includes additional information regarding the impact of noise on aquatic resources as well as our recommendations to minimize this impact.

*Discharge Water from the SCVs* - Water is produced as a by-product of combustion in the SCV process. In addition, industrial supply water would be injected into the SCVs to control $NO_x$ emissions. Under the proposed design, each SCV would generate up to 20 to 30 gpm of water depending on the source water used by the emission control system. The maximum water produced by SCVs during

operation of the LNG Clean Energy Project would be 0.4 mgd. Gulf LNG proposes to discharge the SCV water directly to the Mississippi Sound following pH adjustment. This would require an NPDES permit. To minimize potential water quality impacts associated with the discharge to the Mississippi Sound, water from the SCV neutralization tank would be routed through a submerged high velocity outlet located within the ship berthing area. The outlet would be submerged to take advantage of the buoyancy of the discharge relative to that of the receiving water. Discharging at depth (i.e., 20 feet below the water surface) would enhance the natural mixing and dilution of the effluent as it rises through the water column. Depending on final design, the jet mixing zone would extend from about 5 to 20 feet from the point of discharge. Through proper management of excess SCV water, potential impacts on receiving waters would be minimized.

*LNG Ship Cooling Water Intake and Discharge* - All ships use water to cool their boilers. Usage rates for cargo ships operating in the Gulf of Mexico are typically on the order of 40,500 gpm. However, the cooling demand of LNG ships while offloading would be expected to be substantially lower than for cargo ships operating within Gulf sturgeon critical habitat because the main propulsion machinery would not operate while the LNG ship is offloading. The cooling water would be withdrawn from the Mississippi Sound at the project location. Depending upon engine type, LNG ships could use between 15 and 42 million gallons of water for engine cooling while they are at the berth. Water used for engine cooling would be quickly discharged, and the resulting increase in water temperature is expected to be minor. Additional information on the potential impacts of cooling water intake and discharge on aquatic organisms is presented in section 4.6.2.2.

*Accidental Spills or Leaks of Hazardous Materials* - Spills, leaks, or accidental releases of fuels, lubricants, or other hazardous substances could potentially occur at the LNG terminal during construction and operation of the proposed project or along the LNG ship transit route, which could have an adverse impact on Gulf sturgeon. Depending on the size of the release, Gulf sturgeon could experience direct injury or mortality. Additional information regarding LNG shipping incidents and their potential impacts along the transit corridor is provided in section 4.13.5.3. Gulf LNG would minimize potential impacts associated with spills or leaks of hazardous materials during construction by implementing its SPPC Plan (see section 4.3.1.4 and Appendix C).

*Primary Constituent Elements* - As described above, there are four PCEs of the designated critical habitat that are relevant to the LNG Clean Energy Project. These include abundant food items, water quality, sediment quality, and safe and unobstructed migratory pathways. Potential impacts of construction and operation of the proposed project on these PCEs are described below.

- Abundant Food Items: Known common prey items, such as brachiopods, amphipods, brittle stars, lancelets, and ghost shrimp, are either lacking or less dense (lower abundance) in benthic samples from the project site than from known foraging areas, such as the Suwanee River or Choctawhatchee Bay. In contrast, the benthic community in the ship berthing and maneuvering area is dominated by macroinfuanal species that are known colonizers (e.g., the polychaete *Mediomastus* spp. and the bivalve *Gemma gemma*). These opportunistic species are highly dominant in number, comprising over 60 percent of all benthic macroinfauna. Initial recolonization of dredged areas would commence in a matter of days or weeks, and these areas would become functional benthic communities similar to pre-dredge conditions or to adjacent reference locations in approximately 12 to 18 months. However, later successional stages of benthic recolonization would be more gradual (Applied Biology, Inc., 1979; Blake et al., 1996; Desprez, 2000; and Hammer et al., 2005). Therefore, the temporary loss of benthos resulting from dredging 61.3 acres of critical habitat, and the potential permanent shift in the benthic community that would reestablish in the deeper berth area, would not result in

an adverse modification of this PCE nor would it adversely affect the conservation of the Gulf sturgeon. To better understand the potential impacts of project construction on the biota of this portion of the Mississippi Sound (including habitat and food items of the Gulf sturgeon), Gulf LNG proposes to conduct a 3-year post-construction habitat survey to obtain information on benthic community recovery at the LNG terminal (see Appendix E).

- Water Quality: Salinity at the project site is higher than at the known feeding area at the mouth of the Pascagoula River, but is within the range observed in other areas known to be used by subadult and adult life stages. Other parameters measured at the project site and the nearby Pascagoula River sites, such as dissolved oxygen, pH, and temperature, are within normal ranges. Other water quality parameters not specifically measured, such as hardness, turbidity, or contaminants, are likely to be similar to the characteristics of much of the Mississippi Sound. Other than temporary and localized increases in turbidity during construction and maintenance dredging, and vessel docking and undocking activities when propeller wash would stir up some sediments, the project is not expected to alter water quality characteristics of the critical habitat. Nevertheless, Gulf LNG has agreed to conduct a 3-year post-construction habitat assessment to obtain information on water quality changes as a result of operation of the LNG terminal (see Appendix E). In addition, Gulf LNG would implement BMPs during construction of the proposed project to minimize the release of heavily sediment-laden water to sensitive resource areas and to prevent the release of contaminated discharges, thereby reducing the impact of the project on water quality.

- Sediment Quality: The existing surficial sediments at the proposed project site are primarily sandy with no or very low concentrations of contaminants. Further, elutriate testing, bioassay testing, and bioaccumulation testing conducted by Gulf LNG revealed that project sediments do not result in any significant adverse affects on water quality or the tested organisms (Barry A. Vittor and Associates, Inc., 2005a). While much of the sediments to be dredged include a high percentage of clays, borings taken from the area to be dredged suggest that existing surficial sediments and sediments in the 40-foot below ground surface depth are primarily sands. Therefore, it is likely that the surficial sediment would have a sand composition that would continue to be similar to known feeding areas when dredging is completed. While deeper, the benthic community that recolonizes the sediments in the dredged area would potentially be similar to that currently present at the site.

- Unobstructed Migratory Pathways: Section 2.1.1.1 includes a description of the ship berth and unloading facilities. The unloading platform, mooring/breasting structures, and the interconnecting catwalks would extend off the shoreline for about 1,400 feet and would be supported by tubular-steel piles rather than fill, such that the movements of any subadult or adult Gulf sturgeon through the area would not be prevented. The dredged berth area is short enough that it would not create a false inlet that could confuse sturgeon attempting to commence an upstream movement into freshwater at the mouth of the Pascagoula River. Additionally, much of the in-water portion of the project is located in shallow water (less than 4 feet) that is unlikely being used currently for migration, or for foraging by adults. So while the construction of ship berth and unloading facilities could result in some minor alterations to the movement patterns of Gulf sturgeon, project facilities would not obstruct any migratory pathways that might be used by this species in the project area. Therefore, the project would not result in a meaningful alteration of this PCE.

Gulf Sturgeon Conclusions

To minimize impacts on Gulf Sturgeon and its critical habitat, Gulf LNG would implement agency dredging requirements, concurrent scheduling of future maintenance dredging, and its SPCC Plans. In addition, Gulf LNG has agreed to perform a 3-year post-construction prey and habitat assessment survey of the ship berth and maneuvering area and adjacent areas following the protocols used in the 2005 habitat characterization. Gulf LNG has incorporated these measures in its Mitigation and Monitoring Plans, which were developed in consultation with the NMFS and other applicable agencies. Gulf LNG's draft Mitigation and Monitoring Plans are provided in Appendices F and E, respectively. With the implementation of these measures, we have determined that the Gulf sturgeon and its designated critical habitat would *not likely be adversely affected* by construction and operation of the LNG Clean Energy Project.

### 4.7.2 Other Special Status Species

In addition to those species protected under the ESA, there are a number of other special status species that may occur in the project area. These species are listed in table 4.7.2-1 and include those identified by the MNHP, marine mammals, and migratory birds.

**State-listed Species of Concern**

Gulf LNG consulted with the MNHP to identify state-listed endangered, threatened, rare, and other species of concern with the potential to occur within the proposed project area. In a letter dated December 5, 2004, the MNHP reported one state-listed endangered species and nine state-listed rare species (see table 4.7.2-1). The state-listed endangered brown pelican is also federally listed and is discussed in section 4.7.1.2.

Despite records of previously known occurrences of the nine state-listed rare species in the project area, the only species the MNHP identified as having the potential to be affected by the project is the least tern. The MNHP stated that adverse impacts on the remaining species are not likely to occur (MNHP, 2004). Therefore, only the least tern is discussed further.

The interior population of the least tern was listed as federally endangered in 1985 throughout its range. However, the least tern is not listed as federally endangered within 50 miles of the Gulf of Mexico. Least terns are known to occur primarily on barren to sparsely vegetated riverine sandbars, dike field sandbar islands, sand and gravel pits, and lake and reservoir shorelines (FWS, 1990). In coastal areas, least terns are known to forage on crustaceans, insects, mollusks, and annelids. Least terns prefer nesting sites in open sandy areas, gravelly patches, or exposed flats (FWS, 2005d). In the project area, intertidal mudflats may provide potential nesting habitat for the least tern. Surveys were conducted by Gulf LNG in June and July 2005, and no signs of a breeding colony were observed in the project area. Because suitable nesting habitat is present in the proposed project area and least terns could utilize the habitat in subsequent years, **we recommend that:**

- **Gulf LNG conduct surveys in areas of suitable least tern nesting habitat if construction begins during the least tern nesting season (April 1 through June 30) in those areas. Results of the surveys, along with agency comments and concurrence, should be filed with the Secretary for the review and written approval of the Director of OEP <u>before construction</u>.**

TABLE 4.7.2-1

**State-listed Rare, Threatened, Endangered, and Other Species of Concern Potentially Occurring in the Project Area**

| Species | State Status [a] | Heritage Rank [b] | Preferred Habitat |
|---|---|---|---|
| Birds | | | |
| Brown pelican *Pelecanus occidentalis* | E | S1 N | Coastal areas and waters within 20 miles of the shoreline and in depths up to 80 feet. |
| Peregrine falcon *Falco peregrinus* | NL | SZ N | Coastal areas and river valleys that provide foraging for wintering individuals. |
| Gull-billed tern *Sterna nilotica* | NL | S2 B, S4 N | Foraging habitat occurs in coastal areas, salt marshes, and estuaries; nesting habitat includes barrier islands, dredged material storage piles, and estuarine marshes. |
| Royal tern *Sterna maxima* | NL | S1 B, S4 N | Foraging and loafing habitat occurs in coastal areas, estuaries, mudflats and sandspits; nesting habitat includes barrier islands, dredged material storage piles, and estuarine marshes. |
| Least tern *Sterna antillarum* | NL | S3 B, SZ N | Foraging and loafing habitat occurs in coastal areas, estuaries, mudflats, and sandy beaches; nesting habitat includes barrier islands, dredged material storage piles, and unvegetated flats. |
| Reptiles | | | |
| Mississippi diamondback terrapin *Malaclemys terrapin pileata* | NL | S2 | Coastal salt marshes, estuaries, and tidal creeks; restricted to the Gulf Barrier Islands and Coastal Marshes ecoregion. |
| Gulf salt marsh snake *Nerodia clarkii clarkii* | NL | S2 | Coastal areas in brackish and saltwater estuaries, salt marshes, and tidal mud flats. |
| Plants | | | |
| Hammock prairie-clover *Dalea carnea* | NL | S? | Scrub-shrub and pine savannahs. |
| Pine barren three-awn grass *Aristida spiciformis* | NL | S1 | Longleaf pine, slash pine, saw palmetto flatwoods. |

[a] State Status:
E = Endangered
NL = Not listed

[b] Heritage Status:
S1 = Critically imperiled
S2 = Imperiled
S3 = Rare or uncommon
S4 = Widespread, abundant, and apparently secure in the state, but with cause for long-term concern
S? = Unranked
SZ = Zero occurrences in the state
B = Breeding
N = Nonbreeding

## Marine Mammals

The Marine Mammal Protection Act prohibits, with certain exceptions, the take of marine mammals in waters of the United States. Twenty-nine species of marine mammals have been recorded within the Gulf of Mexico, including 7 species of baleen whale, 21 species of toothed whales and dolphins, and 1 sirenian (manatee). GulfCet I (Davis and Fargion, 1996) and the subsequent GulfCet II surveys (Davis et al., 2002), along with other surveys and opportunistic sightings, have reported numerous species of cetaceans within the northern Gulf of Mexico. The GulfCet II survey identified 19 species of cetaceans in the Gulf of Mexico but concluded that most cetaceans were associated with cyclonic eddies, which are low salinity, nutrient-rich water with enhanced primary productivity. This association is believed to be in response to a concentration of prey species (Davis et al., 2002). The nearest cyclonic eddies to the proposed facility generally occur about 100 miles south of the proposed terminal.

The only species commonly occurring outside the major influences of eddies, specifically on the continental shelf or shelf break, were bottlenose dolphins and Atlantic spotted dolphins. These two species could occur near the proposed facilities. Bottlenose dolphins have shown a tolerance of vessel traffic, as indicated when they approach vessels to ride the wake (Davis and Fargion, 1996). Atlantic spotted dolphins would be expected to either exhibit a similar response or avoid construction vessels. Construction activities would be temporary and no direct physical contact with marine mammals would be expected, particularly with the implementation of our recommended noise mitigation plan (see section 4.6.2.2). As discussed in section 4.7.1, whales could be affected by increased vessel traffic associated with operation of the project in the Gulf of Mexico and open seas. Due to the high mobility of marine mammals, and with implementation of the Strike Avoidance Procedures described in section 4.7.1, no significant adverse impacts on these species are expected.

During transit to the LNG terminal, the potential exists for an accidental or intentional breach of an LNG ship resulting in a release of LNG and associated fire. As stated in section 4.6.1.2, the released LNG would vaporize rapidly upon contact with the warm air and water. Because LNG is not soluble in water and the LNG would completely vaporize shortly after being spilled, there would be no liquid left that could mix and/or contaminate the water. However, since LNG is a cryogenic liquid, the greatest threat to marine mammals from an LNG spill would be thermal stress. Any species that came into direct contact with the LNG would probably experience a sudden cold shock and, depending in what context that contact occurred, the exposure could be lethal, but because of their mobility, marine mammals would most likely detect the temperature change and avoid the area. Additional information on the environmental impacts resulting from the transit of the LNG ships is provided in section 4.13.5.3.

**Migratory Birds**

Field surveys of the project area indicate that habitat exists for various species of migratory birds. The Migratory Bird Treaty Act implements various treaties and conventions for the protection of migratory birds. Under this act, taking, killing, or possessing migratory birds is unlawful. In order to minimize impacts on migratory birds, **we recommend that:**

- **Gulf LNG avoid clearing woody vegetation during the peak nesting period for migratory birds (April 1 through June 30). If vegetation clearing must be conducted during this time, Gulf LNG should survey for all migratory bird nests <u>no more than 3 weeks before commencing work at the LNG terminal and along the sendout pipeline route</u>. If an active migratory bird nest is found, Gulf LNG should consult with the FWS to identify the most appropriate measures that should be taken to avoid or minimize impacts.**

### 4.7.3 Conclusions and Recommendations

A variety of measures have been proposed by Gulf LNG that would minimize impacts on federally listed and other special status species, including implementation of our Plan and Procedures, implementation of Gulf LNG's SPCC Plans, and providing LNG ship captains with the Strike Avoidance Procedures to avoid or minimize impacts on marine mammals and sea turtles. Additionally, we have recommended other mitigation be implemented to avoid or minimize impacts on threatened, endangered, and other special status species (e.g., woody vegetation clearing and additional field surveys). These measures would reduce the loss of vegetated habitats, minimize water quality impacts, and lessen delays in restoration of areas temporarily disturbed during construction. While beneficial to general wildlife, fisheries, and vegetation in the area, these measures would also benefit listed species with the potential to occur in the vicinity of the project. In conclusion**, we recommend that:**

- **Gulf LNG not begin construction activities at the LNG terminal and along the sendout pipeline route <u>until</u>:**

  **a. the FERC completes any necessary consultations with the FWS and NMFS; and**

  **b. Gulf LNG receives written notification from the Director of OEP that construction and/or implementation of conservation measures may begin.**

  **If construction has not begun <u>within 1 year</u> from the date of issuance of the FERC approval of the project, Gulf LNG should consult with the appropriate offices of the FWS and NMFS to update the species list and to verify that previous consultations and determinations of effect are still current. Documentation of these consultations, and the need for additional surveys and survey reports (if required), and FWS or NMFS comments on the surveys and survey reports and their conclusions, should be filed with the Secretary <u>before beginning construction</u>.**

## 4.8 LAND USE, RECREATION, AND VISUAL RESOURCES

The LNG Clean Energy Project would include the construction and operation of an LNG import terminal as well as a 5.0-mile-long, 36-inch-diameter natural gas sendout pipeline and associated aboveground facilities. The LNG terminal would be located within the Port of Pascagoula on the Mississippi Sound, just southeast of the mouth of the Bayou Casotte Harbor in Jackson County, Mississippi. The proposed 36-inch-diameter sendout pipeline would extend from the LNG terminal along the base of the BCDMMS dike to the intersection of State Highway 611 where it would then turn north and terminate within the Stennis Industrial Park. LNG ships would access the proposed LNG terminal via existing shipping channels and would not affect existing land uses along the route.

The project would affect a total of 186.3 acres of land during construction and 130.0 acres of land during operation. Table 4.8-1 summarizes the land use impacts associated with the project.

TABLE 4.8-1

**Land Use Affected by Construction and Operation of the LNG Clean Energy Project**

| | Industrial/ Commercial Land [a] (acres) | | Open Land [b] (acres) | | Open Water [c] (acres) | | Forested Land [d] (acres) | | Total (acres) | |
|---|---|---|---|---|---|---|---|---|---|---|
| Facility | Const. | Oper. | Const. | Oper. | Const. | Oper. | Const. | Oper. | Const. | Oper. |
| LNG Terminal Facilities [e] | 0.0 | 0.0 | 42.6 | 42.6 | 61.3 | 61.3 | 0.0 | 0.0 | 103.9 | 103.9 |
| Pipeline Facilities [f] | 56.5 | 12.6 | 16.7 | 7.3 | 0.0 | 0.0 | 9.2 | 6.2 | 82.4 | 26.1 |
| Project Total | 56.5 | 12.6 | 59.3 | 49.9 | 61.3 | 61.3 | 9.2 | 6.2 | 186.3 | 130.0 |

[a] Industrial/commercial land includes utility support areas, manufacturing or industrial plants, and cleared road and utility rights-of-way.

[b] Open land includes undeveloped, non-forested lands; scrub-shrub uplands; scrub-shrub and emergent wetlands; and intertidal mudflats.

[c] Open water includes those portions of the Mississippi Sound disturbed by construction and operation of the ship berth and unloading facilities.

[d] Forested land includes deciduous, evergreen, and mixed forest lands as well as forested wetland areas.

[e] Includes LNG terminal, marine facilities, and access road. See section 4.8.1 for a more detailed description of the LNG terminal facilities.

[f] Includes pipeline right-of-way, temporary extra workspaces, access roads, contractor yards and support areas, and aboveground facilities. See section 4.8.1 for a more detailed description of the pipeline facilities.

Const. Construction

Oper. Operation

### 4.8.1 Land Use and Ownership

#### LNG Terminal Facilities

The proposed LNG terminal would be located on a 33.3-acre site within the Port of Pascagoula in Jackson County, Mississippi. The land is owned by the State of Mississippi and leased to the JCPA for port operations. The site consists of created land that was once entirely submerged beneath the waters of Mississippi Sound. Reclamation of this land is believed to have occurred sometime during the 1950s and 1960s when dredged material was placed in the near-shore waters. The area is mostly flat and is designated for water-dependent industrial use. Land uses adjacent to the LNG terminal site include the open waters of the Mississippi Sound to the south, Bayou Casotte to the west, the BCDMMS immediately north, and wetlands associated with Priest Bayou and Bayou Rosa to the east. An existing industrial complex, including Chevron's Pascagoula Refinery, is located about 0.5 mile north of the site.

Construction of the marine facilities associated with the LNG terminal would require dredging about 61.3 acres outside of the property fence line; however, all construction activity for the marine facilities would occur from the water and would not require the use of additional lands. An area about 1,200 feet wide by 2,200 feet long would be dredged to an elevation of -42 feet MLLW, with an additional 2 feet for advance maintenance and up to 2 feet of potential overdredge allowance, to create the ship berth and maneuvering area. Gulf LNG proposes to place the dredged material from the marine facilities at the ODMDS located approximately 5 miles south of Horn Island (see section 2.4.1.3).

A road would need to be constructed and permanently maintained to provide access to the LNG terminal. The main terminal access road would begin at the end of State Highway 611 (also called Industrial Road) and proceed west along the toe of the BCDMMS dike for about 0.6 mile where it would then turn to the south and east for 0.3 mile before entering the northwest corner of the LNG terminal site. The access road would permanently affect about 9.3 acres of land.

Table 4.8.1-1 summarizes the acres of each land use that would be affected by construction and operation of the proposed LNG terminal facilities.

TABLE 4.8.1-1

**Land Use Affected by Construction and Operation of the LNG Terminal Facilities**

| | Industrial/ Commercial (acres) | | Open Land (acres) | | Open Water (acres) | | Forested Land (acres) | | Total (acres) | |
|---|---|---|---|---|---|---|---|---|---|---|
| Facility/Use | Const. | Oper. | Const. | Oper. | Const. | Oper. | Const. | Oper. | Const. | Oper. |
| LNG Terminal Site [a] | 0.0 | 0.0 | 33.3 | 33.3 | 0.0 | 0.0 | 0.0 | 0.0 | 33.3 | 33.3 |
| Marine Facilities (Dredged Area) [b] | 0.0 | 0.0 | 0.0 | 0.0 | 61.3 | 61.3 | 0.0 | 0.0 | 61.3 | 61.3 |
| Access Road | 0.0 | 0.0 | 9.3 | 9.3 | 0.0 | 0.0 | 0.0 | 0.0 | 9.3 | 9.3 |
| Total | 0.0 | 0.0 | 42.6 | 42.6 | 61.3 | 61.3 | 0.0 | 0.0 | 103.9 | 103.9 |

[a] The onshore portion of the LNG terminal that includes the LNG storage area, vaporization facilities, hazard detection and response equipment, and administrative and service buildings.

[b] The offshore portion of the LNG terminal that includes the dredged area and the LNG ship berth and unloading facilities.

Const. Construction

Oper. Operation

Construction and operation of the LNG terminal and associated access road would have minimal impacts on land use. Although the area is currently undeveloped open land, it is designated for water-dependent industrial use. The conversion of the site to an industrial use would be consistent with its designated use as well as with other industrial facilities in the area. Construction and operation of the LNG terminal facilities would result in permanent impacts on wetlands (see section 4.4).

Additional land use impacts could occur as a result of construction and operation of the nonjurisdictional facilities associated with the LNG terminal (i.e., electric transmission facilities and water supply pipeline); however, the final route for these facilities has not been determined (see section 2.2).

**Pipeline and Associated Aboveground Facilities**

A 5.0-mile-long, 36-inch-diameter sendout pipeline would be constructed to transport natural gas from the LNG terminal to interconnects with the Gulfstream and Destin pipeline systems within the Stennis Industrial Park as well as the BP gas processing plant. The majority of land that would be crossed by the pipeline would be industrial/commercial land associated with existing pipeline and/or road rights-of-way. Some forested land would also be crossed.

Land use impacts associated with the pipeline would include the disturbance of existing land uses within the construction right-of-way during construction and retention of a new permanent right-of-way for operation of the pipeline. Gulf LNG proposes to use a 110-foot-wide construction right-of-way for the majority of the pipeline route. The construction right-of-way would be reduced to 75 feet in wetlands and would also be reduced in other areas due to site-specific constraints. Following construction, a 50-foot-wide permanent right-of-way would be retained for operation and maintenance of the pipeline. In addition to the construction right-of-way, Gulf LNG would use various temporary extra workspaces, access roads, and contractor yards and support areas to facilitate construction activities (see section 2.3.2).

The aboveground facilities would consist of three interconnects/meter stations, a pig launcher, and a pig receiver. The pig launcher at MP 0.0 would be located within the 33.3-acre LNG terminal site and would not require any additional land for construction or operation. The Gulfstream Interconnect/Meter Station and BP Gas Processing Interconnect/Meter Station at MP 4.6 would require 0.9 acre of land for construction and operation. These facilities would be located adjacent to an existing Gulfstream meter station within the Stennis Industrial Park. The Destin Interconnect/Meter Station and pig receiver at MP 5.3 would be located within Destin's existing compressor station site in the Stennis Industrial Park. These facilities would require 0.3 acre of land for construction and operation.

Construction of the proposed sendout pipeline and associated aboveground facilities would affect a total of about 82.4 acres of land. During construction, about 43.0 acres of land would be disturbed for the pipeline right-of-way, 2.2 acres for temporary extra workspace, 36.0 acres for contractor yards and support areas, and 1.2 acres for aboveground facilities. Gulf LNG would also utilize two existing roadways for temporary access during construction; however, Gulf LNG believes that these roads can be used without improvements or modifications and would not affect any additional land during construction. Table 4.8.1-2 summarizes the acres of each land use that would be affected by construction of the sendout pipeline and associated aboveground facilities.

Of the 82.4 acres of land affected by construction of the pipeline facilities, about 24.9 acres would be retained as new permanent right-of-way and 1.2 acres would be retained for the aboveground facilities (see table 4.8.1-2). The land retained as permanent right-of-way along the sendout pipeline route would be allowed to revert to former use; however, certain activities, such as the construction of aboveground structures, would be prohibited within the permanent right-of-way. The aboveground facilities would be fenced and no future development would be allowed to occur. The remaining 56.3 acres of land used for temporary construction right-of-way, temporary extra workspace, and the contractor yards and support areas would be allowed to revert to prior uses with no restrictions following construction.

The majority of the sendout pipeline route would be located within or adjacent to existing pipeline and road rights-of-way (see table 2.3.2-1). Approximately 3.6 miles (72 percent) of the proposed pipeline would parallel existing pipeline or road rights-of-way. The remaining 1.4 miles (28 percent) would be constructed on newly created right-of-way; however, 1.1 miles of this would be constructed adjacent to the existing dike associated with the BCDMMS and the proposed permanent access road associated with the LNG terminal.

TABLE 4.8.1-2

**Land Use Affected by Construction and Operation of the Pipeline and Associated Aboveground Facilities**

| | Industrial/ Commercial (acres) | | Open Land (acres) | | Open Water (acres) | | Forested Land (acres) | | Total (acres) | |
|---|---|---|---|---|---|---|---|---|---|---|
| Facility/Use | Const. | Oper. | Const. | Oper. | Const. | Oper. | Const. | Oper. | Const. | Oper. |
| Pipeline Right-of-Way [a] | 21.0 | 11.4 | 12.8 | 7.3 | 0.0 | 0.0 | 9.2 | 6.2 | 43.0 | 24.9 |
| Temporary Extra Workspace | 1.6 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.2 | 0.0 |
| Access Roads | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Contractor Yards and Support Areas | 32.7 | 0.0 | 3.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 36.0 | 0.0 |
| Aboveground Facilities | 1.2 | 1.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.2 | 1.2 |
| Total | 56.5 | 12.6 | 16.7 | 7.3 | 0.0 | 0.0 | 9.2 | 6.2 | 82.4 | 26.1 |

[a] Based on construction rights-of-way requested by Gulf LNG, which vary between 75 feet in wetland areas to 110 feet in upland areas. Operation acreage is based on a 50-foot-wide permanent right-of-way in all areas. Acreage for the portion of the pipeline adjacent to the LNG terminal access road is included in the acreage for the LNG terminal facilities (see table 4.8.1-1).

Const. Construction

Oper. Operation

About 3.0 miles (60 percent) of the land that would be crossed by the sendout pipeline is owned by the State of Mississippi, of which about 1.8 miles is associated with the right-of-way for State Highway 611 and 1.2 miles is leased to the JCPA for port operations. The remaining 2.0 miles (40 percent) is privately owned land. Gulf LNG would need to acquire new easements or property to construct and operate the proposed facilities. Gulf LNG would negotiate a one-time payment for each easement. An easement agreement between a company and a landowner typically specifies compensation for losses resulting from construction, including losses of non-renewable and other resources, damages to property during construction, and restriction on existing uses that would not be permitted on the permanent right-of-way after construction.

If an easement cannot be negotiated with a landowner and the project has been Certificated by the FERC, the company may use the right of eminent domain granted to it under section 7(h) of the NGA and the procedures set forth under the *Federal Rules of Civic Procedure* (Rule 71A) to obtain the right-of-way and extra workspace areas. The company would still be required to compensate the landowner for the right-of-way and damages incurred during construction; however, the level of compensation would be determined by a court according to state or federal law.

Gulf LNG would construct and maintain the pipeline in accordance with measures contained in our Plan and Procedures. Our Plan and Procedures address preconstruction planning, construction, restoration, and right-of-way vegetation maintenance for wetlands, waterbodies, and upland areas.

### 4.8.2 Existing Residences and Planned Developments

#### LNG Terminal Facilities

There are no existing or planned residential developments located within 0.5 mile of the proposed LNG terminal. The closest residences are approximately 1.7 miles northwest of the proposed LNG terminal site. The residences in this area were severely damaged or destroyed by Hurricane Katrina. We assumed that these residences would be rebuilt and, therefore, continued to use them as the closest

residences for the purposes of evaluating impacts associated with construction and operation of the LNG terminal.

Potential impacts on residences associated with the proposed LNG terminal could include temporary construction-related impacts and permanent impacts associated with operation. Temporary construction impacts could include inconvenience caused by noise generated during pile driving activities associated with the installation of the proposed facilities. Potential impacts associated with noise from pile driving activities would be minimal because residences are located over 1 mile from the construction site. Additional discussion of noise impacts is provided in section 4.12.2. Permanent impacts on residences associated with operation of the proposed LNG terminal include those on visual resources. Potential visual impacts on existing residences associated with the LNG terminal and LNG ships are discussed in section 4.8.4.

The proposed project would not conflict with any approved residential or commercial development plans; however, Chevron is proposing to expand its existing Pascagoula Refinery, which is located about 0.5 mile north of Gulf LNG's proposed LNG terminal site. Bayou Casotte Energy, a subsidiary of Chevron, is also proposing to site, construct, and operate an LNG import terminal north of Gulf LNG's proposed LNG terminal site (the project is referred to as the Casotte Landing LNG Project). Section 4.14 includes a description of these planned projects and an analysis of potential cumulative effects when considered in conjunction with the LNG Clean Energy Project. No residences or planned residential developments are located along the centerline of the LNG ship transit route.

**Pipeline and Associated Aboveground Facilities**

No residences are located within 50 feet of the proposed sendout pipeline and associated construction work areas. The closest residences are located about 0.4 mile west of the proposed pipeline facilities in the City of Pascagoula. Besides the proposed Casotte Landing LNG Project identified above, no other planned residential or industrial/commercial developments are proposed within 0.25 mile of the proposed pipeline facilities.

### 4.8.3 Recreation and Special Interest Areas

The LNG Clean Energy Project would not affect any state forest land, national or state parks, Indian reservations, wild and scenic rivers, national trails, or registered natural landmarks. There are no developed recreation sites located on or adjacent to the LNG terminal site. However, as previously discussed, the proposed LNG terminal would be located within the Port of Pascagoula on land owned by the State of Mississippi and leased to the JCPA for port operations. A SMA Plan has been developed for the Port of Pascagoula. In addition to the Port of Pascagoula, the Grand Bay Reserve is located in the vicinity of the proposed facilities. During transit to the LNG terminal, the LNG ships would pass between Petit Bois and Horn Islands, which are part of the Gulf Islands National Seashore. Areas for general recreation activities, including recreational boating and fishing, are also located in the project area and along the LNG ship transit route.

**Port of Pascagoula**

During development of the SMA Plan for the Port of Pascagoula in November 1985, an SMA Task Force identified 17 SMAs within a 105 square mile area along the Gulf Coast of Mississippi. Within the Pascagoula SMA, the SMA Task Force delineated two separate planning areas: the Bayou Casotte-Bangs Lake Planning Area and the Pascagoula River Harbor-Middle River Planning Area. The facilities associated with the LNG Clean Energy Project would be located within the Bayou Casotte-Bangs Lake Planning Area within the Pascagoula SMA. The Bayou Casotte-Bangs Lake Planning Area

is further divided into five management units: Greenwood Island, Tenneco/Chevron, Bayou Casotte/Mississippi Sound, Upper Bayou Casotte, and Bangs Lake/Point aux Chenes Bay. The proposed project facilities would be located within the Tenneco/Chevron Management Unit.

The planning and management goals for the Tenneco/Chevron Management Unit provide for state-designated uses, including industrial and general use. Its boundaries are defined as "marsh and water-bottom areas east of the Bayou Casotte entrance channel and immediately south of the existing Chevron development" (Mississippi CMP, SMA Task Force, 1985). Within the Tenneco/Chevron Management Unit is a 320-acre area, referred to as the Tenneco Site, which was previously used as a placement area for dredged material from Bayou Casotte until a new dredged material placement area was chosen adjacent to the site to serve the federal channel and the Port of Pascagoula. The new confined dredged material placement facility is referred to as the BCDMMS.

The COE's DMMP for maintenance of Bayou Casotte includes long-term management strategies and environmental evaluation as well as a mitigation plan for the BCDMMS. The mitigation plan was developed using a wetland delineation conducted in 1996 and included the following specific mitigation at the Tenneco Site:

- creation of 24 acres of wetlands, and
- protection of approximately 25 acres of wetlands.

The COE has completed the creation of the 24-acre wetland area required by the DMMP in an area south of the BCDMMS by installing a rock breakwater and placing fill behind the breakwater. This area has experienced some erosion due to coastal storms and the COE is planning to conduct maintenance activities during the summer of 2006 to restore this area. Construction and operation of the LNG Clean Energy Project would not affect the 24-acre wetland creation area.

The 25-acre wetland protection area appears to be located south and east of the proposed LNG terminal site; however, mapping provided in the SMA Plan and the DMMP does not accurately define the boundaries of the protection area in relation to the existing conditions on the ground. Gulf LNG has indicated that it is coordinating with the COE and the MDMR regarding the specific limits of the creation and protection areas as well as any required mitigation measures for these areas. As discussed in section 4.4.3, Gulf LNG has developed a draft Mitigation Plan that includes the creation of new coastal wetlands to compensate for permanent wetland impacts associated with the development of the LNG terminal and access road.

**Grand Bay Reserve**

The Grand Bay Reserve is located in the vicinity of the proposed LNG Clean Energy Project. Grand Bay Reserve includes 150,000 acres of land in Jackson County, Mississippi and Mobile County, Alabama. Informally designated as the Grand Bay Reserve, the area is owned by a variety of public and private interests, including the Grand Bay National Wildlife Refuge (NWR), the Grand Bay National Estuarine Research Reserve, the Nature Conservancy's Grand Bay Bioreserve, and lands managed by Mississippi and Alabama state agencies. The Grand Bay Reserve contains at least 12 natural communities and 57 species listed as rare or imperiled by the MNHP (see section 4.6.1.1).

The LNG terminal site is located about 0.5 mile west of the Grand Bay Reserve. The sendout pipeline route would pass through about 0.5 mile of the reserve between MPs 1.1 and 1.6. Although within the Grand Bay Reserve area, the land that the pipeline would cross is owned by Jackson County and is within an existing MDOT utility right-of-way (Clark, 2005). Nonetheless, we have recommended that Gulf LNG consult with the Grand Bay Reserve biologist to determine the need for developing site-

specific measures that would avoid or minimize impacts on unique, rare, and imperiled species within the reserve (see section 4.6.1.1).

**Gulf Islands National Seashore**

The Gulf Islands National Seashore was established in 1971 to provide recreation for visitors and to protect the wildlife, barrier islands, salt marshes, historic structures, and archeological sites along the shores of the Gulf of Mexico. In 1978, Congress set aside Horn Island and Petit Bois Island as Wilderness areas.

The proposed LNG terminal would be located about 8 miles north of the Horn Island Pass (between Horn and Petit Bois Islands); therefore, no direct impacts associated with development of the project would occur on these areas. However, Gulf LNG is proposing to place the dredged material associated with construction of the project in the EPA-designated ODMDS located approximately 5 miles south of Horn Island. The transportation of the dredged material to the ODMDS through the Horn Island Pass could have an indirect impact on this area. Indirect impacts associated with LNG marine traffic could also occur during operation of the project. As discussed in section 4.10.2, LNG ships would traverse Horn Island Pass en route to the LNG terminal. Section 4.1.3.5 contains a discussion of the potential for shoreline erosion on Horn Island due to LNG marine traffic. Additional information on the environmental impacts resulting from the transit of the LNG ships is provided in section 4.13.5.3. Gulf LNG has initiated consultation with the National Park Service regarding any potential concerns regarding construction and operation of the LNG Clean Energy Project.

**Recreational Boating and Fishing**

Existing recreational boating and fishing use in the immediate vicinity of the proposed project is limited. The only access for fishing in the area is by boat; there is no public access to or from the site by land. Gulf LNG obtained information from the MDMR regarding ramp pressure (recreational boat use of public boat ramps) to quantify, to the extent possible, recreational boating and fishing use in the project area. According to the MDMR, the nearest public boat ramp to the LNG terminal site is located on the west side of Bayou Casotte on Lander Avenue, about 1.9 miles from the proposed site. Ramp pressure data for this ramp indicate that recreational boating and fishing traffic originating from the Lander Avenue area is relatively limited, peaking at 19 users per day during the months of May, June, July, and August. Additional recreational boaters may utilize the waterway in the vicinity of the project area from access points at different locations such as the Singing River Yacht Club, which is located about 1.7 miles northwest of the LNG terminal site. However, the relatively shallow water depths in the vicinity of the proposed LNG terminal (ranging from 0 to 8 feet but generally less than 4 feet deep) preclude many recreational boaters from utilizing this area.

During construction of the marine facilities, dredging equipment and other barge-mounted machinery would be on station for approximately 21 months. This equipment would primarily operate within the marine terminal area between the shoreline and Bayou Casotte Channel, with the exception of waterborne deliveries of material that would arrive at the site via the dredged navigation channel. Recreational boating and fishing activities are not expected to be significantly affected during construction of the marine facilities because of the nature of the work site (i.e., shallow water) and the fact that recreational boaters who do currently operate in the area have to avoid existing vessel movements similar to those that would be experienced during construction of the project.

Operation of the LNG Clean Energy Project would affect recreational boating and fishing in the Mississippi Sound during the arrival, unloading, and departure of LNG ships. Impacts on recreational boating and fishing could also occur along the waterway from the territorial seas to the facility's berth.

Gulf LNG anticipates that approximately 150 ships would unload at the LNG terminal each year. Docks in the Port of Pascagoula currently accommodate commercial ships, including oil tankers. As a result, marine traffic associated with the project would not introduce any significant new type of impacts on recreational boating or fishing. In addition, because small vessel traffic, including recreational boats, can operate outside the confines of the navigation channels and remain clear of the LNG ships, they would not be adversely affected by the additional ship traffic. However, while in transit or docked, LNG ships would have a security zone enforced around them (see section 4.13.5). Other vessels, including recreational boats, would be prohibited within the security zone during the arrival of LNG ships. These effects would be temporary while the boat is in transit or moored at the ship unloading facility. A detailed discussion of impacts on marine traffic associated with the LNG Clean Energy Project is presented in section 4.10.2. A detailed discussion of potential cryogenic/thermal impacts along the LNG ship transit route is provided in section 4.13.5.

### 4.8.4 Visual Resources

**LNG Terminal Facilities**

The degree of visual impact that may result from a proposed project is typically determined by considering the general character of the existing landscape and the visually prominent features of the proposed facilities. The proposed LNG terminal would be constructed at a currently undeveloped site on the Mississippi Sound just southeast of the mouth of the Bayou Casotte Harbor in Jackson County, Mississippi. The site is located south of an existing industrial complex that includes Chevron's existing Pascagoula Refinery. Topography in the project area is generally flat with primarily scrub-shrub vegetation. There are no residences, schools, or other visually sensitive land uses located in close proximity to the terminal site.

During construction, temporary facilities and equipment would be required, including offices and warehouses, construction equipment, and cargo and crane barges. The construction activities would likely be visible from commercial and recreational boating traffic on the Mississippi Sound and would potentially be visible from the industrial properties located to the north of the project site and residential areas to the northwest along Beach Boulevard. Impacts on visual resources resulting from the use of these construction-related facilities and equipment would be temporary because they would be limited to the duration of construction.

After construction, the most prominent visual feature of the proposed LNG terminal would be the two LNG storage tanks. Each tank would be about 170 feet above the current grade and 258 feet in diameter. This height is generally comparable to industrial structures located north of the terminal site. Chevron's Pascagoula Refinery contains processing equipment that is over 100 feet tall and several large-diameter storage tanks. The proposed vaporization area would contain several additional structures with a lower profile. The slip area that would contain the berth facilities for the unloading of LNG would change the existing visual character of this area from an undeveloped coastline to a marine berth. However, the proposed docking facilities would also be lower in profile than the LNG storage tanks and other nearby industrial sites' facilities.

Exterior lighting at the LNG terminal site would be installed as necessary for general plant operations, worker and visitor safety, and security. Floodlighting would be installed for critical process areas and at the unloading facility. Lower intensity lighting would be installed along internal roads, at general plant areas, and at the perimeter fencing. The LNG terminal would be lighted similarly to the nearby industrial areas. During an interagency scoping meeting for the project, the FWS expressed concerns that migratory birds could be adversely impacted by lighting at the LNG terminal. To address this issue, we have recommended that Gulf LNG develop a lighting plan consistent with the lighting

guidelines developed by the FWS for siting, construction, operation, and decommissioning of communication towers (see section 4.6.1.2).

The LNG storage tanks would be visible from commercial and recreational boating traffic on the Mississippi Sound, industrial properties located to the north of the project site, and residential areas to the northwest along Beach Boulevard. Views within the Mississippi Sound currently consist of the existing industrial facilities developed by Chevron, shipping and rig repair operations within Bayou Casotte, and residential uses to the northwest along Beach Boulevard. Views across Mississippi Sound towards the proposed LNG terminal site from the residential areas along Beach Boulevard also include the Chevron Pascagoula Refinery and the shipping and rig repair operations. The addition of the new industrial development at the proposed terminal site would be consistent with existing land uses in the area. Therefore, while the facility would be visible and permanently impact visual resources in the area, the overall aesthetic effect would be minor.

In addition to the LNG storage tanks and other terminal facilities, overhead electrical transmission lines would be built to the LNG terminal site to supply power for operations; however, the final route for these facilities has not been determined (see section 2.2). Nevertheless, these facilities would not result in significant impacts on visual resources.

**LNG Ships**

Ship traffic is relatively common in the Mississippi Sound and Bayou Casotte Channel. The LNG terminal would be designed to accommodate up to 150 ships per year with capacities ranging from 88,000 to 150,000 $m^3$. LNG ships of this size would have a maximum total length of 950 feet, a beam (width) of 150 feet, and a loaded draft of up to 38 feet. Given their relatively high freeboard, LNG ships tend to have a distinctive appearance compared with other large transport ships. Given their size and route of travel, the LNG ships would be visible from several locations throughout the project area. Generally, the LNG marine traffic would be similar to existing marine traffic conditions and not substantially change the visual character of the area.

**Pipeline and Associated Aboveground Facilities**

Construction and operation of the proposed natural gas sendout pipeline may affect visual resources by altering the terrain and vegetation patterns during construction or right-of-way maintenance and from the presence of new aboveground facilities.

The landscape setting along the proposed sendout pipeline route is generally flat. No designated viewing locations are present in areas overlooking the proposed route. The land use is primarily industrial or open in nature. Impacts on visual resources associated with the pipeline would be primarily temporary, occurring during construction. During construction, the cleared and graded right-of-way, as well as the construction equipment, could be visible from Highway 611 but would be seen in the context of other existing industrial facilities. Following construction, the right-of-way would be restored. The majority of the sendout pipeline would be constructed adjacent to existing rights-of-way. Construction within or adjacent to existing rights-of-way typically reduces impacts on visual resources because it minimizes vegetation clearing and minimizes the creation of new viewpoints from roads.

The aboveground facilities associated with the sendout pipeline consist of three interconnects/meter stations, a pig launcher, and a pig receiver. All of these facilities would be collocated with other proposed or existing facilities and would not have a significant impact on visual resources.

### 4.8.5 Coastal Zone Management

In 1972, Congress passed the CZMA to "preserve, protect, develop, and where possible, to restore or enhance, the resources of the nation's coastal zone for this and succeeding generations" and to "encourage and assist the states to exercise effectively their responsibilities in the coastal zone through the development and implementation of management programs to achieve wise use of the land and water resources of the coastal zone" (16 USC 1452, section 303 (1) and (2)).

Section 307 (c)(3)(A) of the CZMA states that "any applicant for a required federal license or permit to conduct an activity, in or outside the coastal zone, affecting any land or water use or natural resource of the coastal zone of that state shall provide a certification that the proposed activity complies with the enforceable policies of the state's approved program and that such activity will be conducted in a manner consistent with the program." In order to participate in the coastal zone management program, a state is required to prepare a program management plan for approval by the NOAA, Office of Coast and Ocean Resource Management (OCORM). Once the OCORM has approved a plan and its enforceable program policies, a state program gains "federal consistency" jurisdiction. This means that any federal action (e.g., a project requiring federally issued licenses or permits) that takes place within a state's coastal zone must be found to be consistent with state coastal policies before federal action can take place.

The LNG Clean Energy Project is subject to a federal Coastal Zone Consistency Review because it would: 1) involve activities within the coastal zone of Mississippi, and 2) require several federal permits and approvals (see table 1.3-1). Mississippi has an approved CMP administered by the MDMR. The coastal area in Mississippi is defined as Hancock, Harrison, and Jackson Counties. Because all of the facilities associated with the LNG Clean Energy Project would be located within Jackson County, Gulf LNG is responsible for documenting that the project is consistent with the Mississippi CMP.

Gulf LNG submitted a coastal zone management consistency certification statement with the MDMR concurrent with its COE section 404 permit application. In its consistency certification statement, Gulf LNG demonstrated how the project, including the LNG marine traffic in the waterways, would comply with the goals of the Mississippi CMP. Because Gulf LNG has not yet received concurrence from the MDMR that the project is consistent with the Mississippi Coastal Program, **we recommend that:**

- **Gulf LNG file documentation of concurrence from the MDMR that the project is consistent with the Mississippi CMP with the Secretary <u>before construction</u>.**

### 4.8.6 Hazardous Waste Sites

Gulf LNG conducted a search of federal and state environmental databases to identify hazardous waste sites and areas of known contamination in the vicinity of the proposed project facilities. No known sites were identified directly on the LNG terminal site or along the centerline of the proposed sendout pipeline route; however, the following number of sites with reported contamination or potential contamination were identified within a 0.125-mile radius of the proposed project facilities:

- 47 Emergency Response Notification System sites;
- one registered underground or aboveground storage tank site;
- three sites registered under the Toxic Substances Control Act;
- one site registered under the Federal Insecticide, Fungicide, and Rodenticide Act; and
- one NPDES discharge site.

Several of these sites were associated with Chevron's Pascagoula Refinery, First Chemical Corporation, and Mississippi Phosphates Corporation. Gulf LNG evaluated the reported sites to determine if any contamination on these properties could have an adverse impact on construction or operation of the proposed facilities. Based on the results of this review, Gulf LNG does not anticipate encountering contaminated materials during construction of the proposed facilities. However, if areas of potential contamination are discovered during the course of construction, Gulf LNG would instruct the contractor to stop work at the discovery location to allow time to evaluate the potential contamination and to develop a plan for safe handling and disposal of the contaminated materials in accordance with all applicable local, state, and federal regulations. If the contaminated material is groundwater, Gulf LNG would contact personnel in the MDEQ Groundwater Assessment and Remediation Division and would follow the procedures contained in the MDEQ's document, *Brownfield Risk Evaluation Procedures.*

Following Hurricane Katrina, environmental and health officials from the States of Alabama, Mississippi, and Louisiana stated that recent sampling of flood waters from coastal estuaries showed that no significant levels of toxic chemicals were present (MDEQ, 2005). There is no indication that any significant releases of hazardous materials occurred in the project area as a result of the hurricane.

## 4.9 SOCIOECONOMICS

Several potential socioeconomic effects may result from construction and operation of the proposed LNG Clean Energy Project. Many of these potential effects are related to construction, and include the number of local and non-local construction workers who would work on the project; their income and local expenditures; and their impact on population, public services, and temporary housing during the construction period. Other potential effects related to construction include increased tax revenues and local construction expenditures by Gulf LNG. Potential economic benefits associated with operation of the project include increased property tax revenue, increased job opportunities and income, and ongoing local expenditures by Gulf LNG. A discussion of the effects of the proposed project on the local population, economy, employment, housing, public services, and property values is provided below.

Many of the baseline socioeconomic characteristics of the Gulf Coast region have been altered by Hurricane Katrina. The data for this EIS were collected before Hurricane Katrina devastated the project area on August 29, 2005 and the EIS was written before the full economic and social effects of the hurricane were completely cataloged. However, the following section has been updated, as appropriate, to provide additional information regarding the socioeconomic impacts on the project area associated with Hurricane Katrina.

### 4.9.1 Population

The proposed project facilities would be located in Jackson County, Mississippi immediately south of the City of Pascagoula. Due to the large labor requirements for construction, the study area for the LNG Clean Energy Project includes the four incorporated cities in Jackson County, as well as the adjacent counties of Harrison and George Counties, Mississippi and Mobile County, Alabama. Table 4.9.1-1 provides selected population statistics for Jackson, Harrison, and George Counties, Mississippi; Mobile County, Alabama; and the four incorporated cities within Jackson County.

TABLE 4.9.1-1

**Population Conditions in the LNG Clean Energy Project Area**

| | Population | | | Population Density [a] | |
|---|---|---|---|---|---|
| State/County/City | 1990 | 2000 | Percent Change | 1990 | 2000 |
| Mississippi | 2,573,216 | 2,844,658 | 10.5 | 54.9 | 60.6 |
| Jackson County | 115,243 | 131,420 | 14.0 | 158.5 | 180.8 |
| City of Pascagoula | 25,899 | 26,200 | 1.2 | 1,706.6 | 1,726.4 |
| City of Ocean Springs | 14,658 | 17,225 | 17.5 | 1,259.4 | 1,479.9 |
| City of Moss Point | 17,873 | 15,851 | -11.4 | 714.9 | 634.0 |
| City of Gautier | 10,088 | 11,681 | 15.8 | 824.1 | 954.2 |
| Harrison County | 165,365 | 189,601 | 14.7 | 284.6 | 326.3 |
| George County | 16,673 | 19,144 | 14.8 | 34.9 | 40.0 |
| Alabama | 4,040,587 | 4,447,100 | 10.1 | 79.6 | 87.6 |
| Mobile County | 378,643 | 399,843 | 5.6 | 307.0 | 324.2 |

[a] Persons per square mile based on population and area size.

Source: U.S. Census Bureau, 1990 and 2000.

Jackson, Harrison, and George Counties experienced higher growth rates from 1990 to 2000 (14.0 percent, 14.7 percent, and 14.8 percent, respectively) than the State of Mississippi (10.5 percent). Mobile County had a growth rate of 5.6 percent, significantly below the statewide average in Alabama (10.1 percent). The population density in the study area in 2000 was significantly higher than the state-wide

average; Pascagoula and Ocean Springs had population densities 20 times higher than the Mississippi statewide average (1,726.4, 1,479.9, and 60.6 persons/square mile, respectively).

Project area population impacts are expected to be short term and relatively minor. The total population change would equal the total number of non-local construction workers, plus any family members accompanying them. As discussed further in section 4.9.2, Gulf LNG expects to employ predominantly local workers during construction of the project, which is expected to take 38 months. Gulf LNG estimates that about 64 percent of the construction workforce would consist of local hires and that the workers would commute to work from the local four-county area. During construction, Gulf LNG estimates an average workforce of 259 and a peak workforce of 556 occurring in month 25. During peak construction, a short-term influx of about 200 non-local workers is anticipated. Therefore, given the relatively small number of workers who would temporarily relocate to the area during construction, impacts on the local population would be minor.

Operation of the proposed LNG Clean Energy Project would require about 50 permanent positions. These jobs would require specialized expertise and skill, and staff would be comprised of both local and non-local personnel. However, even if all permanent employees were non-local hires, this small number of people would have a negligible impact on the local population.

### 4.9.2 Economy and Employment

In 2000, the educational, health, and social services sector was the largest employment sector in the State of Mississippi; however, manufacturing was the largest employment industry in Jackson and George Counties (U.S. Census Bureau, 2000). The largest employer in Jackson County was Northrop Grumman Ship Systems, with over 12,000 employees (U.S. Bureau of Labor Statistics, 2005a). Table 4.9.2-1 provides a summary of the socioeconomic conditions within the project study area.

TABLE 4.9.2-1

**Socioeconomic Conditions in the LNG Clean Energy Project Area**

| | Per Capita Income | | Civilian Labor Force | Unemployment Rate (percent) | Top Employment Industry |
|---|---|---|---|---|---|
| State/County/City | 1989 | 1999 | 2000 | 2004 | 2000 |
| Mississippi | $9,648 | $15,853 | 1,267,092 | 9.6 [a] | Educational, health, and social services |
| Jackson County | $11,246 | $17,768 | 60,617 | 4.1 | Manufacturing |
| City of Pascagoula | $11,778 | $16,891 | 11,230 | 21.8 [a] | Manufacturing |
| City of Ocean Springs | $13,906 | $22,923 | 8,648 | 3.0 [b] | Educational, health, and social services |
| City of Moss Point | $8,809 | $15,537 | 6,669 | 5.4 [b] | Manufacturing |
| City of Gautier | $11,534 | $17,525 | 5,439 | 4.2 [b] | Manufacturing |
| Harrison County | $10,434 | $18,024 | 87,237 | 4.6 | Arts, entertainment, recreation, accommodation and food services |
| George County | $8,000 | $14,337 | 8,069 | 8.9 | Manufacturing |
| Alabama | $11,486 | $18,189 | 2,047,100 | 3.9 [b] | Education, health, and social services |
| Mobile County | $11,158 | $17,178 | 178,196 | 6.4 | Educational, health, and social services |

[a] Preliminary unemployment rate for September 2005, U.S. Department of Labor - Bureau of Labor Statistics.

[b] Most recent unemployment rate from 2000, U.S. Census Bureau.

Sources: U.S. Census Bureau, 1990 and 2000; U.S. Bureau of Labor Statistics, 2005a and 2005b.

The 1999 per capita income in the project area ranged from $14,337 in George County, Mississippi to $22,923 in the City of Ocean Springs, Mississippi. Similarly, unemployment ranged from 9.1 percent in George County, Mississippi to 3.0 percent in Ocean Springs, Mississippi. Due to Hurricane Katrina, unemployment in the State of Mississippi has increased dramatically from 6.9 percent in August, 2005 to 9.6 percent in September 2005. Similarly, unemployment in Pascagoula increased from 7 percent to 21.8 percent between August and September 2005 (U.S. Bureau of Labor Statistics, 2005b). In addition, Naval Station Pascagoula has been selected for closure by the Base Closure and Realignment Commission. The closure was passed by Congress on November 9, 2005; Naval Station Pascagoula is scheduled to close as early as 2007 (DOD, 2005). Closure of the naval station will result in the loss of 963 permanent jobs in the area. Construction of the proposed project would provide new job opportunities in the area.

The LNG terminal would be constructed over a 38-month period and would employ an average of 259 workers per month. A maximum of about 556 workers would be employed during the peak construction period, which is scheduled to occur in month 25. As discussed in section 4.9.1, Gulf LNG plans to employ predominantly local workers (64 percent) from the project study area. The use of local workers would be somewhat dependent on the construction contractor that is ultimately hired for the project, union agreements, and the methods contractors use to hire subcontractors. Additional construction personnel hired from outside the project area would include highly skilled mechanical, electrical, and instrumentation/control tradesmen who would temporarily relocate to the area.

The Hurricane Katrina reconstruction effort is anticipated to draw heavily from out-of-state workers, with the initial construction efforts focused on rebuilding residential areas. Major activities associated with residential reconstruction are expected to be completed by 2010. Due to the specialized construction requirements of the project, it is anticipated that the majority of workers hired by Gulf LNG would comprise a different sector of the construction workforce than those employed in the reconstruction effort. Therefore, construction employment for the proposed project should not conflict with hurricane reconstruction efforts.

During the proposed 38-month construction period, Gulf LNG estimates that the total project payroll would amount to about $54,400,000, or an average of about $1,400,000 per month. Of this total, two-thirds is expected to go to persons living in Jackson County. During this period, some portion of the construction payroll would be spent locally for the purchase of housing, food, gasoline, entertainment, and luxury items. The dollar amount spent would depend on the number of construction workers in a given area and the duration of their stay.

These direct payroll expenditures would have a positive impact on local economies and would stimulate indirect expenditures within the region. Indirect sales, jobs, and salaries could be created in new or existing businesses and organizations such as construction companies, parts and equipment suppliers, and other businesses that supply goods and services to the facility during construction and operation. In addition, jobs and salaries could be created in establishments that would supply goods and services to the facility's employees and their families, such as restaurants, retail and grocery stores, and banks.

The estimated direct impact of construction on Jackson County personal income would be $41.6 million over the entire construction period based on project payroll and local expenditures. Sales taxes in Mississippi average about 3.6 percent of personal income. Assuming that the recipients of this income make 85 percent of their purchases in Jackson County municipalities, sales tax revenues from these cities would be about $1,273,000. The state would refund 18.5 percent of this amount, or $235,500 back to the city governments in Jackson County. Table 4.9.2-2 provides a summary of tax revenues and fees paid during construction and operation of the proposed project.

TABLE 4.9.2-2

**Tax Revenues and Fees Generated by the LNG Clean Energy Project**

| Tax Revenues and Fees | To State of Mississippi | To Jackson County | To Jackson County Port Authority | To Jackson County Municipalities |
|---|---|---|---|---|
| Construction | | | | |
| Sales taxes | | | | $235,500 |
| Construction contracts | $17,500,000 | | | |
| Ad valorem taxes – school | | $11,049,000 | | |
| Lease fees | | | $1,400,000 | |
| Operation | | | | |
| Ad valorem taxes – except school | | $4,613,000 [a] | | |
| Ad valorem taxes – school | | $3,929,000 [a] | | |
| Lease fees – operation years 1- 5 | | | $667,000 [a, b] | |
| Lease fees – operation years 6 - 30 | | | $500,000 [a, c] | |
| Port charges (harbor, wharfage, and dockage fees) [d] | | | $5,100,000 [a] | |

[a] Annual payment.

[b] The Jackson County Port Authority would receive an annual lease fee of $1 million but would be required to pay one-third of the lease fee to the State of Mississippi's Public Trust Tidelands Fund for the first 5 years of operation.

[c] The Jackson County Port Authority would receive an annual lease fee of $1 million but would be required to pay one-half of the lease fee to the State of Mississippi's Public Trust Tidelands Fund after 5 years of operation.

[d] Based on 150 ships per year.

State taxes from the proposed project would be generated from non-residential construction contracts (labor and materials), which are subject to a 3.5 percent tax in Mississippi. Gulf LNG has estimated that total contract work for the LNG Clean Energy Project would have a value of $500 million. This would generate $17.5 million in tax payments to the State of Mississippi over the course of construction. Over the course of construction, Gulf LNG estimates that a total of $11 million in school taxes would be paid to Jackson County.

Gulf LNG would pay an annual lease fee to the JCPA, the agency responsible for managing ship traffic and operation of the Port of Pascagoula. Lease payments of $1,400,000 would be paid for the estimated 38-month construction period, which would include an option payment of $250,000, annual lease fees of $350,000, and an estimated $100,000 lease fee for a partial year lease.

During operation of the LNG Clean Energy Project, tax revenues and fees associated with the project would include ad valorem property taxes to Jackson County and lease payments and ship charges to the JCPA. Jackson County would receive an estimated $4.6 million annually in ad valorem property tax (except school taxes) and $3.9 million annually in ad valorem school taxes. The JCPA would receive an annual lease fee of $1 million. The JCPA is required to pay one-third of the lease fee to the State of Mississippi's Public Trust Tidelands Fund for the first 5 years of operation and one-half of the lease fee after 5 years. Additionally, Gulf LNG would pay the JCPA about $5,100,000 annually for port charges (harbor, wharfage, and dockage fees).

The anticipated tax and revenue payments associated with the project are likely to take on heightened importance due to losses in property and sales tax revenues from properties and businesses destroyed or severely damaged during Hurricane Katrina. We received letters from the Governor of Mississippi, the Jackson County Economic Development Foundation, and the City of Pascagoula indicating that the project would contribute to the revitalization of the Mississippi Gulf Coast through job creation and economic development.

### 4.9.3 Housing

Housing statistics are presented in tables 4.9.3-1 and 4.9.3-2. Table 4.9.3-1 presents an overview of the total housing units, including occupied and unoccupied units, median monthly rent rates, and median value of occupied units in the project area. Table 4.9.3-2 is a subset of the total vacant housing units listed in table 4.9.3-1 and separates the number of units available for rent, sale, or temporary (e.g., seasonal) use. It is important to note that this data was collected before Hurricane Katrina, which caused extensive damage to residential areas of Jackson and Harrison Counties, Mississippi and moderate damage to George County, Mississippi and Mobile County, Alabama.

TABLE 4.9.3-1

**General Housing Characteristics in the LNG Clean Energy Project Area**

| State/County/City | Total Housing Units | Occupied Units (percent) | Median Value, Owner Occupied Units | Median Monthly Rent | Vacant Housing Units |
|---|---|---|---|---|---|
| Mississippi | 1,161,953 | 90.1 | $71,400 | $439 | 115,519 |
| Jackson County | 51,678 | 92.3 | $80,300 | $522 | 4,002 |
| City of Pascagoula | 10,931 | 90.4 | $69,000 | $486 | 1,053 |
| City of Ocean Springs | 7,072 | 94.0 | $98,900 | $597 | 422 |
| City of Moss Point | 6,237 | 91.6 | $58,900 | $452 | 523 |
| City of Gautier | 4,597 | 92.7 | $85,100 | $568 | 337 |
| Harrison County | 79,636 | 89.8 | $87,200 | $543 | 8,098 |
| George County | 7,513 | 89.7 | $66,500 | $428 | 771 |
| Alabama | 1,963,711 | 88.5 | $85,100 | $447 | 226,631 |
| Mobile County | 165,101 | 91.0 | $80,500 | $476 | 14,922 |

Source: U.S. Census Bureau, 2000, General Housing Characteristics.

TABLE 4.9.3-2

**Unoccupied Housing Characteristics in the LNG Clean Energy Project Area**

| State/County/City | Vacant Rental Units | Units for Sale | Units Rented or Sold, Not Occupied | Vacant for Seasonal, Recreational, or Occasional Use | Vacant for Migrant Workers | Other Vacant |
|---|---|---|---|---|---|---|
| Mississippi | | | | | | |
| Jackson County | 1,367 | 550 | 542 | 613 | 2 | 928 |
| City of Pascagoula | 567 | 99 | 87 | 51 | 1 | 248 |
| City of Ocean Springs | 143 | 93 | 100 | 70 | 0 | 16 |
| City of Moss Point | 121 | 62 | 57 | 32 | 0 | 251 |
| City of Gautier | 140 | 60 | 34 | 72 | 1 | 30 |
| Harrison County | 3,158 | 863 | 674 | 1,673 | 21 | 1,709 |
| George County | 119 | 83 | 71 | 191 | 3 | 304 |
| Alabama | | | | | | |
| Mobile County | 5,316 | 1,690 | 1,352 | 1,757 | 19 | 4,788 |

Source: U.S. Census Bureau, 2000, General Housing Characteristics.

There were about 304,000 total housing units in the project area in 2000, of which 51,678 were located in Jackson County. George County, Mississippi had the lowest number of housing units (7,513) but the highest rental vacancy rate (11.3 percent) in the project area. The study area had a total of 27,793 vacant housing units.

Due to the damage caused to residential areas by Hurricane Katrina, FEMA has created temporary housing called Emergency Group Sites (EGS), which are quickly created travel trailer/mobile home parks that accommodate between 10 and 200 manufactured housing units (FEMA, 2005). There are currently several completed EGS with many more sites under review or construction. Hotels in the project area are now almost fully operational and cleanup and reconstruction of damaged areas is anticipated to be substantially complete by 2010.

As stated in section 4.9.1, about 64 percent of the construction workforce would come from within the project area and would not require temporary housing. An average of 94 non-local workers in any given month would require temporary housing during construction of the LNG Clean Energy Project, with a maximum of 200 workers requiring housing during the peak month of construction. The peak construction period for the proposed project is expected to occur in 2008; therefore, it is anticipated that the majority of displaced residents would no longer be occupying temporary housing facilities (EGS/hotels/motels) and that these facilities would be available if required by project personnel. Therefore, we believe that the non-local workforce associated with construction of the project would have a minor impact on the local supply of temporary housing.

Operation of the proposed LNG Clean Energy Project would require about 50 full-time positions. This staff would be comprised of both local and non-local personnel. However, even if all permanent employees were non-local hires, this small number of people would have a negligible impact on permanent housing demands.

### 4.9.4 Public Services

Jackson, Harrison, George, and Mobile Counties have well developed infrastructure to provide health, police, fire, emergency, and social services near the project area. Public services in the project study area were not significantly impacted by Hurricane Katrina and are fully operational.

A wide range of public services and facilities are offered at different locations from the Pascagoula, Moss Point, Ocean Springs, Gautier, and Mobile areas. Health facilities in Jackson County include two hospitals with a total of 551 beds. The larger of the two hospitals, Singing River Hospital, is located about 7 miles from the LNG terminal site. Alternatively, Harrison County has six hospitals with a total of 997 beds, George County has one hospital with 53 beds, and Mobile County has eight hospitals with a total of 1,849 beds.

All of the municipalities in the four-county study area have police departments. There is one sheriff's department in each county. The Pascagoula Police Department consists of 107 employees, of whom 57 are sworn officers.

In Jackson County, the Cities of Pascagoula, Moss Point, Ocean Springs, and Gautier each have a municipal fire department. The unincorporated areas are protected by a network of seven volunteer fire departments. The Pascagoula Fire Department is located about 6 miles from the proposed LNG terminal site. Fire protection in the unincorporated area where the LNG site would be located is currently provided by the Franklin Creek-Forts Lake Fire Department. It operates out of two stations; the nearest is at Orange Grove Road near Highway 90, about 9 miles from the LNG terminal site.

Because the project site is located outside of city limits, an emergency call would go to the Jackson County Fire Department. However, because the Pascagoula Fire Department is located closer to the terminal than the nearest Jackson County Fire Department (about 6 miles and 9 miles, respectively), an emergency call from the LNG terminal would result in the Pascagoula Fire Department providing the first response to an emergency situation until the Franklin Creek-Forts Lake Fire Department arrives.

The Franklin Creek-Forts Lake Fire Department and City of Pascagoula Fire Department currently have the equipment and personnel necessary to handle a large, industrial-related emergency at the LNG terminal. However, additional training specifically for LNG firefighting would be coordinated with Gulf LNG. These fire departments would also respond to any medical, hazardous materials, safety incidents, and other non-fire emergencies at the terminal. The law enforcement and medical emergency response services are available on the 911 national emergency service number.

Gulf LNG would develop an Emergency Response Plan that would include procedures for coordinating with local, state, and federal emergency response authorities, including the Coast Guard. Specific components of the plan consist of periodic informational meetings, drills, demonstrations, and training sessions associated with potential incidents involving facilities operated by Gulf LNG. Section 4.13.5 includes additional information on the Emergency Response Plan.

A total of 11 school districts are located within the four-county project study area, with a total enrollment of over 125,000 students in 226 schools (Mississippi Department of Education, 2005; Alabama Department of Education, 2005). Of these, Jackson County has 26,000 students enrolled in 54 schools. Assuming that during peak construction all of the 200 non-local workers bring their families with them, it is anticipated that 125 students would be enrolled in area schools during the construction of the LNG Clean Energy Project (based on data that 54.8 percent of households in Mississippi have children under 18 years of age and an average of 1.14 children per family household). This represents a 0.1 percent increase in the current school enrollment, or less than 1 student for each of the 226 schools located within the project study area over the 4 school-year construction period.

The City of Pascagoula Water Department has the capacity to produce 5.5 million gallons of potable water per day. Assuming that during peak construction all 200 non-local workers bring their families with them, construction of the LNG Clean Energy Project would increase demand for potable water by about 42,000 gallons per day, or 0.8 percent of capacity (based on the Mississippi average of 2.6 persons per household and average demand of 80 gallons per person per day).

The Port of Pascagoula would provide access to water supply pipelines for the construction and operation of the LNG Clean Energy Project. The LNG Clean Energy Project would either tie-in to the existing waterline servicing Chevron's Pascagoula Refinery, or would extend a new water pipeline from the entrance to the Port of Pascagoula to the project site. The LNG Clean Energy Project would also require the construction of electric transmission facilities. These facilities would be constructed by the MPC. Additional information on these facilities is provided in section 2.2. In the case of a power outage, two stationary gas turbines would provide power for lighting and other critical equipment. Additionally, an uninterruptible power supply would be sized to ensure a safe process shutdown in the event of a long-term power outage.

Because the non-local workforce would be small relative to the current population of the area, construction of the project would have a minor and short-term impact on local community facilities and services such as law enforcement, fire protection, medical services, schools, and municipal services. Other construction-related demands on local agencies could include increased enforcement activities associated with issuing permits for vehicle load and width limits and local police assistance during construction to facilitate traffic flow. It is estimated that all of the existing service and facilities are adequate to provide services to the additional residents moving into the area as a result of construction and operation of the LNG Clean Energy Project.

### 4.9.5 Property Values

The closest residences to the LNG terminal site are located about 1.7 miles northwest of the site across open water areas of Mississippi Sound. The homes in this area were severely damaged or destroyed by Hurricane Katrina but our analysis assumes that these homes will be rebuilt during the next several years. The following discussion addresses potential impacts on property values, property taxes, and insurance rates associated with construction and operation of the LNG Clean Energy Project.

A 1993 study conducted by the Argonne National Laboratory examined the economic impacts of the presence of "noxious" facilities on local wages and property values (Clark and Nieves, 1993). Eight types of these facilities were studied: nuclear power plants; coal-, gas-, or oil-fired power plants; military chemical weapons sites; hazardous waste sites; refineries; chemical weapon storage facilities; former storage sites that are now contaminated; and LNG facilities. The study examined the effects of 262 facilities on standardized 1,000 square-mile areas across the United States. Eleven of these were LNG facilities. The results of the study concluded that the presence of 5 of the 8 types of "noxious" facilities have a significantly negative effect on property values and a positive effect on wages. However, the study concluded that the presence of an LNG facility did not have a significant positive or negative effect on either wages or property values (Clark and Nieves, 1993). Based on the location of the LNG terminal at an existing industrially designated site near other industrial facilities and the information from these studies, we do not believe that the construction and operation of the LNG terminal would negatively affect property values in the surrounding area.

Property taxes are generally based on the actual use of the land. Construction of the natural gas sendout pipeline would not change the general use of the land, but would preclude construction of aboveground structures on the permanent right-of-way. Because most of the land that would be crossed by the sendout pipeline has been previously developed for industrial use, adverse impacts on property taxes due to the LNG Clean Energy Project are not anticipated.

During the scoping process, comments were received about the potential effect of the LNG terminal on homeowner insurance rates and the availability of insurance coverage. Insurance advisors consulted on other LNG projects have indicated that LNG terminals do not have an impact on homeowner insurance rates. Homeowner insurance rates are generally set on a county-wide basis, with individual rate adjustments made to reflect the age and value of the property and the claims record of the owner; insurance rates are not based on the surrounding landscape or structures at the local level. However, insurance companies may reject coverage in an area based on high risks. Typically, insurance coverage may be denied when a property is in a poor state of repair or located along the coast where it could be vulnerable to storms. These types of factors would affect the availability of insurance coverage, not the presence of the facility itself (Giganti Insurance, 2004). Based on the above information, the project is not expected to have an impact on insurance rates of homeowners in the vicinity of the project.

### 4.9.6 Environmental Justice

In December 1997, the CEQ called upon the federal agencies to actively scrutinize the following issues with respect to environmental justice (CEQ, 1997):

- the racial and economic composition of affected communities;
- health-related issues that may amplify project effects on minority or low-income individuals; and
- public participation strategies, including community or tribal participation in the process.

Tables 4.9.6-1 and 4.9.6-2 list the demographic composition and economic status of Jackson County residents. The minority population within the City of Pascagoula is less than 33 percent. On average, the City of Pascagoula had higher median household income levels than the statewide average, but had a higher percentage of families living below the poverty level than the state as a whole. It is important to note in this comparison that the LNG Clean Energy Project would be located in an industrial area. The nearest residences to the LNG terminal site are 1.7 miles away and the closest residences to the sendout pipeline route are 0.4 mile away. The LNG ship transit route crosses mostly open water and does not pass through any areas with residences.

TABLE 4.9.6-1

**Population Statistics for the Area Surrounding the LNG Clean Energy Project**

| Location | Total Population | White | Black or African American | American Indian or Alaska Native | Asian | Persons Reporting Some Other Race | Hispanic or Latino Origin |
|---|---|---|---|---|---|---|---|
| Mississippi | 2,844,658 | 1,746,099 | 1,033,809 | 11,652 | 18,626 | 34,472 | 39,569 |
| Jackson County | 131,420 | 99,026 | 27,432 | 440 | 2,059 | 2,463 | 2,807 |
| City of Pascagoula | 26,200 | 17,594 | 7,590 | 47 | 253 | 716 | 1,019 |

Source: U.S. Census Bureau, 2000.

TABLE 4.9.6-2

**Economic Statistics for the Area Surrounding the LNG Clean Energy Project**

| Location | Labor Force (2000) | Median Household Income (1999) | Families Below Poverty (Percent) | Percent of Civilian Workforce Unemployed |
|---|---|---|---|---|
| Mississippi | 1,282,757 | 31,330 | 16.0 | 7.4 |
| Jackson County | 63,177 | 39,118 | 10.5 | 6.7 |
| City of Pascagoula | 12,165 | 32,042 | 18.1 | 9.3 |

Source: U.S. Census Bureau, 2000.

The primary health issue related to the project is the risk associated with facility fires, and LNG release from LNG ships, or pipeline failure. Section 4.13 addresses these risks and the measures that would be taken by Gulf LNG to minimize them. These risks would not be disproportionately borne by any minority or low-income group.

As discussed in section 1.4, Gulf LNG has conducted an open house held in Moss Point, Mississippi on April 5, 2005. On April 20, 2005, Gulf LNG held a site visit that was open to the public. In addition, the NEPA process is designed to solicit public input during preparation of the EIS and all public documents filed in association with the LNG Clean Energy Project can be accessed via the FERC's website.[1] On April 20, 2005, the FERC conducted a public scoping meeting in Pascagoula to provide an opportunity for the general public to learn more about the LNG Clean Energy Project and to participate in our analysis by commenting on issues to be included in the EIS. Nine people commented at the meeting. On December 7, 2005, the Coast Guard conducted a public meeting in Pascagoula to provide an

[1] Using the "eLibrary" link, select "General Search" from the eLibrary menu and enter the docket number, excluding the last three digits, in the "Docket Number" field (i.e., CP06-12, CP06-13 and CP06-14). Be sure to select an appropriate date range.

opportunity for the general public to provide comments on waterway suitability and maritime safety and security aspects of the proposed LNG facilities. Five people commented at the meeting. On June 22, 2006, the FERC conducted a public meeting in Pascagoula to receive comments on the draft EIS. Four people provided comments.

The FERC believes the proposed project is practical, economical, and designed to meet energy infrastructure needs while minimizing environmental, safety, and engineering concerns. The FERC has not identified any human health or environmental effects that would be borne disproportionately by any minority or low-income group that are high and adverse.

## 4.10 TRANSPORTATION

Several potential impacts on vehicular and marine traffic may result from the construction and operation of the LNG Clean Energy Project. Potential impacts on vehicular traffic would generally be related to the construction of the facilities and are the result of the influx of workers commuting to and from the project site as well as the transport of construction materials. Marine traffic impacts would generally result from the increase in large vessel movements in the Port of Pascagoula during both construction and operation of the facilities.

A discussion of potential impacts on land and marine transportation resulting from construction and operation of the LNG Clean Energy Project is provided below. The project would not result in a change in air traffic patterns or affect current or future operations at any nearby airport. A discussion of the cumulative impacts of the project on local transportation infrastructure when considered with other proposed or reasonably foreseeable projects in the area is included in section 4.14.7.

### 4.10.1 Land Transportation

The local highway system in the project area includes an interstate highway, U.S. highway, and state highway. Traffic from Pascagoula, Mississippi to Mobile, Alabama is provided by Interstate 10 and U.S. Highway 90. During Hurricane Katrina, U.S. Highway 90 experienced significant damage but is expected to be fully rebuilt by 2007 (Scruggs, 2005). State Highway 63, a divided 4-lane highway, begins at the intersection of U.S. Highway 90 and State Highway 611 and runs north to intersect with Interstate 10. Table 4.10.1-1 provides information on the location and traffic flow of key roads in the vicinity of the proposed project.

TABLE 4.10.1-1

**Key Roads in the Vicinity of the LNG Clean Energy Project and their Current Daily Traffic Volumes**

| Road | Location | Vehicles per Day |
|---|---|---|
| Interstate 10 | West of State Highway 63 | 48,000 |
| Interstate 10 | East of State Highway 63 | 39,000 |
| U.S. Highway 90 | West of State Highway 63 | 29,000 |
| U.S. Highway 90 | East of State Highway 63 | 14,000 |
| State Highway 63 | Between Interstate 10 and U.S. Highway 90 | 20,000 |
| State Highway 611 | 4-lane portion south of U.S. Highway 90 | 12,000 |
| State Highway 611 | 2-lane portion south of U.S. Highway 90 | 9,300 |

Access to the project site would be from State Highway 611, which extends south from U.S. Highway 90 and ends about 1 mile north of the site. When project activities are initiated, a permanent access road would be constructed connecting State Highway 611 with the project site. State Highway 611 in this area is primarily used by Chevron's Pascagoula Refinery and other heavy industry. Traffic on State Highway 611 is light, except when Chevron's Pascagoula Refinery employees are arriving or departing from work. During peak flow, up to 1,556 vehicles per hour use State Highway 611, which results in a slight backup of traffic at the intersection of State Highway 611 and Orchard Avenue (located 1.9 miles south of U.S. Highway 90).

Gulf LNG commissioned a Traffic Impact Assessment to assess the project's potential effects on area roadways. An average of 259 workers would be employed over the construction period, with a peak workforce of 556. In accordance with industry norms, Gulf LNG anticipates a vehicle occupancy rate of 1.3 persons per vehicle. This translates to an average of 200 vehicles per day and a peak of 428 vehicles per day transiting to the project site. Gulf LNG anticipates that about 382 construction material deliveries

to and from the construction site would be made daily during peak construction periods. Assuming a peak of 428 worker vehicles and 382 construction material deliveries per day, a total of 810 trips would be made to the project site during construction (1,620 individual vehicle trips per day).

When compared to historical levels of traffic on State Highway 611, the addition of 810 trips (1,620 individual vehicles trips per day) would represent a 13.5 percent and 17.4 percent increase in traffic on the 4-lane and 2-lane portions of State Highway 611, respectively. To alleviate potential traffic congestion, Gulf LNG would schedule deliveries of construction materials so that they avoid peak traffic periods when possible. In addition, Gulf LNG is planning to have off-site construction parking at its proposed contractor yard and support area on the Port of Pascagoula property. Workers would be ferried from the off-site parking area to the project site via tugs and other small boats already engaged in activities related to the project. If necessary, Gulf LNG would schedule work hours to correspond with times of low traffic flow to further mitigate traffic congestion. Gulf LNG states that it will continue to consult with the MDOT and Jackson County regarding any additional traffic mitigation measures required before the initiation of construction activities. To document these consultations, **we recommend that:**

- **Gulf LNG file the outcome of the consultations with the MDOT and Jackson County regarding the need for traffic mitigation measures with the Secretary <u>before construction</u>.**

Operation of the LNG Clean Energy Project would require an estimated 50 employees. The additional traffic generated by these employees on a daily basis would not result in a significant increase in local traffic volume, and would not adversely affect traffic on area roadways.

### 4.10.2 Marine Transportation

During construction of the project, steel and pre-cast concrete structural elements and load-out materials would be delivered to the construction site via barge. Barges used to deliver construction materials would be loaded-out at an off-site waterfront facility and towed to the LNG terminal site using tug boats. The proposed project would most likely use a nearby facility on the Gulf Coast for fabrication and load-out (see section 2.4.1.3). The most likely route taken, assuming the use of nearby facilities on the coast, would be via the GIWW along the Mississippi Sound, and then to the Bayou Casotte Channel at Pascagoula. Barges would then follow the Bayou Casotte Channel to the project site. The Pascagoula Pilots see the heavy tow traffic on the GIWW as one of the largest transportation concerns, reporting as many as eight tows in the approaches to the intersection during a single deep-draft vessel transit. Increases in tow traffic in the GIWW as a result of the project would be between 5 and 10 barges per week throughout construction.

With the exception of a new turning basin and ship berth at the terminal itself, LNG ships would reach the proposed terminal using existing shipping channels. Vessels the size of LNG ships are restricted to one-way traffic within the channels. Throughout operation, LNG ships would enter and depart the project area via Bayou Casotte Harbor, as is the case with most of the seagoing shipments bound for the Port of Pascagoula. The route traversed by LNG ships calling on the proposed terminal is divided into a number of segments. LNG ships would enter the port area through the Pascagoula Bar Channel starting at the "HI" sea buoy and traveling northeast in a straight line approximately 3.3 nautical miles to buoys 11 and 12, which mark the beginning of the Horn Island Pass Channel. From there, ships would travel for about 1.2 nautical miles through Horn Island Pass, transitioning from northeast to north with two turns. Each LNG vessel would be guided from the sea buoy to the dock by two Pascagoula Pilots. The Pascagoula Pilots anticipate that at least two additional pilots and one pilot boat would be needed to accommodate the proposed LNG Clean Energy Project.

The Horn Island Pass is considered the most challenging portion of the channel system due to the variable and frequently strong cross-currents. These currents require the Pascagoula Pilots to navigate close to the edge of the channel in order to make a necessary turn, bringing the vessel close to the western edge of Petit Bois Island. To overcome the currents in this area, the Pascagoula Pilots recommend an inbound transit speed of at least 10 knots. Conversely, increasing speed also increases the potential for ship squat, defined as the loss in under-keel clearance as a ship moves at forward speed, compared to when stationary (Royal Institute of Naval Architects, 2005). Due in part to these challenges, ships larger than 700 feet in length or 125 feet in width can enter or leave the port only during daylight hours.

After passing Petit Bois Island, the ships would continue north along the Lower Pascagoula Channel for about 3.7 nautical miles to the Bayou Casotte Channel, which branches off from the Pascagoula Channel at a junction commonly referred to as the "Y." From this junction, LNG ships would continue north approximately 3.7 nautical miles to the LNG terminal. The total transit distance from the sea buoy in the Gulf of Mexico to the LNG Clean Energy project site is about 11.9 nautical miles.

In most ports, the greatest constraint on traffic management is the availability of tugs. The Pascagoula Pilots consider the current tug fleet operating in the port to be adequate for current operations; however, additional tugs would likely be required to accommodate the proposed LNG project. Gulf LNG would provide needed information for ship-assist tug companies to determine the requirement for adequate tugs, with sufficient power rating, to meet the needs of the LNG terminals. The Pascagoula Pilots have also indicated that they would need to add at least two pilots to their workforce to accommodate the increased marine traffic associated with operation of the proposed LNG terminal. Although it takes up to 1 year to become a fully qualified and licensed Pascagoula Pilot, the timeframe involved in permitting and constructing the LNG terminal would provide ample opportunity to make the necessary workforce adjustments.

Anticipated impacts on traffic are based on the assumption that the Coast Guard would establish a security zone for ships in transit to the LNG terminal. The exact size of the security zone has not been determined; however, assuming the security zone extended 2 miles ahead and 1 mile behind the ship, the maximum delay expected due to the transit of an LNG vessel would be 1.5 hours. About 150 LNG ships associated with the LNG Clean Energy Project would be transiting the ship channels per year, an average of one one-way transit per day, and the schedule of these trips would be known in advance. Therefore, the realistic maximum delay an LNG ship transiting the channel could pose on a vessel transiting the GIWW would be about 30 minutes. As a result, the LNG Clean Energy Project would have limited impacts on marine traffic.

An assessment of LNG shipping impacts on the Port of Pascagoula associated with the LNG Clean Energy Project was conducted by Shiner Moseley and Associates, Inc. The assessment was included as part of the WSA completed for the project (see section 4.13.5.2). The Coast Guard, with input from the Pascagoula AMSC, has completed an initial review of Gulf LNG's WSA in accordance with the guidance in Coast Guard NVIC 05-05. The WSA review focused on the navigation safety and maritime security risks posed by LNG marine traffic, and the measures needed to responsibly manage these security risks. The WSA itself is designated Sensitive Security Information as defined in 49 CFR Part 1520. Because any unauthorized disclosure of these details could be employed to circumvent the proposed security measures, they are not releasable to the public.

As a result of this review, the Coast Guard advised the FERC in its WSR letter dated March 7, 2006, that the Pascagoula Bar, Horn Island Pass, Lower Pascagoula, and Bayou Casotte Channels can accommodate the LNG marine traffic associated with the project. The letter stated that there is sufficient capability within the port community to responsibly manage the safety and security risks of this project. In a follow-up letter to the FERC dated September 5, 2006, the Coast Guard clarified that the March 7,

2006 letter gave a preliminary evaluation to meet the recommendations of NVIC 05-05. The September 5 letter also stated that any final determination of waterway suitability is contingent upon an evaluation of certain conditions, including those identified in section 2.0. With the completion of this final EIS, the Coast Guard will complete its review and issue an LOR to address the suitability of the waterways for LNG transport.

Information on potential impacts on recreational boating and fishing in the project area is provided in section 4.8.3. Additional discussion of marine traffic and transportation as it relates to marine safety, including potential cryogenic/thermal impacts along the LNG ship transit route, is provided in section 4.13.5.

## 4.11 CULTURAL RESOURCES

Section 106 of the NHPA, as amended, requires that the FERC take into account the effects of its undertakings (including the issuance of authorizations or Certificates) on properties listed in, or eligible for listing in, the NRHP and to provide the ACHP an opportunity to comment on the undertaking. Gulf LNG, as a non-federal party, is assisting the FERC in meeting its obligations under section 106 and the implementing regulations in 36 CFR Part 800.

### 4.11.1 Cultural Resources Assessment

The proposed LNG Clean Energy Project includes two LNG storage tanks, a ship berth and unloading facilities (i.e., marine facilities), vaporization facilities, and a 5.0-mile long natural gas pipeline with associated aboveground facilities. Electric transmission facilities and a water supply pipeline, which would be constructed by local utility companies, would be required to connect the proposed project facilities with existing utilities. The project would also include the placement of dredged material in the ODMDS located approximately 5 miles south of Horn Island. The area of potential effect (APE) for archaeological study includes the LNG terminal site (33.3 acres); marine facilities (61.3 acres); permanent LNG terminal access road (9.3 acres); and natural gas sendout pipeline and associated aboveground facilities (82.4 acres), including construction right-of-way (43.0 acres), temporary extra workspace (2.2 acres), contractor yards and support areas (36.0 acres), and aboveground facilities (1.2 acres). The APE for architectural properties encompasses 0.5 mile, centered on the LNG terminal site and the natural gas pipeline centerline.

As part of its application, Gulf LNG provided the FERC with its cultural resources assessment of the project area. This assessment included a literature review, site file check, and consultation with the Mississippi State Historic Preservation Office (SHPO) by qualified archaeologists. In addition, Gulf LNG provided the FERC with its unanticipated discovery plan (see section 4.11.2) and its initial contacts with federally recognized Native American tribes (see section 4.11.3).

Gulf LNG's literature review and site file check revealed no NRHP-eligible properties or previously identified archaeological sites within the project area. The nearest previously identified archaeological site, 22JK674, is located nearly 0.25 mile west of the proposed pipeline. The nearest previously identified architectural property is a historic district in downtown Pascagoula, located west of the project area.

Gulf LNG consulted with the Mississippi SHPO by letter on four occasions between December 3, 2004 and May 5, 2005, documenting the evolving locations of the LNG terminal, marine facilities, natural gas pipeline, and dredged material placement. The Mississippi SHPO recommended that no cultural resources surveys of the project area be required and that "no properties listed in or eligible for listing in the National Register of Historic Places will be affected." Based on the Mississippi SHPO's recommendation, Gulf LNG did not conduct a cultural resources survey of the proposed project area. Much of the project area is believed to have been disturbed by previous construction and dredging activities. The sendout pipeline parallels existing pipelines and roadways.

Gulf LNG also consulted with the Mississippi SHPO regarding the need for and level of intensity of any cultural resources surveys at three contractor yards and support areas and the ODMDS. The Mississippi SHPO again stated that no historic proprieties would be affected by the proposed project and no cultural resources surveys were required.

The LNG Clean Energy Project area is not presently connected to local water and electrical utilities. Electric transmission facilities and a water supply pipeline would be constructed to connect the

LNG terminal with existing utilities. Gulf LNG has requested that the local utilities provide results of efforts to document the presence of previously identified cultural resources and the need for a cultural resources survey within the proposed connection zones. To ensure that potential cultural resources issues associated with these facilities are adequately addressed, we have recommended that Gulf LNG file with the Commission the status and copies of any surveys and reports prepared for cultural resources before construction of the nonjurisdictional facilities (see section 2.2).

The LNG ships would transit along the waterway from the territorial seas to the berthing facility, passing through the Horn Island Pass. In the unlikely event of an LNG spill, the physical properties of LNG would limit any potential impacts on cultural resources on either Horn or Petit Bois Island. Additional information on the environmental impacts resulting from the transit of the LNG ships is provided in section 4.13.5.3.

### 4.11.2 Unanticipated Discovery Plan

As part of its application, Gulf LNG provided its *Plan and Procedures Addressing Unanticipated Discoveries of Cultural Resources and Human Remains* to be used in the event that cultural resources or human remains are discovered during construction. The plan describes the procedures that would be undertaken in the event previously unidentified cultural resources or human remains are encountered during construction. As part of the FERC's Pre-Filing Process, Gulf LNG provided the Mississippi SHPO with copies of its unanticipated discovery plan in June 2005. In a letter dated July 13, 2005, the Mississippi SHPO found the plan to be adequate and satisfactory.

### 4.11.3 Native American Consultation

Gulf LNG contacted four Native American tribes whose traditional territories would be directly affected by the proposed project or who had been identified by the Mississippi SHPO or other knowledgeable parties as having a potential interest in cultural resources impacts. These tribes included the Tunica-Biloxi Tribe, the Jena Band of Choctaw, the Mississippi Band of Choctaw Indians, and the Choctaw Nation of Oklahoma. Gulf LNG sent its initial consultation letters to the tribes on December 13, 2004. These letters described the proposed project and provided the tribes with the opportunity to comment on the project and identify sites or places that might be of religious or cultural significance to them. To date, none of the tribes have requested any information regarding the proposed project.

### 4.11.4 Impact and Mitigation

The FERC, in consultation with the Mississippi SHPO, has determined that there would be no impact on any properties listed or eligible for listing in the NRHP for the proposed project; therefore, no mitigation would be required.

## 4.12 AIR QUALITY AND NOISE

### 4.12.1 Air Quality

#### 4.12.1.1 Regional Climate

The local climate for the project area is humid subtropical with temperate winters and hot humid summers. Based on data from the National Weather Service Station in Mobile, Alabama, the prevailing winds are from the south and average about 9 miles per hour (mph). The winds supply the moisture that results in high humidity and frequent afternoon thunderstorms. Thunderstorms occur approximately 70 to 80 days per year along the coast.

This portion of Mississippi is subject to severe weather. According to the NOAA Storm Events Database, numerous tornados, hurricanes, and tropical storms occurred in Jackson County, Mississippi between 1950 and 2004. Data for the recent hurricanes, Rita and Katrina, are not yet available from NOAA.

According to data obtained from the Office of the Mississippi Climatologist for National Weather Service Cooperative Station Pascagoula 3NE for the period 1971 to 2000, precipitation averages about 67 inches per year with the most rainfall occurring in July. The mean monthly temperatures in the Pascagoula area range from a low of 49.4 °F to a high of 80.8 °F, with an average annual temperature of approximately 66 °F.

#### 4.12.1.2 Existing Air Quality

**Ambient Air Quality Standards**

The EPA has established National Ambient Air Quality Standards (NAAQS) for criteria pollutants for the purpose of protecting human health (primary standards) and public welfare (secondary standards). The EPA has set NAAQS for the following criteria pollutants: nitrogen dioxide ($NO_2$), CO, $O_3$, $SO_2$, lead, particulate matter with an aerodynamic diameter less than or equal to 10 microns ($PM_{10}$), and particulate matter with an aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$).

The EPA has implemented a new 8-hour ozone standard that is now in effect. The 1-hour ozone standard was revoked on June 15, 2005. The MDEQ adopted the NAAQS as the ambient air quality standards in the State of Mississippi under Regulation APC-S-4; however this regulation has not been amended to reflect the revocation of the 1-hour ozone standard.

**Air Quality Control Regions and Attainment Status**

Air quality control regions (AQCR) are areas established for air quality planning purposes in which implementation plans describe how ambient air quality standards will be achieved and maintained. The proposed project area is located in the Southern Mississippi Interstate AQCR.

AQCRs were established by the EPA and local agencies, in accordance with section 107 of the CAA, as a means to implement the CAA and comply with the NAAQS through state implementation plans. The AQCRs are intra- and interstate regions such as large metropolitan areas where improvement of the air quality in one portion of the AQCR requires emission reductions throughout the AQCR. Each AQCR, or portion thereof, is designated based on compliance with the NAAQS. AQCR designations fall under three categories as follows: “attainment” (areas in compliance with the NAAQS); “nonattainment” (areas not in compliance with the NAAQS); or “unclassifiable.” Jackson County is designated “attainment” or “unclassifiable” for all criteria pollutants.

## Air Quality Monitoring and Existing Air Quality

The MDEQ maintains a network of air quality monitors located throughout the state for a variety of purposes. Data from many of those monitors are reported to the EPA AirData database (EPA, 2005c). The ambient air quality standards and available monitoring data are summarized in table 4.12.1-1.

TABLE 4.12.1-1

**National Ambient Air Quality Standards and Local Background Data for the LNG Clean Energy Project**

| Pollutant | Averaging Time | Primary Standard | Secondary Standard | Background Value | Monitoring Station Number | Monitoring Station Location |
|---|---|---|---|---|---|---|
| $SO_2$ | Annual [a] | 0.03 ppm | - | 0.003 ppm | 28059006 | Pascagoula, MS |
| | 24-hour [b] | 0.14 ppm | - | 0.02 ppm | 28059006 | Pascagoula, MS |
| | 3-hour [b] | - | 0.5 ppm | 0.046 ppm | 28059006 | Pascagoula, MS |
| $PM_{10}$ | Annual [a] | 50 μg/m$^3$ | 50 μg/m$^3$ | 20.0 μg/m$^3$ | 28059006 | Pascagoula, MS |
| | 24-hour [b] | 150 μg/m$^3$ | 150 μg/m$^3$ | 51.0 μg/m$^3$ | 28059006 | Pascagoula, MS |
| $PM_{2.5}$ | Annual [a] | 15 μg/m$^3$ | 15 μg/m$^3$ | 15.2 μg/m$^3$ | 28059006 | Pascagoula, MS |
| | 24-hour [c] | 65 μg/m$^3$ | 65 μg/m$^3$ | 32.0 μg/m$^3$ | 28059006 | Pascagoula, MS |
| CO | 8-hour [d] | 9 ppm | - | 1.7 ppm | 010973101 | Mobile, AL |
| | 1-hour [d] | 35 ppm | - | 2.0 ppm | 010973101 | Mobile, AL |
| Ozone | 8-hour [e] | 0.08 ppm | 0.08 ppm | 0.084 ppm | 28059006 | Pascagoula, MS |
| | 1-hour [f, g] | 0.12 ppm | 0.12 ppm | 0.099 ppm | 28059006 | Pascagoula, MS |
| $NO_2$ | Annual [a] | 0.05 ppm | 0.05 ppm | 0.008 ppm | 28059006 | Pascagoula, MS |
| Lead | Quarter | 1.5 μg/m$^3$ | - | NA | NA | NA |

[a] Background value based on maximum annual average from 2002 to 2005.
[b] Background value based on the maximum yearly high 2nd high value from 2002 to 2005.
[c] Background value based on the maximum yearly 98th percentile of 24-hour values from 2002 to 2005.
[d] Background value based on the maximum yearly high 2nd high value from 2002 to 2003.
[e] Background value based on the maximum yearly high 4th high value from 2002 to 2005.
[f] Background value based on the maximum yearly high 2nd high value from 2002 to 2005.
[g] The Mississippi air regulations have not been amended to reflect the revocation of the 1-hour ozone standard.
μg/m$^3$ micrograms per cubic meter
ppm parts per million
NA No data available

### 4.12.1.3 Regulatory Requirements for Air Quality

The proposed LNG Clean Energy Project is potentially subject to a variety of federal, state, and local regulations pertaining to construction or operation of air emission sources. The MDEQ has primary jurisdiction over air emissions produced by the LNG terminal. The MDEQ enforces its own regulations as well as the EPA's federal requirements. The following sections summarize the applicability of various federal and state regulations. Jackson County does not have any additional air permit requirements beyond the MDEQ and federal programs.

Although Jackson County is designated as in attainment for all of the NAAQS, to avoid exceedances of the $O_3$ standards, 40 CFR Part 80.27 mandates using less volatile gasoline from May through September.

**Federal Air Quality Requirements**

The CAA, 42 USC 7401 et seq., as amended in 1977 and 1990, and 40 CFR Parts 50 through 99 are the basic federal statutes and regulations governing air pollution in the United States. The following federal requirements have been reviewed for applicability to the proposed LNG Clean Energy Project.

New Source Review/Prevention of Significant Deterioration

Separate preconstruction review procedures have been established for projects that are proposed to be built in attainment areas versus nonattainment areas. The preconstruction review process for new or modified major sources located in attainment areas is called New Source Review (NSR) and may include a Prevention of Significant Deterioration (PSD) review. This review process is intended to keep new air emission sources from causing existing air quality to deteriorate beyond acceptable levels codified in the federal regulations.

The proposed LNG terminal is located in a designated attainment area for the NAAQS. Therefore, new major sources and major modifications in this area are subject to the NSR/PSD rule. To be classified as a major PSD source, the potential emissions from the source must either be: 1) greater than 100 tons per year (tpy) for any pollutant regulated by the CAA for sources that are among the 28 source categories listed in section 169 of the CAA or 2) greater than 250 tpy for any pollutant regulated by the CAA for sources that are not among the 28 source categories. The PSD requirements are codified in Mississippi Regulation APC-S-5. An applicability determination letter from the MDEQ dated May 1, 2006 indicates that the proposed LNG terminal is not one of the 28 listed source categories and would not be subject to the PSD requirements, as long as the facility does not emit 250 tpy or more of any criteria pollutant. The estimated operational emissions from stationary sources (including unloading emissions) are projected to be below the 250 tpy threshold (see section 4.12.1.4). Therefore, the proposed project would not be subject to PSD major source requirements.

One additional factor considered in the PSD permit review process is potential impacts on protected Class 1 Wilderness areas. If a project is located within 100 kilometers of a federal Class I area, additional modeling analysis may be required to determine the potential impacts on the area. The proposed project is within 47 kilometers of the Breton NWR, a federally designated Class I area.

At the MDEQ's request, Gulf LNG performed a refined air quality modeling analysis using the EPA's ISCST3 model to estimate the potential ambient impacts on the Breton NWR resulting from the emissions of $NO_x$, $PM_{10}$, and $SO_2$ associated with the project. Modeling was performed for the proposed facility and for the facility including ship unloading emissions. Maximum hourly emissions were modeled to evaluate short-term averaging period impacts, and annual emission rates were used to evaluate long-term impacts. Rural dispersion conditions were assumed to be consistent with the surrounding area. Impacts of emissions were predicted at receptors located in the vicinity of the refuge. Five years of meteorological data provided by the MDEQ were used for the analysis. The maximum predicted impacts of $NO_x$, $SO_2$, and $PM_{10}$ were determined and compared to the Class I modeling Significant Impact Levels (SILs) and increments. The modeling results for the facility, including ship unloading emissions, indicate that the maximum predicted impacts associated with the project would be below the identified Class I increments.

In addition to the ambient air impacts, a Level-1 screening analysis was performed to estimate the potential impacts on visibility in the Breton NWR. The analysis was performed using the EPA's VISCREEN and standard Level-1 default parameters. The analysis assumed meteorological conditions of Class F atmospheric stability and a wind speed of 1 meter per second. A background visual range of 178.6 kilometers; an annual average reference level light-extinction coefficient of 21.9 inverse

megagrams for the Breton NWR; and a source-observer distance of 46.5 kilometers, equivalent to the minimum distance between the proposed project and the Breton NWR, were also used in the analysis.

Modeled emission rates for $NO_x$ and particulate matter were based on a reasonable worst-case operating scenario that included the SCVs, vent stack heater, mobile crane, LNG ship sources associated with unloading operations, gas turbines, and diesel air compressor. The resulting maximum predicted values of plume perceptibility and plume contrast inside the Class 1 area were below the default screening thresholds and demonstrates that the project would not be expected to have adverse visibility impacts on the Breton NWR.

The FERC staff required Gulf LNG to conduct an additional refined Class I and Class II modeling analysis to evaluate the potential impacts of the proposed project using a different model suggested for use in complex coastal environments similar to the proposed project location. Section 4.12.1.4 includes a discussion of the additional refined Class I and Class II modeling analyses performed by Gulf LNG to assess impacts associated with operation of the proposed project as requested by the Commission.

New Source Performance Standards

New Source Performance Standards (NSPS), codified in 40 CFR Part 60, establish requirements for new, modified, or reconstructed units in specific source categories. NSPS requirements include emission limits, monitoring, reporting, and recordkeeping. The following NSPS requirements were identified as potentially applicable to the specified sources at the facility.

Subpart Dc of 40 CFR Part 60, *Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units*, applies to fuel-fired steam-generating units with a heat input capacity of less than 100 million British thermal units per hour (MMBtu/hr) each. The definition of an applicable unit includes sources that produce steam or heat water or any other heat transfer medium. The 10 SCVs are each rated at 96 MMBtu/hr and would burn natural gas. The heaters associated with the SCVs are therefore subject to Subpart Dc and would comply with the requirements, as applicable. Since the SCVs are natural gas-fired, they are not subject to NSPS limits on particulate matter or $SO_2$.

Subpart Kb of 40 CFR Part 60, *Standards of Performance for Volatile Organic Liquid Storage Vessels*, lists affected emission sources as storage vessels containing volatile organic liquids (VOL). Regulatory applicability is dependent on the construction date, size, and vapor pressure of the storage vessel and its contents. Subpart Kb applies to new tanks, unless otherwise exempted, that have a storage capacity between 75 $m^3$ (19,813 gallons) and 151 $m^3$ (39,890 gallons) and contain volatile organic compounds (VOC) with a maximum true vapor pressure greater than or equal to 15.0 kilopascals (kPa). Subpart Kb also applies to tanks that have a storage capacity greater than or equal to 151 $m^3$ and contain VOCs with a maximum true vapor pressure greater than or equal to 3.5 kPa. Each of the LNG storage tanks would have a capacity of 160,000 $m^3$, which meets the volume criteria for Subpart Kb. The LNG is considered a VOL because a small portion of the LNG would consist of VOCs. The vapor pressure of the VOC (assumed to be propane) that would be stored in the LNG tanks is approximately 0.0007 kPa at the proposed storage temperature of -256 °F (Perry and Green, 1997). Therefore, the proposed LNG storage tanks are not subject to NSPS Subpart Kb.

Subpart IIII of 40 CFR Part 60, *Standards of Performance for Stationary Compression Ignition Internal Combustion Engines*, applies to stationary compression ignition internal combustion engines that commence construction, modification, or reconstruction after July 11, 2005. This rule has not yet been promulgated. However, Gulf LNG would assess the applicability of the standards upon promulgation to the proposed diesel generator, diesel firewater pump engines, and diesel air compressor engine and would comply with the requirements, as applicable.

Subpart KKKK of 40 CFR Part 60, *Standards of Performance for Stationary Combustion Turbines*, applies to stationary combustion turbines with a heat input capacity greater than 10 MMBtu/hr on a high heating value basis that commence construction, reconstruction, or modification after February 18, 2005. The proposed gas turbines would each meet the definition of an "emergency combustion turbine" codified in 40 CFR Part 60.4420 exempting them from the $NO_x$ emission limits specified in 40 CFR Part 60.4320. However, the gas turbines would be subject to and would comply with the $SO_2$ emission standards specified in 40 CFR Part 60.4330(a), the fuel sulfur monitoring requirements in 40 CFR Part 60.4360, the initial reporting requirements in 40 CFR Part 40.4390(a), and the operation and maintenance requirements in 40 CFR Part 60.4333(a).

National Emissions Standards for Hazardous Air Pollutants

The National Emissions Standards for Hazardous Air Pollutants (NESHAP), codified in 40 CFR Parts 61 and 63, regulate hazardous air pollutant (HAP) emissions. Part 61 was promulgated before the 1990 Clean Air Act Amendments (CAAA) and regulates only eight types of hazardous substances (asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride).

The 1990 CAAA established a list of 189 HAPs, resulting in the promulgation of Part 63. Part 63, also known as the Maximum Achievable Control Technology standards, regulates HAP emissions from major sources of HAP emissions and specific source categories that emit HAPs. Part 63 defines a major source of HAPs as any source that has the potential to emit 10 tpy of any single HAP or 25 tpy of HAPs in aggregate.

LNG storage and processing facilities do not fall under one of the source categories regulated by Part 61; therefore, the requirements of Part 61 are not applicable to the proposed LNG terminal. Part 63 establishes HAP emission standards for marine vessel loading operations (Subpart Y); oil and gas production facilities (Subpart HH); natural gas transmission and storage facilities (Subpart HHH); industrial, commercial, and institutional boilers and process heaters (Subpart DDDDD); and reciprocating internal combustion engines (Subpart ZZZZ). All of these subparts establish requirements for major sources of HAPs only. HAP emissions (in aggregate) from the proposed LNG terminal would be about 7.7 tpy and the single largest HAP emitted by the facilities would be hexane at a rate of approximately 7.3 tpy. Since HAP emissions from the LNG terminal would not exceed the single or aggregate thresholds, the LNG terminal would not be a major source of HAPs and would not be subject to the NESHAPs.

Chemical Accident Prevention Provisions

The chemical accident prevention provisions, codified in 40 CFR Part 68, are federal regulations designed to prevent the release of hazardous materials in the event of an accident and minimize potential impacts if a release does occur. The regulations contain a list of substances and threshold quantities for determining applicability to stationary sources. If a stationary source stores, handles, or processes one or more substances on this list in a quantity equal to or greater than that specified in the regulation, the facility must prepare and submit a risk management plan (RMP). If a facility does not have a listed substance on-site, or the quantity of a listed substance is below the applicability threshold, the facility does not need to prepare an RMP. In the latter case, the facility still must comply with requirements of the general duty provisions in section 112(r)(1) of the 1990 CAAA if there is any regulated substance or other extremely hazardous substance on site.

Stationary sources are defined in 40 CFR Part 68 as any buildings, structures, equipment, installations, or substance-emitting stationary activities that belong to the same industrial group, are located on one or more contiguous properties, are under the control of the same person (or persons under

common control), and from which an accidental release may occur. However, the definition also states that the term "stationary source" does not apply to transportation, including storage incidental to transportation, of any regulated substance or any other extremely hazardous substance. The term "transportation" includes transportation subject to oversight or regulation under 49 CFR Parts 192, 193, or 195 or a state natural gas or hazardous liquid program for which the state has in effect a certification to the DOT under 49 USC section 60105. Based on these definitions, the only substance that would be potentially applicable to the RMP regulation is the LNG that is stored incidental to transportation. Therefore, an RMP is not required for this facility. However, the facility would need to comply with the general duty provisions of the 1990 CAAA as discussed above.

Title V Operating Permit

Title V of the CAA requires states to establish an air operating permit program. The requirements of Title V are outlined in 40 CFR Part 70 and the permits required by these regulations are often referred to as Part 70 permits. Mississippi has incorporated this program in APC-S-6.

If a facility's actual or potential emissions meet or exceed the major source threshold for a criteria pollutant or HAP, the facility is required to obtain a Title V operating permit. The major source threshold level for an air emission source in Jackson County is 100 tpy for any criteria pollutants ($PM_{10}$, $SO_2$, $NO_x$, VOC, or CO), 10 tpy of any single HAP, or 25 tpy of all HAPs in aggregate. The facility's potential to emit for $NO_x$ and CO would exceed the major source thresholds. Therefore, the proposed facility would be required to obtain a Title V operating permit.

General Conformity

40 CFR Parts 51 and 93 define the requirements for determining conformity for federal actions to state or federal implementation plans. A conformity analysis is required for each criteria pollutant where the total of direct and indirect emissions in a nonattainment or maintenance area caused by a federal action would equal or exceed any of the rates specified in the applicable implementation plan. The proposed project would be located in an attainment area. Therefore, the General Conformity requirements do not apply.

Control of Emissions from New and In-Use Nonroad Compression Ignition Engines

40 CFR Part 89 requires the control of emissions from nonroad compression ignition engines. The engine in the mobile crane would meet the definition of a nonroad engine and would be subject to the exhaust emission standards in 40 CFR Part 89.112.

**State Air Quality Requirements**

The MDEQ is the air permitting authority for the proposed project. The MDEQ air quality regulations are codified in APC-S-1 through APC-S-10. These regulations incorporate the federal requirements from 40 CFR Parts 50 through 99 and establish permit review procedures for all facilities that emit pollutants to the ambient air. As indicated above, the facility is subject to the Title V permitting requirements; therefore, the facility would be required to obtain a state permit to construct with federally enforceable limits. The MDEQ permit would require compliance with all applicable federal and state air regulations.

Under federal regulations (40 CFR Part 70.8(b)), the air permitting authority shall provide any affected state a copy of the draft operating permit for review and comment. An affected state is one whose air quality may be affected and that is contiguous to the state in which a Title V operating permit,

permit modification, or permit renewal is being proposed or one that is within 50 miles of the permitted source. The proposed LNG terminal would be located within 50 miles of the Louisiana and Alabama borders; therefore, the Louisiana Department of Environmental Quality and the Alabama Department of Environmental Management would be given the opportunity to review and comment on Gulf LNG's draft operating permit prior to issuance by the MDEQ.

A summary of the state air regulations potentially applicable to the LNG Clean Energy Project is provided below.

APC-S-1 – General Regulations on the Control of Emissions and Emission Standards

APC-S-1 includes the general rules that are applicable to all sources. The SCVs, vent stack heater, and emergency generators would be subject to the particulate matter requirements under this regulation. The requirements in APC-S-1 include opacity limits, nuisance prohibition, and $SO_2$ emissions.

APC-S-2 – Permit Regulation for the Construction and/or Operation of Air Emissions Equipment

APC-S-2 includes the requirements for obtaining permits to construct. The proposed LNG terminal would be required to obtain a construction permit before beginning construction.

APC-S-3 – Prevention of Air Pollution Emergency Episodes

APC-S-3 includes regulatory requirements related to air pollution emergency episodes. Specific requirements of APC-S-3 include preparation of an emission control action program for any facility that emits more than 0.25 ton per day of pollutants for which standards have been adopted.

APC-S-6 – Title V Regulations

APC-S-6 contains the requirements for obtaining federal operating permits pursuant to the Title V operating permit program as described above.

#### 4.12.1.4 Impact and Mitigation

**Construction**

The activities that would generate air emissions during construction of the proposed LNG Clean Energy Project include:

- site preparation (earthmoving);
- operation of vehicles and trucks during construction;
- operation of marine vessels during construction;
- installation of terminal components;
- slip excavation and dredging activities;
- dock construction;
- pipeline and pipeline interconnection construction; and
- worker commuting trips.

Site preparation would include stripping the top layer of earth, removal of earth from high elevation areas to level the LNG terminal site to finished grade, constructing the perimeter wall dike and LNG storage tank dike, and site preparation for other facilities. Site preparation activities would generate

fugitive dust from earthmoving and movement of construction equipment over unpaved surfaces as well as tailpipe emissions from construction equipment and vehicle engines. The construction equipment and vehicles would be powered by internal combustion engines that would generate $PM_{10}$, $PM_{2.5}$, $SO_2$, $NO_x$, VOC, and CO emissions. Site preparation equipment would include cranes, trucks, bulldozers, front-end loaders, backhoes, compactors, graders, and dump trucks.

Installation of the LNG terminal components would include constructing unloading dock pile caps and beams, deck slabs, mooring and breasting dolphin caps, LNG unloading and vapor return arms, major mechanical equipment, and piping and instrumentation, as well as construction of LNG storage tanks, foundations, pipe racks, and buildings. Construction equipment at the LNG terminal site would include cranes, backhoes, pile drivers, welders, and generators, which would generate tailpipe and dust emissions similar to the site preparation activities.

Gulf LNG would dredge an estimated 2.96 million $yd^3$ of material during construction of the ship berth and maneuvering area. The emissions generated by these activities would be predominantly combustion emissions from the construction equipment and vehicle engines. The construction equipment would include a mechanical dredge, tugboats, a workboat, cranes, excavator, barge, bulldozers, and trucks. Diesel-powered pile-driving hammers would be used to install all piles for the structures associated with the marine facilities. The hammers would be internal combustion, open-top hammers that are typically used for this type of construction. Other equipment would likely include smaller hydraulic lifting cranes, gas- and diesel-powered air compressors, welding machines, and power generators.

Site truck traffic and worker commuter vehicles would generate fugitive dust from travel on paved and unpaved surfaces as well as tailpipe emissions. Construction of the LNG terminal facilities would take place over a period of approximately 38 months. The internal combustion engines for most of the construction equipment would burn diesel fuel. Some of the pickup trucks and most of the commuter vehicles would burn gasoline.

Air emissions would also be generated during construction of the proposed natural gas sendout pipeline. The pipeline construction activities would take place over a period of about 6 months. Similar to emissions associated with construction of the LNG terminal, pipeline construction activities would generate fugitive dust as well as combustion emissions from construction equipment, commuter trips, and supply vehicles. Equipment that would be used for pipeline construction activities includes earthmoving equipment, compressors, pumps, trenchers, stringing trucks, HDD equipment, welding rigs, and equipment for restoring disturbed areas. The internal combustion engines powering most of the pipeline construction equipment and vehicles would burn diesel fuel and the remaining vehicles would burn gasoline.

The estimated emissions from the LNG terminal and pipeline construction activities were based on EPA emission factors for stationary engines (for construction equipment tailpipe emissions) and EPA MOBILE 6.2 for commuter vehicle tailpipe emissions. Gulf LNG indicated that it would use the diesel fuels that are commercially available in the project area at the time of construction.

The emissions from construction activities would include $PM_{2.5}$, $PM_{10}$, $NO_x$, CO, sulfur oxides ($SO_x$), VOCs, and HAPs. The estimated criteria pollutant emissions from construction are broken down by year and summarized in table 4.12.1-2.

TABLE 4.12.1-2

**Estimated Emissions by Year Associated with Construction of the LNG Clean Energy Project**

| Year/Source Category | $PM_{10}/PM_{2.5}$ [a] (tons) | $NO_x$ (tons) | CO (tons) | $SO_x$ (tons) | VOCs (tons) |
|---|---|---|---|---|---|
| 2006 | | | | | |
| Construction Equipment [b] | 2.9 | 66.1 | 21.3 | 9.3 | 4.2 |
| Fugitive Dust | 598.4 | 0.0 | 0.0 | 0.0 | 0.0 |
| Commuter Traffic | 0.002 | 0.077 | 1.4 | 0.00068 | 0.077 |
| Delivery Vehicles | 0.0064 | 0.18 | 0.046 | 0.0077 | 0.0091 |
| Emissions Subtotal | 601.3 | 66.4 | 22.7 | 9.3 | 4.3 |
| 2007 | | | | | |
| Construction Equipment [b] | 15.1 | 340.1 | 107.3 | 46.0 | 22.6 |
| Fugitive Dust | 598.4 | 0.0 | 0.0 | 0.0 | 0.0 |
| Commuter Traffic | 0.27 | 1.7 | 30.8 | 0.016 | 1.7 |
| Delivery Vehicles | 0.0022 | 0.066 | 0.017 | 0.0 | 0.0034 |
| Emissions Subtotal | 613.8 | 341.9 | 138.1 | 46.0 | 24.3 |
| 2008 | | | | | |
| Construction Equipment (LNG Terminal) [b] | 14.9 | 336.6 | 105.4 | 44.1 | 22.7 |
| Fugitive Dust (LNG Terminal) | 598.4 | 0.0 | 0.0 | 0.0 | 0.0 |
| Construction Equipment (Pipeline) [b] | 0.9 | 19.6 | 5.0 | 2.6 | 1.3 |
| Fugitive Dust (Pipeline) | 285.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Commuter Traffic (LNG Terminal and Pipeline) | 0.89 | 5.2 | 97.9 | 0.050 | 5.2 |
| Delivery Vehicles (LNG Terminal and Pipeline) | 0.0015 | 0.048 | 0.012 | 0.000 | 0.0026 |
| Emissions Subtotal | 900.2 | 361.4 | 208.3 | 46.8 | 29.2 |
| 2009 | | | | | |
| Construction Equipment [b] | 7.4 | 52.1 | 52.1 | 22.1 | 11.2 |
| Fugitive Dust | 598.4 | 0.0 | 0.0 | 0.0 | 0.0 |
| Commuter Traffic | 0.027 | 0.81 | 15.6 | 0.0084 | 0.81 |
| Delivery Vehicles | 0.0013 | 0.043 | 0.011 | 0.000 | 0.0024 |
| Emissions Subtotal | 605.8 | 53.0 | 67.7 | 22.1 | 12.0 |
| Total Construction Emissions | 2,721.1 | 822.6 | 436.9 | 124.2 | 69.8 |

[a] All PM is conservatively estimated to be less than 2.5 microns in diameter; therefore, the PM emissions are equal to the $PM_{2.5}$ emissions.

[b] Construction equipment emissions include both on- and non-road construction equipment.

NA No data available

The primary air pollutants emitted during the construction period would be $NO_x$ (includes $NO_2$), CO, $SO_x$ (includes $SO_2$), and $PM_{10}/PM_{2.5}$ generated by the construction equipment. The emissions from the construction process would increase the pollutant concentrations in the vicinity of the project; however, their effect on ambient air quality would vary with time due to the construction schedule, the mobility of the sources, and the variety of emission sources. Construction emissions of $NO_x$, CO, $SO_x$, and VOCs per year would be below the proposed total operating emissions per year. Modeling was performed for the operating emissions and is discussed in detail below. The results of the modeling indicate that there would not be a significant impact on air quality in the vicinity of the project. Since the construction emissions would be below the operating emissions for these pollutants and the modeling results indicate that there would not be a significant impact, construction activities are not expected to have a significant impact on air quality in the vicinity of the project with respect to $NO_x$, CO, $SO_x$, and VOCs.

$PM_{10}/PM_{2.5}$ would be the primary pollutant of concern during construction. Most of the predicted $PM_{10}$ emissions are associated with fugitive dust produced during construction of the LNG terminal facilities and associated pipeline. Fugitive dust could have an impact in the immediate vicinity of construction activity and would cease once construction in a particular area is complete. Measures Gulf LNG would implement to reduce dust emissions include applying water, using BMPs, and scheduling construction operations to avoid concurrent operations by larger emission sources when feasible. To ensure that measures are implemented to reduce nuisance dust emissions during construction, **we recommend that:**

- **Gulf LNG prepare a Fugitive Dust Control Plan that specifies the following:**

  **a. the precautions that would be taken to minimize fugitive dust emissions from construction activities and when/how the measures would be applied;**

  **b. the individuals with authority to determine if/when water needs to be reapplied for dust control; and**

  **c. the individuals with authority to stop work if the contractor does not comply with dust control measures.**

  **This plan should be filed with the Secretary for the review and written approval of the Director of OEP <u>before construction</u>.**

**Operation**

Sources of air emissions associated with operation of the proposed LNG terminal would include:

- ten 96 MMBtu/hr SCVs;
- one 12.5 MMBtu/hr vent stack heater;
- two 142 MMBtu/hr stationary gas turbines;
- two diesel-fired firewater pumps (one 625 horsepower (hp) and one 600 hp);
- one 500-kilowatt generator powered by a 670-hp diesel engine;
- one diesel-powered air compressor (rated at 250 hp);
- one 350-hp mobile crane;
- fugitive emission sources (valves, flanges, sampling ports, and marine vessel offloading equipment);
- two 160,000-$m^3$ full-containment, doubled-walled LNG storage tanks;
- four 250-gallon diesel fuel storage tanks;
- LNG ships and tugboats; and
- worker commuter vehicles.

The primary source of emissions associated with the LNG terminal would be the SCVs. Ten SCVs, each with a heat input capacity of approximately 96 MMBtu/hr, would be used to vaporize the LNG. The potential emissions for the SCVs are based on all 10 SCVs operating at full capacity for the entire year and on a minimum fuel heating value. SCV emission factors for $NO_x$ and CO are based on preliminary vendor design data. EPA AP-42 emission factors for natural gas combustion are used for other pollutants.

The heated vent stack system would consist of the intermediate fluid heater and the vent stack. In the event that gas is vented to the atmosphere, gas would flow through a heat exchanger where a heated intermediate fluid would ensure that the gas being vented is heated to a temperature that allows the gas to be lighter than air, allowing the gas to rise and dissipate into the atmosphere. The vent stack heater would have a heat input capacity of approximately 12.5 MMBtu/hr. The potential emissions from the vent stack heater are based on continuous operation of the vent stack heater for the entire year and on a minimum fuel heating value. The vent stack heater emission factors for $NO_x$ and CO are based on preliminary vendor design data. EPA AP-42 emission factors for natural gas combustion are used for other pollutants.

Two stationary gas turbines, each with a rated heat input capacity of approximately 142 MMBtu/hr),would be used to provide power to the facility in the event that power from the external grid is interrupted. $NO_x$ and CO emission estimates are based on vendor supplied data. EPA AP-42 emission factors are used to estimate the emissions for the remaining pollutants. The potential annual emissions from the two stationary gas turbines are based on 1,000 hours per year.

One diesel generator, with a rated output of 500 kilowatt, would be used to provide electric power to start a gas turbine and to provide standby power in the event that either gas turbine is unavailable. The diesel engine would have a rating of 670 hp. The potential emissions are based on 1,000 hours per year of operation. The emission factors for $NO_x$ and CO are based on vendor data and the remaining pollutants are estimated using EPA AP-42 emission factors.

Two diesel engines, with rated outputs of approximately 625 hp (466 kilowatt) and 600 hp (447 kilowatt), respectively, would be used to provide firewater (one would be a standby to provide seawater from the berth area in the event that the stored freshwater supply was exhausted). The engines would operate periodically for required routine readiness testing. The potential emissions from the firewater pumps are based on 1,000 hours per year of operation each. The engine emission factors for $NO_x$ and CO are based on preliminary vendor design data. EPA AP-42 emission factors for diesel oil combustion in large stationary internal combustion engines are used for other pollutants.

One diesel-powered air compressor with a rated output of approximately 250 hp would be used at the project site on an as needed basis. Potential emissions are based on 500 hours per year of operation. Emission factors for $NO_x$ and CO are based on preliminary vendor design data. EPA AP-42 emission factors for diesel oil combustion in industrial engines are used for other pollutants.

One diesel-powered mobile crane with a rated output of approximately 350 hp would be used at the terminal as needed. The $NO_x$ and CO emissions are calculated based on EPA Tier 3 and Tier 2/Tier 3 emissions standards for nonroad diesel engines, respectively. The $SO_2$ emissions are estimated using mass balance assuming full conversion of sulfur to $SO_2$. $PM_{10}$ emissions are based on EPA Tier 2 emissions standards for nonroad diesel engines. The VOC emissions are calculated using an EPA AP-42 emission factor for diesel industrial engines. The potential annual emissions are based on 1,000 hours per year of operation.

Fugitive emissions associated with small leaks of VOCs from equipment such as valves, flanges, sampling ports, and marine vessel offloading equipment are calculated based on preliminary equipment

counts, EPA emission factors, and on two representative LNG compositions. The potential emissions from equipment leaks are based on continuous operation of all potential fugitive emission sources.

Four diesel fuel storage tanks, each with a capacity of approximately 250 gallons, would be used to provide fuel for the two firewater pumps and the air compressor. Emissions from the diesel fuel storage tanks are based on a throughput equal to the calculated fuel usage corresponding to 500 hours of operation for each associated device. Potential VOC emissions attributable to breathing and working losses from the tanks were calculated using the EPA TANKS 4.0 model.

Two full-containment, double-walled LNG storage tanks, each with a nominal capacity of 160,000 $m^3$, would be used to store LNG at the site. The LNG storage, transfer, and vapor handling systems are closed so that there would be no emissions from the LNG storage tanks during normal operation. The terminal would not include any diesel-powered equipment often incorporated at other facilities for activities such as vessel unloading. The transfer of LNG and vapor between ships and the terminal would be accomplished via hydraulic arms and cryogenic piping using electrically driven pumps and compressors. The pumps used to transfer the LNG to the terminal would be on the visiting LNG ships, and the power to drive these pumps would be generated by the LNG ships. This activity would result in additional emissions. Gulf LNG would not own or operate the LNG ships calling on the terminal or the tugboats, pilot boats, and Coast Guard vessels that may play a role in LNG ship operations. The marine vessel emissions represent the emissions generated by the round trip travel from the state seaward boundary to the LNG terminal for a total of 6 miles. The emissions estimates are based on available shipping information and EPA marine vessel emission factors, and assume 150 LNG ship calls per year with each call taking about 24 hours including offloading/hotelling.

Table 4.12.1-3 summarizes Gulf LNG's estimated air emissions that would be generated by stationary sources as well as mobile sources associated with the LNG terminal.

Unregulated pollutants such as methane (a primary component of LNG) would be emitted during operation of the LNG terminal. Some of the LNG would vaporize during storage or transfer during ship unloading. The vaporized LNG is referred to as boil-off gas. The boil-off gas generated by the LNG terminal during operation would be minimized through the use of a closed system to capture the vapor, which would be pumped into the LNG ship during LNG offloading or condensed in a direct contact condenser with LNG as the contact liquid and then combined with the sendout natural gas prior to the sendout pumps.

Gulf LNG would minimize air emissions from the proposed stationary sources through the use of clean fuel (natural gas and low sulfur diesel oil), the employment of BMPs for operation and maintenance procedures, and limiting annual hours of operation from the diesel-fired units. No operational emissions from the sendout pipeline would be regulated by the MDEQ or EPA air quality regulations. Operational emissions would be limited to blowdown emissions that would occur during emergency situations and fugitive emissions during operation. Blowdowns would rarely occur and fugitive emissions would be negligible due to the small amount of natural gas emitted and the small fraction of VOCs contained in the natural gas. Therefore, these emissions would not have a significant effect on air quality.

TABLE 4.12.1-3

**Estimated Stationary Sources and Marine Vessel Emissions for Operation of the LNG Terminal**

| Emission Source | $PM_{10}/PM_{2.5}$ (tpy) | $NO_x$ (tpy) | CO (tpy) | $SO_2$ [a] (tpy) | VOC (tpy) | HAPs (tpy) |
|---|---|---|---|---|---|---|
| **Stationary Sources** | | | | | | |
| SCVs [b] | 4.2 | 163.3 | 129.8 | 2.2 | 21.2 | 7.3 |
| Vent Stack Heater [b] | 0.4 | 2.2 | 1.4 | 0.0 | 0.3 | 0.1 |
| Stationary gas turbines [c] | 0.9 | 14.2 | 17.2 | 0.1 | 0.3 | 0.1 |
| Standby Diesel Generator [c] | 0.2 | 1.5 | 1.2 | 0.1 | 0.2 | 0.004 |
| Firewater Pumps [c] | 0.4 | 9.5 | 0.7 | 0.3 | 0.4 | 0.01 |
| Standby Diesel-Powered Air Compressor [c] | 0.3 | 1.9 | 0.4 | 0.1 | 0.3 | 0.01 |
| Mobile Crane [c] | 0.02 | 0.5 | 0.4 | 0.03 | 0.2 | 0.002 |
| Fugitive Emissions [d] | --- | --- | --- | --- | 12.0 | --- |
| Diesel Fuel Storage Tanks | --- | --- | --- | --- | 0.0003 | --- |
| LNG Ship Unloading | 1.8 | 35.1 | 2.7 | 48.5 | 1.2 | 0.1 |
| **Stationary Source Emissions Subtotal** | **8.2** | **228.2** | **153.8** | **51.3** | **36.1** | **7.6** |
| **Mobile Sources** | | | | | | |
| LNG Ships – Cruise | 2.3 | 135.8 | 9.0 | 159.5 | 0.8 | 0.03 |
| LNG Ships – Reduced Speed Zone | 0.6 | 37.0 | 4.8 | 45.5 | 0.6 | 0.02 |
| LNG Ships – Maneuvering | 0.4 | 22.6 | 5.4 | 29.4 | 1.0 | 0.04 |
| LNG Ships – Hotelling | 9.7 | 187.3 | 14.3 | 258.6 | 6.3 | 0.25 |
| Pilot Boats | 0.04 | 2.5 | 0.13 | 2.9 | 0.01 | 0.001 |
| Coast Guard Escort Boats | 0.05 | 6.7 | 192.9 | 0.15 | 5.6 | 0.01 |
| Tug Assists | 0.8 | 49.6 | 2.7 | 57.7 | 0.2 | 0.01 |
| Commuter Traffic | 0.0 | 0.34 | 6.6 | 0.0 | 0.3 | 0.001 |
| **Mobile Source Emissions Subtotal** | **13.9** | **441.8** | **235.8** | **553.8** | **14.8** | **0.4** |
| **Total Emissions** | **22.1** | **670.0** | **389.6** | **605.1** | **50.9** | **8.0** |

[a] $SO_2$ emissions are based on sulfur present in the fuel. Most LNG has no detectable sulfur; however, LNG from some regions may contain a nominal amount. Gulf LNG is not limiting the LNG source to any specific region, therefore 0.2 grain per 100 standard cubic feet was assumed to be present. The sulfur content for the marine vessels fuel was conservatively estimated at 3.5 percent.

[b] Annual emissions for all 10 SCVs and the fluid heater are based on each unit operating 8,760 hours per year.

[c] Annual emissions for the stationary gas turbines, standby diesel generator, firewater pumps, air compressor, and mobile crane are based on operating 1,000 hours per year per unit.

[d] Fugitive emissions are VOCs associated with equipment leaks at valves, flanges, seals, etc.

tpy tons per year
NA No data available

During operation of the LNG Clean Energy Project, air emissions from LNG ships and other project-related vessels would occur along the entire waterway from the territorial seas to the ship berth. The impacts of the LNG ships and other marine vessels within state waters are discussed above under the emissions inventories and below under the operational impact assessment. During transit in federal and International waters, the LNG ships would usually burn boil-off gas from vaporized LNG. The boil-off gas (or natural gas) burned during ship transit is a "cleaner burning" fuel with lower emissions than the heavy weight fuel typically burned during maneuvering, hotelling, and unloading operations while coming into and out of port. The operation of the LNG ships in transit outside of state waters would be moving at faster speeds and would be in a localized area for a shorter time period, and would be operating using a "cleaner burning" fuel than the transit within state waters. During times when operating off of boil-off gas is not feasible, the ships would use heavy fuels. The emissions to any one localized area during ship transit outside of state waters would be temporary and transient and would be occurring at

distances allowing for considerable dispersion before reaching any sensitive receptors; therefore, air emissions from ship transit are not expected to result in a significant impact on air quality.

Operational Impact Assessment

In order to provide a more thorough evaluation of the potential impacts on air quality in the vicinity of the proposed project, the FERC asked Gulf LNG to conduct a quantitative assessment of project air emissions. The assessment included air dispersion modeling analyses to predict off-site (i.e., ambient) concentrations in the vicinity of the project for $PM_{10}$, $SO_2$, $NO_2$, and CO resulting from the proposed emissions associated with operation of the project for comparison to appropriate federal air quality standards. A summary of the methodology and results of the Class I and Class II analyses is provided below.

Impacts were predicted at the Breton NWR Class I area and in the Class II area surrounding the LNG terminal. The modeling was conducted using the CALPUFF model with a 3-year meteorological data set (2001 through 2003) previously approved by state and federal agencies for modeling sources in this region. CALPUFF is an advanced regulatory guideline model approved by the EPA for assessing coastline effects, overwater transport, and other non-steady-state effects that significantly contribute to the downwind dispersion of pollutants being emitted from sources such as the proposed LNG terminal. Gulf LNG evaluated impacts for the following three scenarios:

- Scenario A: Project emissions from sources that would be under the direct control of Gulf LNG. This included emissions from the stationary sources at the LNG terminal.

- Scenario B: Scenario A plus emissions associated with LNG carrier unloading and hotelling activities while at berth.

- Scenario C: Scenario B plus emissions from LNG carriers in transit to and from the terminal, working tugs, and Coast Guard escort boats operating within a moored safety/security zone defined by the Commission as an area extending 500 yards in all directions from the area occupied by a typical LNG carrier at berth.

The modeled emissions associated with each scenario were consistent with the operating rates information Gulf LNG had previously provided to the Commission and the air permit application submitted to the MDEQ. Two different modeling analyses were conducted for each of these three emissions scenarios, one for the Breton NWR Class I area and one for the Class II area surrounding the facility.

Predicted impacts on the Breton NWR Class I area were compared to Class I SILs defined by the EPA for $SO_2$, $PM_{10}$, and $NO_2$, and predicted visibility impacts and predicted nitrogen and sulfur deposition were compared to applicable thresholds. Visibility impacts were assessed using the procedures from Federal Land Manager's Air Quality Related Workgroup (FLAG) Phase I Report (2000) and they were also assessed using procedures recommended by the EPA to assess visibility in the Best Available Retrofit Technology (BART) program. Tables 4.12.1-4 and 4.12.1-5 present the predicted visibility impacts based on the FLAG and BART procedures, respectively.

TABLE 4.12.1-4

**Visibility Impact Summary at the Breton NWR Class I Area Using the FLAG Method [a]**

| Year | Scenario | Maximum Change in Light Extinction (%) | Receptor | Date | Days with ΔBext > 5% | Days with ΔBext > 10% |
|---|---|---|---|---|---|---|
| 2001 | A | 2.11 | 790.195; -1075.680 | Day 294, 2001 | 0 | 0 |
| | B | 6.82 | 790.111; -1074.751 | Day 294, 2001 | 1 | 0 |
| | C | 7.18 | 790.111; -1074.751 | Day 294, 2001 | 2 | 0 |
| 2002 | A | 2.64 | 791.167; -1077.465 | Day 101, 2002 | 0 | 0 |
| | B | 7.74 | 791.167; -1077.465 | Day 101, 2002 | 1 | 0 |
| | C | 8.12 | 791.167; -1077.465 | Day 101, 2002 | 1 | 0 |
| 2003 | A | 1.49 | 785.506; -1068.610 | Day 57, 2003 | 0 | 0 |
| | B | 4.35 | 785.506; -1068.610 | Day 32, 2003 | 0 | 0 |
| | C | 4.60 | 785.506; -1068.610 | Day 32, 2003 | 0 | 0 |

[a] This analysis used the FLAG Method 2 and a maximum hourly relative humidity of 95 percent.

ΔBext Change in atmospheric light extinction

TABLE 4.12.1-5

**Visibility Impact Summary at the Breton NWR Class I Area Using the BART Method [a]**

| Year | Scenario | Maximum/98th Percentile Change in Light Extinction (%) | Receptor for Maximum Change in Light Extinction | Date for Maximum Change in Light Extinction | Days with ΔBext > 5% | Days with ΔBext > 10% |
|---|---|---|---|---|---|---|
| 2001 | A | 1.24 / 0.65 | 790.195; -1075.680 | Day 294, 2001 | 0 | 0 |
| | B | 4.29 / 2.16 | 790.111; -1074.751 | Day 294, 2001 | 0 | 0 |
| | C | 4.52 / 2.26 | 790.111; -1074.751 | Day 294, 2001 | 0 | 0 |
| 2002 | A | 1.43 / 0.47 | 791.167; -1077.465 | Day 101, 2002 | 0 | 0 |
| | B | 4.61 / 1.79 | 791.167; -1077.465 | Day 101, 2002 | 0 | 0 |
| | C | 4.83 / 1.88 | 791.167; -1077.465 | Day 101, 2002 | 0 | 0 |
| 2003 | A | 0.94 / 0.34 | 791.167; -1077.465 | Day 294, 2003 | 0 | 0 |
| | B | 3.69 / 1.74 | 789.223; -1073.894 | Day 294, 2003 | 0 | 0 |
| | C | 3.87 / 1.82 | 789.223; -1073.894 | Day 294, 2003 | 0 | 0 |

[a] This analysis used the BART Method 6 and a maximum hourly relative humidity of 95 percent.

ΔBext Change in atmospheric light extinction

As discussed in the FLAG Report, federal land managers are concerned about situations where a change in extinction from new source growth is greater than 5 percent as compared against natural conditions. Further, changes in extinction greater than 10 percent are generally considered unacceptable by the federal land managers and would likely raise objections to additional pollutant loading without mitigation. The results in table 4.12.1-4 show that the predicted percent change in light extinction would not exceed the 10 percent threshold during any of the modeled meteorological data years for any of the three scenarios. However, a total of five exceedances of the 5 percent threshold were predicted to occur during the 2001 and 2002 meteorological data years for scenarios B and C. The results in table 4.12.1-5 show no predicted exceedances of either the 5 percent or 10 percent change in light extinction threshold at the 98th percentile value. These results indicate that the project would not have a significant impact on visibility at the Breton NWR Class I area.

Table 4.12.1-6 presents the predicted maximum annual sulfur and nitrogen deposition values that would result from the proposed project for comparison to the applicable deposition thresholds established by the federal land managers. As shown, there were no modeled deposition values predicted to exceed a deposition threshold; therefore, sulfur and nitrogen deposition resulting from the project would not be considered significant.

TABLE 4.12.1-6

**Summary of Maximum Annual Average Nitrogen and Sulfur Deposition at the Breton NWR Class I Area**

| Year | Scenario | Deposition Analysis Threshold for Nitrogen (kg/ha/yr) | Predicted Nitrogen Deposition (kg/ha/yr) | Deposition Analysis Threshold for Sulfur (kg/ha/yr) | Predicted Sulfur Deposition (kg/ha/yr) |
|---|---|---|---|---|---|
| 2001 | A | 5E-03 | 0.591E-03 | 5E-03 | 0.091E-03 |
| | B | 5E-03 | 1.538E-03 | 5E-03 | 3.945E-03 |
| | C | 5E-03 | 1.690E-03 | 5E-03 | 4.220E-03 |
| 2002 | A | 5E-03 | 0.469E-03 | 5E-03 | 0.083E-03 |
| | B | 5E-03 | 1.188E-03 | 5E-03 | 3.348E-03 |
| | C | 5E-03 | 1.302E-03 | 5E-03 | 3.582E-03 |
| 2003 | A | 5E-03 | 0.550E-03 | 5E-03 | 0.075E-03 |
| | B | 5E-03 | 1.351E-03 | 5E-03 | 3.014E-03 |
| | C | 5E-03 | 1.478E-03 | 5E-03 | 3.224E-03 |

kg/ha/yr kilograms per hectare per year

Table 4.12.1-7 presents the modeled $SO_2$, $PM_{10}$, and $NO_x$ impacts resulting from the project for comparison to the Class I area SILs. The modeled pollutant impacts shown in the table for each scenario and modeled meteorological data year were below the applicable Class I area SILs. The results demonstrate that the project would not significantly impact the existing air quality at the Breton NWR.

Predicted impacts on Class II areas were compared to Class II SILs and the results were added to the background value and compared to the NAAQS that have been defined by the EPA for $SO_2$, $PM_{10}$, $NO_2$, and CO. Table 4.12.1-8 presents the modeled $SO_2$, $PM_{10}$, $NO_2$, and CO impacts resulting from the project.

Pollutant impacts presented in table 4.12.1-8 resulting from one or more of the three scenarios evaluated were predicted to exceed their applicable SILs, except for annual $PM_{10,}$ 1-hour CO, and 8-hour CO. Since several pollutant impacts for some scenarios exceeded their applicable SILs, this would normally trigger further evaluation including other sources in the area. For the pollutants that exceeded their applicable SILs, a cumulative impacts evaluation was conducted and the results of this analysis are presented in section 4.14.8. However, when the predicted impacts are added to available monitored background concentrations in the vicinity of the proposed project, none of the impacts would exceed the NAAQS.

TABLE 4.12.1-7

**Summary of Modeled Impacts on the Breton NWR Class I Area [a]**

| Scenario | Pollutants | Averaging Period | Significant Impact Level ($\mu g/m^3$) | Year 2001 Modeled Impact ($\mu g/m^3$) | Year 2002 Modeled Impact ($\mu g/m^3$) | Year 2003 Modeled Impact ($\mu g/m^3$) |
|---|---|---|---|---|---|---|
| A | $SO_2$ | 3-hour | 1.0 | 0.011 | 0.008 | 0.008 |
| | | 24-hour | 0.2 | 0.002 | 0.001 | 0.002 |
| | | Annual | 0.1 | 0.0001 | 0.0001 | 0.0001 |
| | $PM_{10}$ | 24-hour | 0.3 | 0.012 | 0.009 | 0.009 |
| | | Annual | 0.2 | 0.0005 | 0.0004 | 0.0004 |
| | $NO_x$ | Annual | 0.1 | 0.0077 | 0.0062 | 0.0056 |
| B | $SO_2$ | 3-hour | 1.0 | 0.728 | 0.516 | 0.705 |
| | | 24-hour | 0.2 | 0.194 | 0.113 | 0.181 |
| | | Annual | 0.1 | 0.0058 | 0.0042 | 0.0046 |
| | $PM_{10}$ | 24-hour | 0.3 | 0.054 | 0.045 | 0.045 |
| | | Annual | 0.2 | 0.0018 | 0.0013 | 0.0015 |
| | $NO_x$ | Annual | 0.1 | 0.0187 | 0.0139 | 0.0133 |
| C | $SO_2$ | 3-hour | 1.0 | 0.729 | 0.517 | 0.706 |
| | | 24-hour | 0.2 | 0.1998 | 0.116 | 0.186 |
| | | Annual | 0.1 | 0.0062 | 0.0045 | 0.0049 |
| | $PM_{10}$ | 24-hour | 0.3 | 0.056 | 0.047 | 0.047 |
| | | Annual | 0.2 | 0.0020 | 0.0015 | 0.0016 |
| | $NO_x$ | Annual | 0.1 | 0.0205 | 0.0152 | 0.0146 |

[a] Modeled impacts for short-term averaging periods are based on predicted high-second high (H2H) concentrations for each year. Modeled impacts for the annual averaging period are based on the predicted highest concentration for each year.

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

TABLE 4.12.1-8

**Summary of Modeled Class II Area Impacts** [a]

| Scenario | Pollutants | Averaging Period | Significant Impact Level ($\mu g/m^3$) | Year 2001 Modeled Impact ($\mu g/m^3$) | Year 2002 Modeled Impact ($\mu g/m^3$) | Year 2003 Modeled Impact ($\mu g/m^3$) | Background Value [b] ($\mu g/m^3$) | NAAQS ($\mu g/m^3$) |
|---|---|---|---|---|---|---|---|---|
| A | $SO_2$ | 3-hour | 25 | 4.43 | 5.47 | 4.72 | 121 | 1,300 |
| | | 24-hour | 5 | 1.39 | 1.45 | 1.50 | 52 | 365 |
| | | Annual | 1 | 0.22 | 0.27 | 0.24 | 8 | 80 |
| | $PM_{10}$ | 24-hour | 5 | 6.5 | 5.5 | 5.0 | 51 | 150 |
| | | Annual | 1 | 0.45 | 0.56 | 0.51 | 20 | 50 |
| | $NO_2$ | Annual | 1 | 13.8 | 17.3 | 15.8 | 15 | 100 |
| | CO | 1-hour | 2,000 | 428.7 | 607.9 | 438.9 | 2,290 | 40,000 |
| | | 8-hour | 500 | 172.8 | 148.9 | 153.7 | 1,947 | 10,000 |
| B | $SO_2$ | 3-hour | 25 | 105.4 | 105.3 | 108.2 | 121 | 1,300 |
| | | 24-hour | 5 | 55.7 | 44.6 | 39.8 | 52 | 365 |
| | | Annual | 1 | 1.59 | 1.46 | 1.03 | 8 | 80 |
| | $PM_{10}$ | 24-hour | 5 | 10.3 | 8.2 | 7.4 | 51 | 150 |
| | | Annual | 1 | 0.56 | 0.63 | 0.61 | 20 | 50 |
| | $NO_2$ | Annual | 1 | 15.2 | 18.2 | 17.1 | 15 | 100 |
| | CO | 1-hour | 2,000 | 428.7 | 608.0 | 438.9 | 2,290 | 40,000 |
| | | 8-hour | 500 | 173.8 | 148.9 | 153.7 | 1,947 | 10,000 |
| C | $SO_2$ | 3-hour | 25 | 105.5 | 105.4 | 108.4 | 121 | 1,300 |
| | | 24-hour | 5 | 57.4 | 45.9 | 41.0 | 52 | 365 |
| | | Annual | 1 | 1.70 | 1.56 | 1.1 | 8 | 80 |
| | $PM_{10}$ | 24-hour | 5 | 10.9 | 8.7 | 7.9 | 51 | 150 |
| | | Annual | 1 | 0.58 | 0.64 | 0.62 | 20 | 50 |
| | $NO_2$ | Annual | 1 | 15.5 | 18.4 | 17.3 | 15 | 100 |
| | CO | 1-hour | 2,000 | 429.2 | 609.3 | 438.9 | 2,290 | 40,000 |
| | | 8-hour | 500 | 174.4 | 148.9 | 156.3 | 1,947 | 10,000 |

[a] Modeled impacts for short-term averaging periods are based on predicted high-second high (H2H) concentrations for each year. Modeled impacts for the annual averaging period are based on the predicted highest concentration for each year.

[b] Background values were obtained from the EPA AIRDATA database (http://www.epa.gov/oar/data/geosel.html) as follows:
- Annual values based on maximum value from 3 most recent years of available data.
- Short-term values based on H2H value from 3 most recent years of available data.
- A conversion factor of 1 ppm CO = 1,145 $\mu g/m^3$ was used to convert selected EPA AIRDATA from the Mobile, Alabama monitoring station.
- A conversion factor of 1 ppm $NO_2$ = 1,880 $\mu g/m^3$ was used to convert selected EPA AIRDATA from the Pascagoula, Mississippi monitoring station.
- A conversion factor of 1 ppm $SO_2$ = 2,620 $\mu g/m^3$ was used to convert selected EPA AIRDATA from the Pascagoula, Mississippi monitoring station.
- Selected $PM_{10}$ EPA AIRDATA are from the Pascagoula, Mississippi monitoring station.

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

### 4.12.2 Noise

Noise would affect the local environment during both the construction and operation of the proposed LNG Clean Energy Project. At any location, both the magnitude and frequency of environmental noise may vary considerably over the course of the day and throughout the week. This variation is caused in part by changing weather conditions and the effects of seasonal vegetative cover.

Two measures used by federal agencies to relate the time varying quality of environmental noise to its known effect on people are the 24-hour equivalent sound level ($L_{eq(24)}$) and the day-night sound level ($L_{dn}$). The $L_{eq(24)}$ is the level of steady sound with the same total (equivalent) energy as the time-varying sound of interest, averaged over a 24-hour period. The $L_{dn}$ is the $L_{eq(24)}$ with 10 decibels on the A-weighted scale (dBA) added to the nighttime sound levels between the hours of 10 p.m. and 7 a.m., to account for the greater sensitivity of people to sound during the nighttime hours. The A-weighted scale is used because human hearing is less sensitive to low and high frequencies than mid-range frequencies.

#### 4.12.2.1 Noise Regulations

In 1974, the EPA published *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety* (EPA, 1974). This publication evaluates the effects of environmental noise with respect to health and safety. The document provides information for state and local governments to use in developing their own ambient noise standards. The EPA has determined that in order to protect the public from activity interference and annoyance outdoors in residential areas, noise levels should not exceed an $L_{dn}$ of 55 dBA. An $L_{dn}$ of 55 dBA is equivalent to a continuous noise level of 48.6 dBA for facilities that operate at a constant level of noise. The FERC has adopted this criterion for new compression and associated facilities, and it is used here to assess the potential noise impact from operation of the proposed LNG terminal.

The State of Mississippi does not have noise regulations that would apply to the proposed project. Similarly, Jackson County, where the proposed LNG terminal would be located, has no local ordinance limiting construction-related noise.

#### 4.12.2.2 Existing Noise Levels

Gulf LNG determined, through a review of aerial photography and surveys in the project area, that no existing noise-sensitive areas (NSAs) were located within 1 mile of the proposed LNG terminal site. The nearest NSA was located in the City of Pascagoula, about 1.7 miles to the northwest of the LNG terminal site. The residences in this area were severely damaged or destroyed by Hurricane Katrina. Gulf LNG assumed that these residences would be rebuilt and, therefore, continued to use them as the closest NSA for purposes of this noise evaluation. The nearest NSA to the proposed LNG terminal site is shown on figure 4.12.2-1.

The typical $L_{dn}$ noise level for urban areas is approximately 65 dBA and for suburban areas it is approximately 55 dBA. Although the nearest NSA is in the City of Pascagoula, which is an urban area, Gulf LNG took a conservative approach in the analysis and used an $L_{dn}$ of 55 dBA as the background noise level for the NSA. The area around the proposed LNG terminal is currently undeveloped within an approximate 2,000-foot radius of the site and the area beyond that consists primarily of industrial properties. Published background noise in undeveloped areas is approximately 40 to 45 dBA $L_{dn}$ (EPA, 1974).

The 5.0-mile-long sendout pipeline would primarily cross undeveloped (open) and industrial developed properties. No residential properties border the pipeline right-of-way. The primary background noise sources along the pipeline right-of-way include Chevron's Pascagoula Refinery, industrial machinery, roads, and railroads.

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Figure 4.12.2-1 Noise-Sensitive Area

Public access for the above information is available only through the Public Reference Room, or by e-mail at public.referenceroom@ferc.gov.

#### 4.12.2.3 Impact and Mitigation

Potential impacts associated with the LNG Clean Energy Project could include short-term increases in noise during construction and long-term increases in noise during operation. These potential noise increases were compared with the FERC standard for permissible noise levels at NSAs.

**Construction**

Construction activities at the LNG terminal would generate temporary increases in sound levels over an approximate 3-year period, predominantly during the day. Construction activity and associated noise impacts would vary depending on the phase of construction in progress. The initial phase of construction, which involves excavation, filling, and grading with heavy earth-moving equipment, would generate relatively high noise levels. Significant noise levels would also result from dredging for the ship berth and maneuvering area and pile driving for the jetty platform and the LNG storage tank foundations. Less noise would be generated by construction of the LNG storage tanks and buildings and the installation of mechanical and electrical equipment.

Heavy equipment (bulldozers, loaders, dump trucks) would be the primary noise source during the excavation phase. Noise levels from construction equipment would typically range from 65 to 85 dBA at 50 feet from the source. Estimated noise levels from typical construction equipment are listed in table 4.12.2-1. Noise generated during excavation would be primarily from diesel engines.

TABLE 4.12.2-1

**Estimated Construction Equipment Noise**

| Equipment Type | Noise at 50 feet (dBA) |
|---|---|
| Heavy Equipment | 85 |
| Air Compressors | 84 |
| Welders | 67 |
| Concrete Truck | 71 |
| Miscellaneous Trucks (pickup trucks, etc.) | 65 |

Source: EPA, 1971.

Dredging activities would occur 24 hours per day, 7 days per week. Primary noise sources would include diesel dredges with associated pumps as well as the tugboats used to position the dredges. Noise levels associated with the dredging activities are estimated to be approximately 80 to 90 dBA at a distance of 50 feet. Predicted noise levels at the nearest NSA would range from about 36 to 46 dBA, which are below existing ambient noise levels.

Gulf LNG anticipates that impact-type pile drivers would be used during construction of the proposed facilities. Impact-type pile drivers produce a peak level of approximately 104 dBA at 50 feet (EPA, 1971), which equates to a sound power level of approximately 136 dBA. Using geometric spreading alone, this level is reduced to 59 dBA at the 1.7-mile distance to the nearest NSA. Taking into consideration other attenuating factors such as atmospheric absorption and ground attenuation, noise levels ranging from 55 to 60 dBA may be expected at the nearest NSA. $L_{eq(24)}$ noise levels would be lower, at about 50 dBA.

Pile driving is scheduled to occur over 10-hour shifts, 6 days per week over an approximate 37-week period. The corresponding $L_{dn}$ noise level at the nearest NSA would be approximately 57 dBA.

During the day, these levels would be audible but would not have a significant impact because of the very short duration of each impulse and the background noise created by traffic and other noise-producing activities near the NSAs.

Vibration levels detectable to humans would not extend beyond about 500 feet from the pile driving operation (Maekawa, 1994). The nearest NSA would be approximately 9,000 feet (1.7 miles) northwest of the pile driving site. No structures were identified within 500 feet of the proposed pile driving activity. The construction of the proposed facility, particularly pile driving, would also result in the generation and propagation of underwater noise energy. Additional information on the impacts of this noise energy on aquatic resources is provided in section 4.6.2.2.

With the exception of a slightly elevated (57 $L_{dn}$) noise level associated with pile driving, the predicted noise levels at the nearest NSA during excavation and dredging would be below the FERC's $L_{dn}$ of 55 dBA. In general, the threshold of perception of noise change by the human ear is 3 dBA, which indicates that the short-term 2 dBA increase in noise during pile driving activities would likely not be detected at the nearest NSA. Although construction activities at the LNG terminal may be audible during relatively quiet periods, noise-related impacts are expected to be minimal.

Increases in noise levels during construction of the sendout pipeline would be limited to areas close to the construction activity. The magnitude of the impact would depend on the noise level generated by various equipment types, duration of the construction activity, and distance between the noise source and the receptor. Construction equipment would include miscellaneous trucks, bulldozers, backhoes, and side-boom tractors. Noise levels from construction equipment would typically range from 65 to 85 dBA at 50 feet from the source. Because the pipeline would be constructed through predominantly industrial areas, with no nearby residences, construction of the pipeline would have no noise-related impacts on residential areas.

**Operation**

Gulf LNG performed computer modeling in order to calculate noise levels that would be generated by operation of the proposed LNG terminal. The commercially available CadnaA model developed by Datakustik GmBH was used for the analysis. The software takes into account geometric spreading losses, ground and atmospheric effects, shielding from barriers and buildings, and reflections from surfaces. The ground surface was considered to be primarily reflective, which is conservative.

Sound level data for the proposed equipment were obtained either from vendors or were calculated using empirical formulas based on process and mechanical equipment data. Manufacturers' noise control treatments typically supplied with equipment packages to meet near-field noise level specifications for Occupational Safety and Health Administration noise exposure requirements were included in the modeling for the instrument air packages.

The vapor return blowers, boil-off gas compressors, boil-off gas booster compressors, instrument air packages, and the nitrogen package would be enclosed in sheds with only partial walls. Although these sheds would attenuate some of the noise from equipment inside, their presence was not factored in the modeling analysis. Table 4.12.2-2 provides the estimated equipment quantities and sound power levels used in the modeling.

| Table 4.12.2-2<br>**Equipment Quantities and Sound Power Levels Used in the Modeling** | | |
|---|---|---|
| Equipment | Number in Use | Sound Power Level per Item (dBA) |
| Boil-Off Gas Compressors (590 horsepower each) | 2 | 116 |
| Boil-Off Gas Booster Compressor (1,282 horsepower) | 1 | 111 |
| Nitrogen Package | 1 | 113 |
| Instrument Air Packages | 2 | 98 |
| Vapor Return Blowers (135 horsepower each) | 2 | 91 |
| Submerged Combustion Vaporizer Blower | 10 | 117 |

Table 4.12.2-3 presents the results of the modeling along with a comparison with the existing ambient level, the expected future noise level after adding the facility noise to the ambient, and the increase in ambient level as a result of adding the facility.

Table 4.12.2-3

**Predicted Ldn Noise Levels at the Nearest Noise-Sensitive Area Associated with the LNG Terminal**

| NSA | Distance and Direction | Existing Ambient $L_{dn}$ (dBA) | Predicted Facility Contribution (dBA) | Ambient + Facility (dBA) | Predicted Increase in Ambient (dBA) |
|---|---|---|---|---|---|
| 1 | 1.7 miles | 55.0 | 36.1 | 55.1 | 0.1 |

The results of the noise impact analysis indicate that the noise attributable to the project would be lower than the FERC sound level requirement of 55 dBA $L_{dn}$ at the nearest NSA. We recognize, however, that actual results may be different from those obtained from modeling. Therefore, **we recommend that:**

- **Gulf LNG make all reasonable efforts to ensure its predicted noise levels from the LNG terminal are not exceeded at the NSA and file noise surveys with the Secretary <u>no later than 60 days</u> after placing the LNG terminal in service. However, if the noise attributable to the operation of the LNG terminal exceeds 55 dBA $L_{dn}$ at a NSA, Gulf LNG should file a report on what changes are needed and should install additional noise controls to meet the level <u>within 1 year</u> of the in-service date. Gulf LNG should confirm compliance with these requirements by filing a second noise survey with the Secretary <u>no later than 60 days</u> after it installs the additional noise controls.**

Vessel traffic associated with operation of the project would generate underwater sounds. Cargo vessels, which are in the same category as LNG ships, are known to emit high levels of low frequency sound (6.8 to 7.7 hertz at 181 to 190 decibels (re: 1 μPa)) capable of traveling long distances (Richardson, et al., 1995). Noise generated by LNG ships is generally omni-directional, emitting from all sides of the vessel (Whale and Dolphin Conservation Society, 2004). However, noise levels are greatest on the sides of the ship and weakest on the front and rear of the ship. As discussed in section 4.6.2.2, fish may exhibit a transient avoidance behavior in response to LNG ship noise along the waterway from the territorial seas to the proposed LNG terminal. Above-water noise associated with the LNG vessels would be similar to other large vessel traffic along the waterway and would not result in significant impacts on environmental resources.

## 4.13 RELIABILITY AND SAFETY

Three federal agencies share in the oversight of the safety and security of LNG import terminals: the FERC, the Coast Guard, and the DOT. The FERC authorizes the siting and construction of LNG import terminals and is the lead federal agency under NEPA to analyze the environmental, safety, security, and cryogenic design of proposed facilities. The Coast Guard has authority over the safety of the LNG vessels and the marine transfer area. The Coast Guard also has authority over security of LNG vessels and the entire LNG facility. In conjunction with this, the Coast Guard determines the suitability of waterways for LNG marine traffic by issuing an LOR. The DOT has exclusive authority to promulgate and enforce safety regulations and standards over the onshore LNG facilities beginning at the last valve immediately before the LNG storage tank(s).

In February 2004, the three participating agencies entered into an Interagency Agreement to assure that they work in a coordinated manner to address the full range of issues regarding safety and security at LNG import terminals, including the terminal facilities and tanker operations, and to maximize the exchange of information related to the safety and security aspects of the LNG facilities and related marine operations. The Interagency Agreement ensures a seamless safety and security review by the three federal agencies.

The operation of Gulf LNG's proposed LNG terminal poses a potential hazard that could affect the public safety without strict design and operational measures to control potential accidents. The primary concerns are those events that could lead to an LNG spill of sufficient magnitude to create an off-site hazard, including events occurring during the course of but not limited to LNG vessel transits. However, it is also important to recognize the stringent requirements for the design, construction, operation, and maintenance of the facility as well as the extensive safety systems to detect and control potential hazards.

With the exception of the October 20, 1944 fire at the LNG facility in Cleveland, Ohio, the operating history of United States LNG facilities has been free of LNG safety-related incidents resulting in adverse effects to the public or the environment. The 1944 Cleveland incident was attributed to the use of materials inadequately suited for cryogenic temperatures and the lack of spill impoundments at the site.[2] More recently, an operational accident occurred in 1979 at the Cove Point LNG facility in Lusby, Maryland, when a pump seal failed, resulting in gas vapors entering an electrical conduit and settling in a confined space. When a worker switched off a circuit breaker, the gas ignited, resulting in heavy damage to the building and a worker fatality. Lessons learned from this accident resulted in changing the national fire codes, with the participation of the FERC, to ensure that the situation would not occur again. The proposed facilities would be designed, constructed, and operated in compliance with these codes.

On January 19, 2004, a blast occurred at Sonatrach's Skikda, Algeria LNG liquefaction facility that killed 27 and injured 56 workers. No members of the public were injured. Preliminary findings of the accident investigation suggest that a cold hydrocarbon leak occurred at Liquefaction Train 40 and was introduced to the high-pressure steam boiler by the combustion air fan. An explosion developed inside the boiler firebox which subsequently triggered a larger explosion of the hydrocarbon vapors in the immediate vicinity. The resulting fire damaged the adjacent liquefaction process and liquid petroleum gas (LPG) separation equipment of Train 40, and spread to Trains 20 and 30. Although Trains 10, 20,

[2] For a description of the incident and the findings of the investigation, see "U.S. Bureau of Mines, Report on the Investigation of the Fire at the Liquefaction, Storage, and Regasification Plant of the East Ohio Gas Co., Cleveland, Ohio, October 20, 1944, February 1946."

and 30 had been modernized in 1998-1999, Train 40 had been operating with its original equipment since start-up in 1981.

Although there are major differences between the equipment involved in the accident at Skikda and that of the proposal by Gulf LNG (i.e., high-pressure steam boilers that power refrigerant compressors would not be used here nor are they used at any LNG facility under FERC jurisdiction), the sequence of cascading events identifies potential failure modes that warrant further evaluation. To ensure that all potential hazards are addressed, we have provided a recommendation in section 4.13.2, Cryogenic Design and Technical Review, to address this issue.

A discussion of the principal properties and hazards associated with LNG is presented in section 4.13.1. A summary of our preliminary design and technical review of the cryogenic aspects of the LNG terminal is presented in section 4.13.2. Storage and retention systems are discussed in section 4.13.3. An analysis of the thermal radiation and flammable vapor cloud hazards resulting from a credible land-based LNG spill is presented in section 4.13.4, while the safety aspects of LNG transportation by ship is discussed and summarized in section 4.13.5. A discussion on security awareness related to terrorism is presented in section 4.13.6. A discussion of pipeline safety is presented in section 4.13.7. Additional safety issues identified in scoping are addressed in section 4.13.8. Conclusions on safety issues are in section 4.13.9.

### 4.13.1 LNG Hazards

LNG's principal hazards result from its cryogenic temperature (-260 °F), flammability, and vapor dispersion characteristics. As a liquid, LNG will neither burn nor explode. Although it can cause freeze burns and, depending on the length of exposure, more serious injury, its extremely cold state does not present a significant hazard to the public, which rarely, if ever, comes in contact with it as a liquid. As a cryogenic liquid, LNG will quickly cool materials it contacts, causing extreme thermal stress in materials not specifically designed for ultra-cold conditions. Such thermal stresses could subsequently subject the material to brittleness, fracture, or other loss of tensile strength. These hazards, however, are not substantially different from the hazards associated with the storage and transportation of liquid oxygen (-296 °F) or several other cryogenic gases that have been routinely produced and transported in the United States.

Methane, the primary component of LNG, is colorless, odorless and tasteless, and is classified as a simple asphyxiant. Methane could, however, cause extreme health hazards, including death, if inhaled in significant quantities within a limited time. At very cold temperatures, methane vapors could cause freeze burns. Asphyxiation, like freezing, normally represents a negligible risk to the public from LNG facilities.

When released from its containment vessel and/or transfer system, LNG will first produce a vapor or gas. This vapor, if ignited, represents the primary hazard to the public. LNG vaporizes rapidly when exposed to ambient heat sources such as water or soil, producing 620 to 630 standard cubic feet of natural gas for each cubic foot of liquid. LNG vapors in a 5 to 15 percent mixture with air are highly flammable. The amount of flammable vapor produced per unit of time depends on factors such as wind conditions, the amount of LNG spilled, and whether it is spilled on water or land. Depending on the amount spilled, LNG may form a liquid pool that will spread unless contained by a dike.

Once a flammable vapor-air mixture from an LNG spill has been ignited, the flame front will propagate back to the spill site if the vapor concentration along this path is sufficiently high to support the combustion process. An unconfined methane-air mixture will burn slowly, tending to ignite combustible materials within the vapor cloud, whereas fast flame speeds tend to produce flash burns rather than self-sustaining ignition.

LNG is not explosive as it is normally transported and stored. However, LNG vapors (primarily methane) can explode if contained within a confined space, such as a building, structure, or confined space aboard an LNG ship, and ignited. There is no evidence, however, suggesting that LNG is explosive in unconfined open areas. Experiments to determine if unconfined methane-air mixtures will explode have been conducted and, to date, have all been negative. Unconfined methane-air mixtures will burn but will not explode. Nevertheless, a number of experimental programs have been conducted to determine the "amount of initiator charge" required to detonate an unconfined methane-air mixture.

Over the years, various parties have occasionally expressed the energy content of an LNG storage tank or LNG ship in equivalent tons of trinitrotoluene (TNT), as an implied measure of its explosive potential. However, such a simplistic analogy fails to consider that explosive forces are not just a function of the total energy content but also of the rate of energy release. For an explosion to occur, the rate of energy release must be nearly instantaneous, such as with a TNT charge initiated by a blasting cap. Unlike TNT or other explosives which inherently contain an oxidizer, an unconfined vapor cloud must be mixed with oxygen within the flammability range of the fuel for combustion to occur. For a large unconfined vapor cloud, the flammability range tends to exist at the mixing zone at the edges of the cloud. When ignited, flame speeds of about 20 to 25 meters/second (66 to 82 feet/second) and local over pressures up to 0.2 psig have been estimated for methane-rich fuels, well below the flame speeds and over pressures associated with explosion.

A rapid phase transition (RPT) can occur when a portion of LNG spilled onto water changes from liquid to gas, virtually instantaneously. Unlike an explosion that releases energy and combustion products from a chemical reaction as described above, an RPT is the result of heat transferred to the liquid inducing a change to the vapor state. The rapid expansion from the liquid to vapor state can cause locally large overpressures. RPTs have been observed during LNG test spills onto water. In some test cases, the overpressures generated were strong enough to damage test equipment in the immediate vicinity of the LNG release point. The sizes of the overpressure events have been generally small and are estimated to be equivalent to several pounds of TNT. Such a small overpressure is not expected to cause significant damage to an LNG vessel. However, the RPT may increase the rate of LNG pool spreading and the LNG vaporization rate.

### 4.13.2 Cryogenic Design and Technical Review

The cryogenic design and technical review emphasizes the engineering design and safety concepts as well as the projected operational reliability of the proposed facilities. The principle areas of coverage include: materials in cryogenic environments; insulation systems; cryogenic safety; thermodynamics; heat transfer; instrumentation; cryogenic processes; and other relevant safety systems.

Study and evaluation of information for the proposed design and installation of Gulf LNG's terminal has been performed by the FERC staff. The design and specifications submitted for the proposed facility to date are considered to be preliminary but would be the basis for any detailed design to follow. A significant amount of the design involving final selection of equipment manufacturers, process conditions and resolution of some safety related issues would be completed in the next phase of the project development if authorization is granted by the Commission. This information would need to be submitted to FERC staff for review and approval.

As a result of the technical review of the information provided in the submittal documents, a number of concerns were identified by staff relating to the reliability, operability, and safety of the proposed design. In response to staff's questions, Gulf LNG provided written answers prior to the site visit and technical conference on March 7-8, 2006. However, several areas of concern are noted that require additional consideration and/or action on behalf of the company. Follow up on those items

requiring additional action should be documented in reports to be filed with the FERC. As a result, **we recommend that:**

> **The following measures should apply to the LNG terminal design and construction details. Information pertaining to these specific recommendations should be filed with the Secretary for review and approval by the Director of OEP either: prior to initial site preparation; prior to construction of final design; prior to commissioning; or prior to commencement of service as indicated by each specific recommendation. Items relating to Resource Report 13-*Engineering and Design Material* and security should be submitted as critical energy infrastructure information (CEII) pursuant to 18 CFR Parts 388.112 and PL01-1. Information pertaining to items such as: off-site emergency response; procedures for public notification and evacuation; and construction and operating reporting requirements would be subject to public disclosure. Gulf LNG should file this information a minimum of 30 days before approval to proceed is required.**
>
> - **Complete plan drawings and a list of the hazard detection equipment should be filed <u>prior to initial site preparation</u>. The list should include the instrument tag number, type and location, alarm locations, and shutdown functions of the proposed hazard detection equipment. Plan drawings should clearly show the location of all detection equipment.**
>
> - **A technical review addressing the following information for the proposed facility should be filed <u>prior to initial site preparation</u>:**
>
> **a. Identification of all combustion/ventilation air intake equipment and the distances to any possible hydrocarbon release (LNG, flammable refrigerants, flammable liquids, and flammable gases); and**
>
> **b. A demonstration that these areas are adequately covered by hazard detection devices, including a description of how these devices would isolate or shutdown any combustion equipment whose continued operation could add to or sustain an emergency.**
>
> - **Complete plan drawings and a list of the fixed and wheeled dry-chemical, fire extinguishing, and high expansion foam hazard control equipment should be filed <u>prior to initial site preparation</u>. The list should include the equipment tag number, type, size, equipment covered, and automatic and manual remote signals initiating discharge of the units. Plan drawings should clearly show the planned location of all fixed and wheeled extinguishers.**
>
> - **Facility plans showing the proposed location of, and area covered by, each monitor, hydrant, deluge system, hose, and sprinkler, as well as piping and instrumentation diagrams, of the firewater system should be filed <u>prior to initial site preparation</u>.**
>
> - **A copy of the hazard design review and list of recommendations that are to be incorporated in the final facility design should be filed <u>prior to initial site preparation</u>.**
>
> - **Drawings of the storage tank piping support structure and support of horizontal piping at grade should be filed <u>prior to initial site preparation</u>.**

- **Procedures should be developed for off-site contractors' responsibilities, restrictions, limitations and supervision of these contractors by Gulf LNG staff, prior to initial site preparation.**

- **The final design of the hazard detection equipment should identify manufacturer and model.**

- **The final design of the fixed and wheeled dry-chemical, fire extinguishing, and high expansion foam hazard control equipment should identify manufacturer and model.**

- **The final design should include detailed drawings of the spill control system to be applied to the LNG tank roof.**

- **The final design should include details of the LNG tank tilt settlement and differential settlement limits between each LNG tank and piping and procedures to be implemented in the event that limits are exceeded.**

- **The final design should include details of the pipe supports and restraints designed to prevent damage to piping systems and equipment in the event of a storm surge anticipated for a Category 4 hurricane.**

- **The final design should include details of the boil-off gas flow measurement system provided for each tank.**

- **The final design should include P&IDs and drawings of the meter station.**

- **The final design should include a fire protection evaluation carried out in accordance with the requirements of NFPA 59A, chapter 9.1.2.**

- **The final design should include details of the shutdown logic, including cause and effect matrices for alarms and shutdowns.**

- **The final design should include emergency shutdown of equipment and systems activated by hazard detection devices for flammable gas, fire, and cryogenic spills, when applicable.**

- **The final design should include details of the air gaps to be installed downstream of all seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system. Each air gap should vent to a safe location and be equipped with a leak detection device that: should continuously monitor for the presence of a flammable fluid; should alarm the hazardous condition; and should shutdown the appropriate systems.**

- **The final design should include a hazard and operability (HAZOP) review of the completed design. A copy of the review and a list of the recommendations should be filed.**

- **The P&IDs in the final design should show and number all valves including drain, vent, main, and car sealed.**

- **The final design should specify that the LNG tank carbon steel piping support plates and connections to piping supports should be designed to ensure that corrosion protection is adequately provided and provisions for corrosion monitoring and maintenance of carbon steel attachments are to be included in the design and maintenance procedures.**

- **The final design should include safeguards to be installed to protect aboveground firewater piping, including post indicator valves, from inadvertent damage.**

- **The final design should specify that all hazard detection equipment should include redundancy and fault detection and fault alarm monitoring in all potentially hazardous areas and enclosures.**

- **All valves including drain, vent, main, and car sealed valves should be tagged in the field during construction and prior to commissioning.**

- **The design details and procedures to record and to prevent the tank fill rate from exceeding the maximum fill rate specified by the tank designer should be filed prior to commissioning.**

- **A tabulated list of the proposed hand-held fire extinguishers should be filed prior to commissioning. The list should include the equipment number, type, size, number, and location. Plan drawings should include the type, size, and number of all hand-held fire extinguishers.**

- **Operation and maintenance procedures and manuals, as well as safety procedure manuals, should be filed prior to commissioning.**

- **The contingency plan for failure of the LNG tank outer containment should be filed prior to commissioning.**

- **A copy of the criteria for horizontal and rotational movement of the inner vessel for use during and after cool down should be filed prior to commissioning.**

- **The maintenance procedures to be filed prior to commissioning should state that a foundation elevation survey of all LNG tanks should be made on an annual basis.**

- **The FERC staff should be notified of any proposed revisions to the security plan and physical security of the facility prior to commencement of service.**

- **Progress on the construction of the LNG terminal should be reported in monthly reports filed with the Secretary. Details should include a summary of activities, projected schedule for completion, problems encountered, and remedial actions taken. Problems of significant magnitude should be reported to the FERC within 24 hours.**

**In addition, we recommend that the following measures should apply throughout the life of the facility:**

- **The facility should be subject to regular FERC staff technical reviews and site inspections on at least an annual basis or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, the Company should respond to a specific data request including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed piping and instrumentation diagrams reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted annual report, should be submitted.**

- **Semi-annual operational reports should be filed with the Secretary to identify changes in facility design and operating conditions, abnormal operating experiences, activities (including ship arrivals, quantity and composition of imported LNG, vaporization quantities, boil-off/flash gas, etc.), plant modifications including future plans and progress thereof. Abnormalities should include, but not be limited to: unloading/shipping problems, potential hazardous conditions from off-site vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tanks, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, vapor or liquid releases, fires involving natural gas and/or from other sources, negative pressure (vacuum) within a storage tank and higher than predicted boil-off rates. Adverse weather conditions and the effect on the facility also should be reported. Reports should be submitted within 45 days after each period ending June 30 and December 31. In addition to the above items, a section entitled "Significant plant modifications proposed for the next 12 months (dates)" also should be included in the semi-annual operational reports. Such information would provide the FERC staff with early notice of anticipated future construction/maintenance projects at the LNG facility.**

- **In the event the temperature of any region of any secondary containment, including imbedded pipe supports, becomes less than the minimum specified operating temperature for the material, the Commission should be notified within 24 hours and procedures for corrective action should be specified.**

- **Significant non-scheduled events, including safety-related incidents (i.e., LNG or natural gas releases, fires, explosions, mechanical failures, unusual over pressurization, and major injuries) and security related incidents (i.e., attempts to enter site, suspicious activities) should be reported to Commission staff within 24 hours. In the event an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification should be made immediately, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification should be made to Commission staff within 24 hours. This notification practice should be incorporated into the LNG facility's emergency plan. Examples of reportable LNG-related incidents include:**

**a. fire;**

**b. explosion;**

**c. estimated property damage of $50,000 or more;**

**d. death or personal injury necessitating in-patient hospitalization;**

**e. free flow of LNG that results in pooling;**

**f. unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes gas or LNG;**

**g. any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes gas or LNG;**

**h. any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes gas or LNG to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure limiting or control devices;**

**i. a leak in an LNG facility that contains or processes gas or LNG that constitutes an emergency;**

**j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;**

**k. any condition that could lead to a hazard and cause a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility;**

**l. safety-related incidents to LNG vessels occurring at or en route to and from the LNG facility; or**

**m. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.**

**In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, Commission staff would determine the need for an on-site inspection by Commission staff, and the timing of an initial incident report (normally within 10 days) and follow-up reports.**

Recent hurricane activity in the Gulf Coast region has increased concerns about the possible effects of natural disasters on existing and proposed LNG facilities. The 2005 Atlantic hurricane season was the most active season on record with hurricanes Katrina and Rita directly affecting Gulf Coast port areas in which existing, under-construction, and planned terminals are located. The FERC staff, recognizing the recent trend in the region towards more numerous and powerful storms, has intensified its review of the design criteria for the Gulf LNG facility with respect to high wind speed and storm surge conditions.

All critical structures at the proposed LNG Terminal would be designed per 49 CFR Subtitle B Part 193.2067 for a 183 mile per hour 3-second wind gust speed. All other non-critical structures would be designed per ASCE 7 (series), "Minimum Design Loads for Buildings and Other Structures," which dictates a 3-second gust design wind speed of 150 mph for the project location. The design storm surge elevation is based on the SLOSH model. Gulf LNG proposes to construct a storm surge wall with an elevation of 27 feet around the terminal facility.

### 4.13.3 Storage and Retention Systems

LNG storage tanks come in a variety of categories. The following are descriptions of the tank designs most commonly used worldwide:

- single containment cylindrical metal tanks (predominately used in the U.S.);
- spherical storage tanks (predominately used in LNG carriers);
- double containment cylindrical metal inner tank and metal or concrete outer tank (commonly thought of as an LNG tank with a high wall dike);
- full containment cylindrical metal inner tank and metal or concrete outer tank (five proposals authorized by the commission; several applications currently proposed to the commission, including Gulf LNG);
- pre-stressed cylindrical concrete tank with an internal metal membrane (membrane tank) (none in the U.S.); and
- cryogenic cylindrical concrete tank; internal cryogenic tank, and pre-stressed concrete outer tank (one operational in the U.S.; the remainder worldwide).

These tank categories are described in Annex H of the European Standard for LNG facilities (EN 1473) and are summarized below for the LNG storage tanks commonly found in proposals before the Commission.

H.1 Single containment tank

A single primary container and generally an outer shell designed and constructed so that only the primary container is required to meet the low temperature ductility requirements for storage of the product.

The outer shell (if any) of a single containment storage tank is primarily for the retention and protection of insulation and to contain the purge gas pressure, but is not designed to contain refrigerated liquid in the event of leakage from the primary container.

An aboveground single containment tank shall be surrounded by a bund (dike) wall to contain any leakage. Examples of single containment are given in figure H.1.

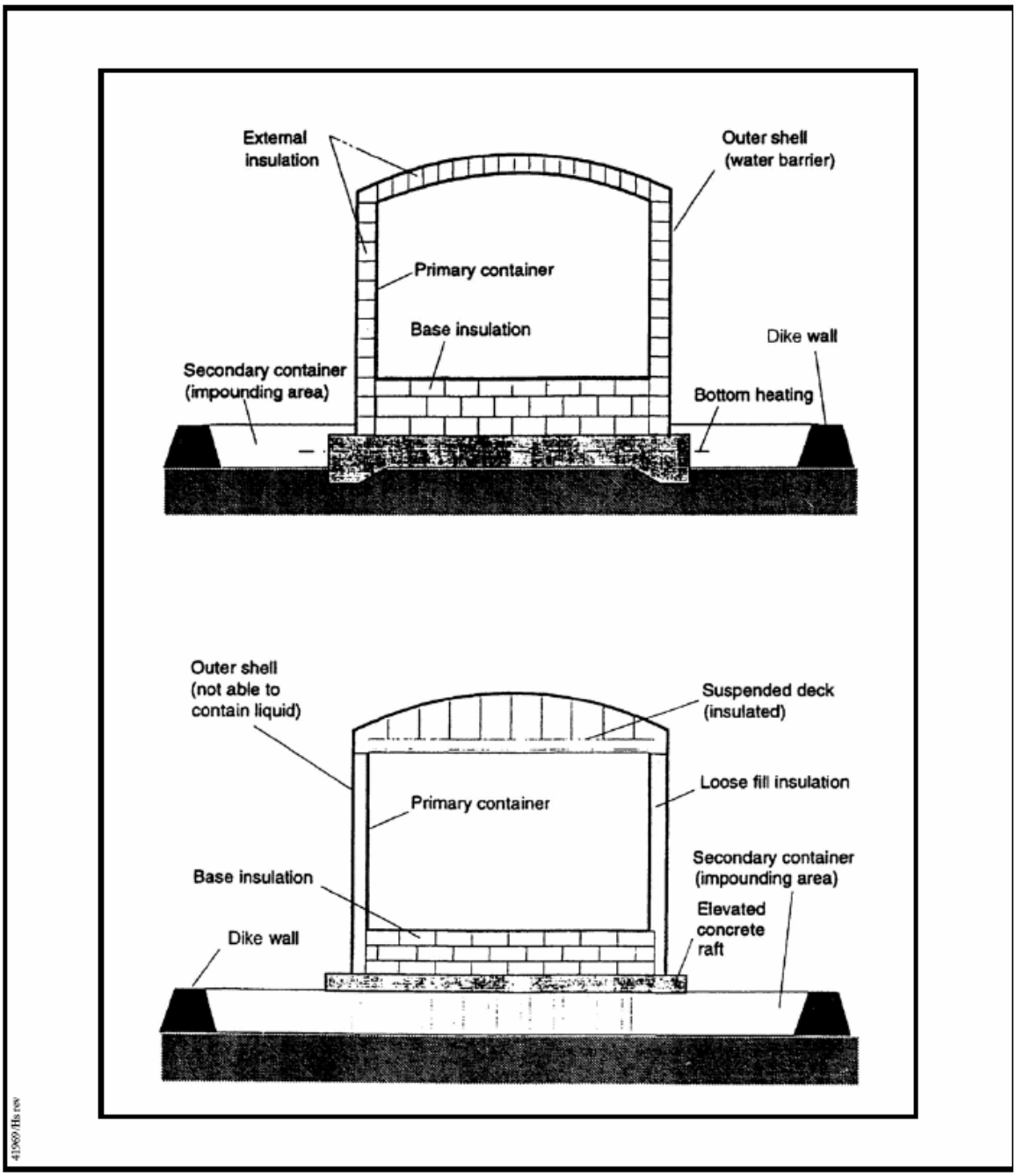


Figure H.1
Examples of Single Containment Tanks

H.3 Double containment tank

A double containment tank is designed and constructed so that both the inner self-supporting primary container and the secondary container are capable of independently containing the refrigerated liquid stored. To minimize the pool of escaping liquid, the secondary container should be located at a distance not exceeding 6 meters from the primary container.

The primary container contains the refrigerated liquid under normal operating conditions. The secondary container is intended to contain any leakage of the refrigerated liquid, but it is not intended to contain any vapor resulting from this leakage.

Examples of double containment tanks are given in figure H.3. Figure H.3 does not imply that the secondary container is necessarily as high as the primary container.

H.4 Full containment tank

A tank designed and constructed so that both the self supporting primary container and the secondary container are capable of independently containing the refrigerated liquid stored and one of them can contain its vapor. The secondary container can be 3 to 6 feet (1 or 2 meters) in distance from the primary container.

The primary container contains the refrigerated liquid under normal operating conditions. The outer roof is supported by the secondary container. The secondary container shall be capable both of containing the refrigerated liquid and of controlled venting of the vapor resulting from product leakage after a credible event. Examples of full containment tanks are given in figure H.4.

Single-, double- and full-containment LNG storage tanks have been authorized by the FERC for use at new LNG import facilities or expansions of existing terminals. To date, only single- and double-containment tanks have been constructed and operated. Several full-containment tanks have started construction in the United States, while approximately 50 have been constructed worldwide. During the review of earlier proposals, a number of issues surfaced concerning the applicability of existing codes and regulations to full-containment tanks. Specifically, the term "full containment" does not appear in U.S. codes or standards for LNG facilities, including the Federal Safety Standards in Title 49 CFR Part 193, NFPA 59A, or API 620. As a result, some project proponents have made the assumption that to design and construct a full-containment tank in accordance with EN 1473 will satisfy the U.S. codes and standards.

For example, it has been suggested that thermal exclusion zones are not required for a full-containment tank because EN 1473 does not consider a tank fire scenario for full-containment tanks with a pre-stressed concrete wall and concrete roof. The staffs of the FERC and the DOT's Office of Pipeline Safety (OPS) do not agree because neither NFPA 59A nor Part 193 excludes full-containment tanks from thermal exclusion zone requirements. As a result, a thermal exclusion zone analysis is required for an LNG storage tank fire at the top of the secondary container (see section 4.13.4).

Further, EN 1473 does not specify a minimum distance to the property line for full-containment tanks because no tank fire scenario is considered. However, NFPA 59A requires a separation of 0.7 times the tank diameter from the property line. Gulf LNG's proposed tank separation distance to the property line meets this separation requirement.

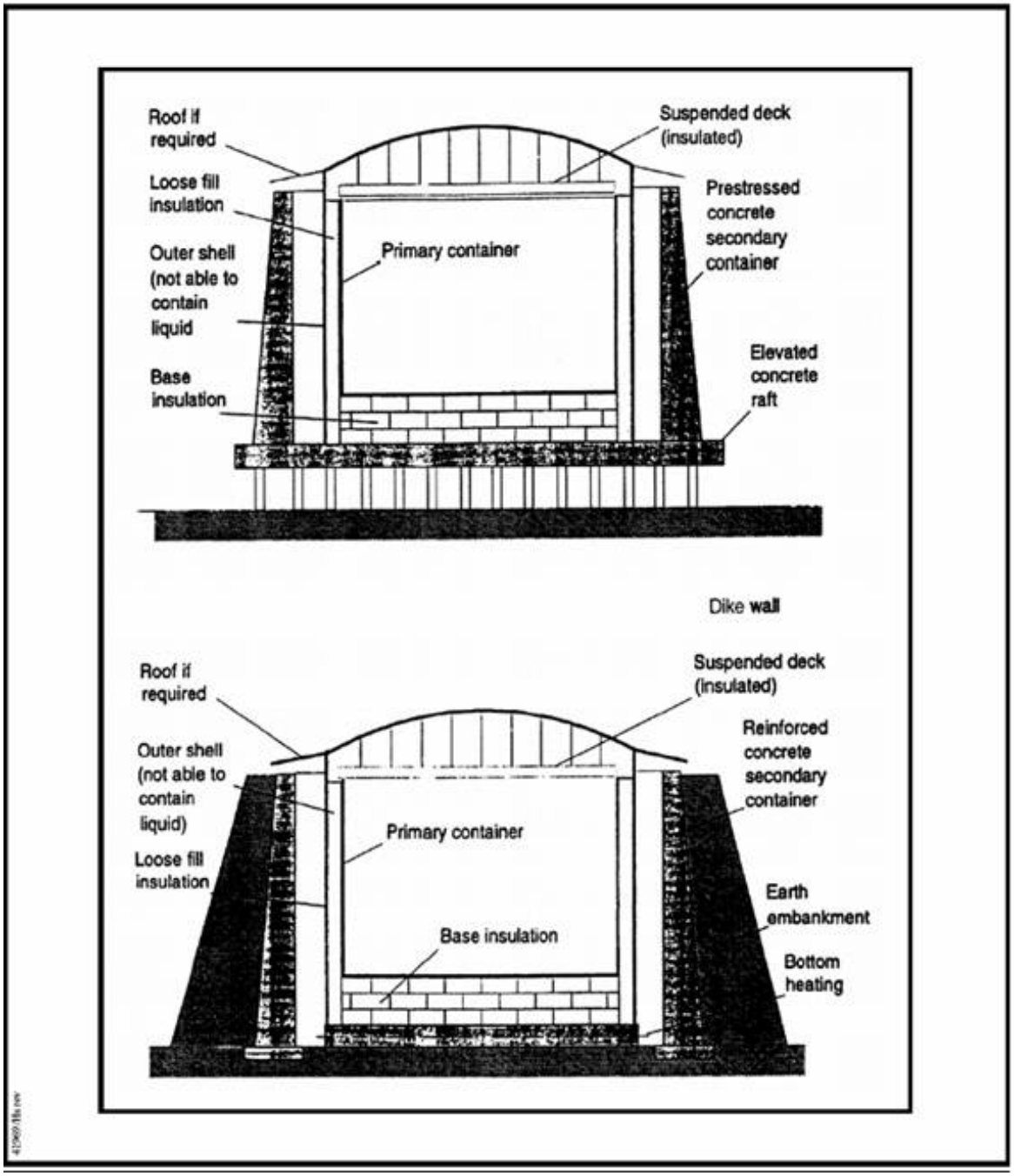


Figure H.3
Examples of Double Containment Tanks

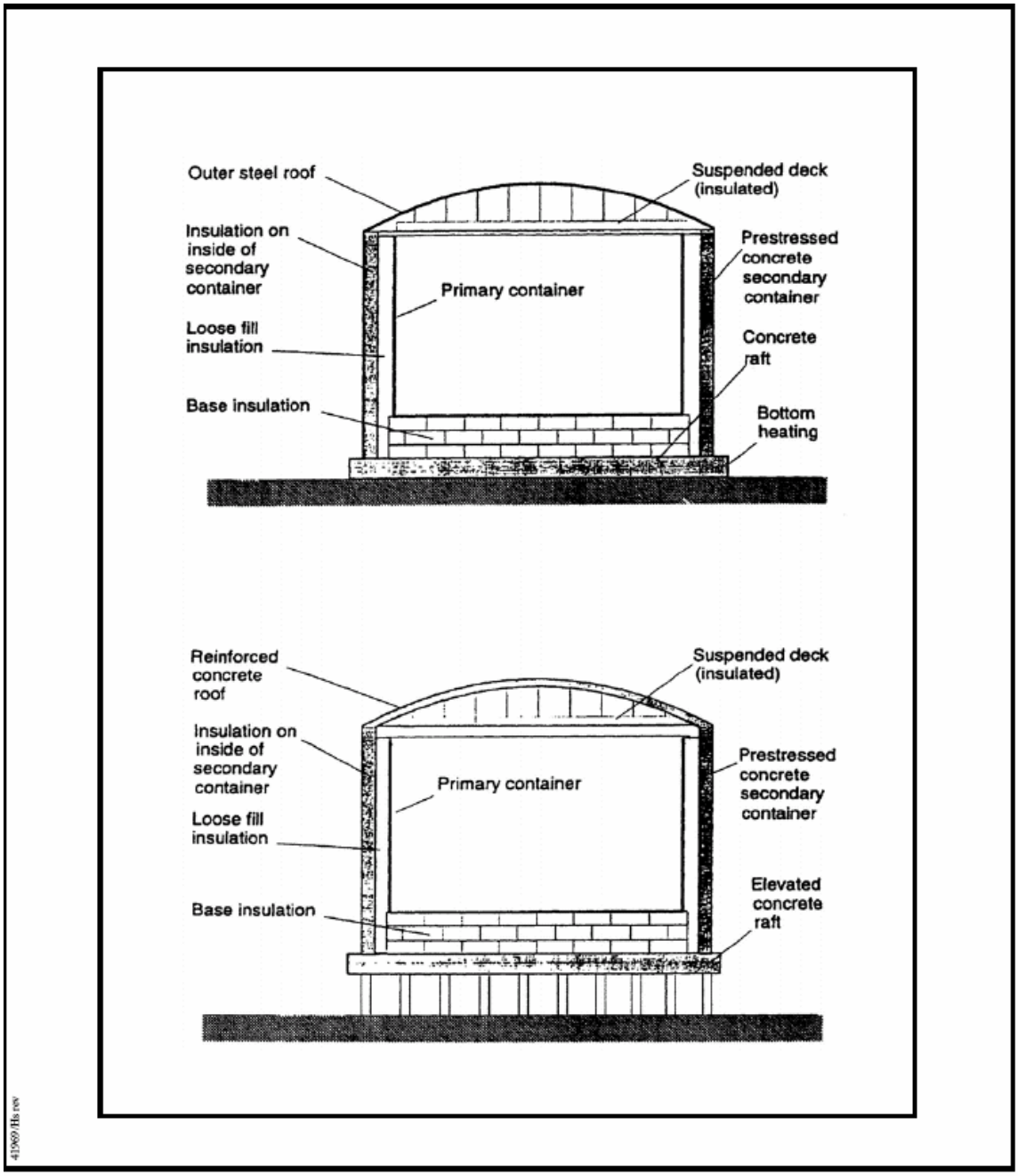


Figure H.4
Examples of Full Containment Tanks

Another issue regarding the full-containment design is that the tank outer wall (secondary containment) serves as the impoundment, a concept allowed under Parts 193.2161 and 193.2167, and under the "exception" in figure 2.2.2.6 of NFPA 59A. A specific concern is the dual function of the concrete secondary container - it serves both the operational function of holding the insulation and gas pressure, and a safety function of containing liquid in the event of an inner tank failure. Conversely, in single- and double-containment tanks, independent systems provide operational and safety functions. While recognition must be given to the benefits of a concrete secondary container with respect to external events, such as projectiles or small aircraft, its ability to provide the dual functions while retaining its integrity has not been convincingly supported for all scenarios. This becomes increasingly important as proposed site acreage is reduced and buffer zones between adjacent properties are minimized. As such, the FERC staff considers it prudent design practice to provide some form of barrier to prevent liquid from flowing to an unintended area (i.e., outside the plant property) in the event that the storage tank primary and secondary containers fail.

Concerns have also been expressed that the barrier could be considered a containment and prohibit certain equipment being located within the barrier and/or may conflict with other parts of the various codes with respect to hazardous and electrical code classifications. Other concerns are that the barrier could be considered an impounding area that would require new thermal and vapor cloud calculations. The purpose of the barrier is to prevent liquid from flowing off the plant property, and it is not the intent to define a containment or impounding area for thermal radiation or flammable vapor exclusion zone calculations or other code requirements.

Gulf LNG proposes to install a storm surge wall around the LNG storage tanks. The structure would be constructed to an elevation of 27 feet and would enclose an area approximately 897.5 feet by 700 feet. The structure's volumetric capacity would exceed 100 percent of a single LNG tank's maximum liquid capacity. Rainwater that collects inside the storm surge wall would be drained into a spill impoundment basin and pumped out in accordance with 49 CFR Part 193.2173. This storm surge wall would confine LNG on the project site in the event of any hypothetical catastrophic event.

### 4.13.4 Siting Requirements – Thermal and Vapor Dispersion Exclusion Zones

#### Regulatory Requirements

The LNG facilities proposed in this project must comply with the siting requirements of 49 CFR Part 193, Subpart B. On March 30, 2000, the DOT revised 49 CFR Part 193 to incorporate NFPA 59A (1996 edition) into the LNG regulations. On April 9, 2004, the DOT further revised 49 CFR Part 193 to incorporate the 2001 edition of NFPA 59A. The following sections specifically address off-site hazards:

- **Part 193.2001, Scope of Part,** excludes any matter other than siting provisions pertaining to marine cargo transfer systems between the marine vessel and the last manifold or valve immediately before a storage tank.

- **Part 193.2051, Scope,** states that each LNG facility designed, replaced, relocated or significantly altered after March 31, 2000, must be provided with siting requirements in accordance with Subpart B and NFPA 59A. In the event of a conflict with NFPA 59A, then Part 193 prevails.

- **Part 193.2057, Thermal radiation protection,** requires that each LNG container and LNG transfer system have thermal exclusion zones based on three radiation flux levels in accordance with section 2.2.3.2 of NFPA 59A.

- **Part 193.2059, Flammable vapor-gas dispersion protection,** requires that each LNG container and LNG transfer system have a dispersion exclusion zone in accordance with sections 2.2.3.3 and 2.2.3.4 of NFPA 59A.

For the following LNG facilities that are proposed in this project, we have identified the applicable siting requirements from Part 193 and NFPA 59A:

- Two 1,006,400-barrel (160,000 $m^3$) full containment LNG storage tanks - Parts 193.2057 and 2059 require the establishment of thermal and flammable vapor exclusion zones for LNG tanks. NFPA 59A section 2.2.3.2 specifies four thermal exclusion zones based on the design spill and the impounding area. NFPA 59A sections 2.2.3.3 and 2.2.3.4 specify a flammable vapor exclusion zone for the design spill which is determined with section 2.2.3.5.

- One marine LNG unloading berth and a cargo transfer system consisting of three 16-inch-diameter liquid transfer arms and one 16-inch-diameter vapor return arm; and two 30-inch-diameter transfer lines - Parts 193.2001, 2057, and 2059 require thermal and flammable vapor exclusion zones for the transfer system. NFPA 59A does not address LNG transfer systems.

- Six 3,841 gpm in-tank pumps (three per tank) and eight 1,832-gpm high-pressure sendout pumps - Parts 193.2057 and 2059 require thermal and flammable vapor exclusion zones. NFPA 59A section 2.2.3.2 specifies the thermal exclusion zone and sections 2.2.3.3 and 2.2.3.4 specify the flammable vapor exclusion zone based on the design spill.

- Ten SCVs - Same requirements as for LNG pumps.

The incorporation of the NFPA 59A requirements into Part 193 has resulted in some confusion and possible misinterpretation in applying the siting requirements. Parts 193.2057 and 2059 require exclusion zones for LNG transfer systems, which are defined to include transfer piping. However, NFPA 59A only requires exclusion zones for "transfer areas" which are defined as the part of the plant where liquids are introduced or removed from the facility such as truck loading or ship unloading areas. The definition of transfer area in NFPA 59A specifically excludes permanent plant piping such as cargo transfer lines. Additionally, NFPA 59A section 2.2.3.1 (2001) specifically excludes transfer area at the water edge of marine terminals. When the DOT incorporated NFPA 59A into its regulations, it removed the requirement for impounding systems around transfer piping (old Part 193.2149). In the preamble to the final rule, the DOT determined that the most likely sources of leaks within LNG plants are LNG storage tanks, cargo transfer areas, and vaporizers and process equipment, which are all addressed in NFPA 59A section 2.2.1.2. The result is that while Part 193 retains exclusion zones for LNG transfer systems, neither Part 193 nor NFPA 59A requires the impoundment from which to base the calculations. We do not believe that this was the intent, nor do we believe that omitting containment for transfer piping is a sound engineering practice. The FERC staff will continue to require containment for all LNG transfer piping within a plant site.

The incorporation of NFPA 59A also changed the way in which design spills and impoundment capacities may be determined. Under section 2.2.2.2, the capacity of impounding areas for vaporization, process, or LNG transfer areas must equal the greatest volume during a 10-minute period from any single accidental leakage source or during a shorter time period based upon demonstrable surveillance and shutdown provisions acceptable to the authority having jurisdiction. Similar criteria appear in section 2.2.3.5 for determining the design spill used in thermal and flammable vapor exclusion zone calculations. Prior to the incorporation of NFPA 59A, the design spill in Part 193 assumed the rupture of a single

transfer pipe with the greatest overall flow capacity, for not less than 10 minutes (old Part 193.2059(d)). As a result, the spill rate for vaporization, process, or LNG transfer areas may be assumed to be a "leakage source" rather than a full pipe rupture; however, the spill duration must be 10 minutes unless the authority having jurisdiction (i.e., DOT's OPS) determines that a shorter time is acceptable. Again, given the confusion in applying the two requirements, the FERC staff will continue to utilize the 10-minute spill criteria at the maximum flow possible for containment sizing. This will ensure that impoundments are sized for a catastrophic failure, while recognizing that less conservative spill scenarios may be appropriate for vapor exclusion zone calculations. In giving recognition to the integrity of all-welded transfer piping, the determination of the single accidental leakage source should be based on an evaluation of all small diameter attachments to the transfer piping for instrumentation, pressure relief, recirculation, etc., and any flanges that may be used at valves or other equipment, in order to determine the largest spill rate. This approach is the result of discussions with DOT's OPS concerning the basis for design spills and application to exclusion zone determinations for proposals before the Commission.

**Impoundment Systems and Design Spills**

Part 193.2181 specifies that the impoundment system serving a single LNG storage tank must have a volumetric capacity of 110 percent of the LNG tank's maximum liquid capacity. Gulf LNG's proposed LNG storage tank impoundments would be the outer concrete container surrounding the inner container that holds the LNG. Each LNG storage tank's maximum liquid capacity would be 44,728,632 gallons. The volumetric capacity of the concrete wall would be 52,020,070 gallons, which would exceed the 110 percent requirement by 2,818,575 gallons.

Gulf LNG proposes only one insulated concrete impoundment basin, the main impoundment basin, at the LNG terminal site. The main impoundment basin would measure 60-feet-long by 60-feet-wide, with a depth of 20-feet and a usable capacity of 538,597 gallons. The impoundment basin would be located between the LNG storage tanks and the processing area, within the storm surge wall. Gulf LNG sized the main impoundment basin for a full rupture of the 30-inch transfer line, a flow rate of 53,839 gpm. This 10-minute spill would be 538,390 gallons. The main impoundment basin would also contain spill from the in-tank pumps withdrawal header and the processing area. Each LNG storage tank would be equipped with three in-tank pumps, each rated at 3,841 gpm. With three pumps operating, the volume for a 10-minute spill from the in-tank pump withdrawal header would be 115,230 gallons. The maximum flow from the processing area would be from the high pressure pump suction header. A 10-minute spill from the high pressure pump suction header would release 133,210 gallons of LNG. Each of these individual spills would be contained by the main impoundment basin.

According to table 2.2.3.5 of NFPA 59A, the design spill is the largest flow from the container (i.e., storage tank) withdrawal pumps for a 10-minute duration at full-rated capacity. This would be a guillotine rupture of the discharge header for the in-tank LNG pumps, which would result in a 10-minute spill volume of 115,230 gallons.

The design spill for the impounding areas serving only vaporization, process, or LNG transfer areas is the flow from any single accidental leakage source for a 10-minute duration. FERC staff considered that credible LNG spills could result from breaks of a 3-inch-diameter bypass from the unloading line header and a 6-inch-diameter recycle line downstream of a single high pressure pump. These design spills would generate spill volumes of 35,180 gallons and 18,320 gallons, respectively.

Table 4.13.4-1 presents the impounding areas, spill size volumes and design spill volumes for the various spill scenarios. The largest design spill collected by the main impoundment basin would be used to calculate exclusion zones for that sump.

| TABLE 4.13.4-1<br>**Impoundment Areas** | | | |
|---|---|---|---|
| Source | Spill Size (gallons) | Impoundment System | Impoundment Size (gallons) |
| Impoundment sizing spills: | | | |
| LNG Storage Tank | 49,201,495 | Concrete Wall | 52,020,070 |
| Marine Cargo System | 528,390 | Main Impoundment Basin | 538,597 |
| In-tank LNG Pumps | 115,230 | Main Impoundment Basin | 538,597 |
| High Pressure Pumps Suction Header | 133,210 | Main Impoundment Basin | 538,597 |
| Design spills: | | | |
| In-tank pump withdrawal header | 115,230 | Main Impoundment Basin | 538,597 |
| Ship unloading line – 3" connection | 35,180 | Main Impoundment Basin | 538,597 |
| High pressure pump outlet – 6" connection | 18,320 | Main Impoundment Basin | 538,597 |

## Thermal Exclusion Zone

If a large quantity of LNG is spilled in the presence of an ignition source, the resulting LNG pool fire could cause high levels of thermal radiation. Exclusion distances for various flux levels were calculated according to 49 CFR Part 193.2057 and section 2.2.3.2 of NFPA 59A, using the "LNGFIRE III" computer program model developed by the Gas Research Institute. NFPA 59A establishes certain atmospheric conditions (0 mph wind speed, 70 °F, and 50 percent relative humidity) which are to be used in calculating the distances. However, Part 193.2057 supersedes these requirements and stipulates that wind speed, ambient temperature, and relative humidity which produce the maximum exclusion distances must be used, except for conditions that occur less than 5 percent of the time based on recorded data for the area. FERC staff selected the following ambient conditions that would produce the maximum distances: wind speed of 15 mph; ambient temperature of 43 °F; and 60 percent relative humidity. These conditions yield longer distances than the 0 mph wind speed, 70 °F ambient temperature, and 50 percent relative humidity specified in NFPA 59A.

Thermal radiation distances were calculated for 1,600 to 10,000 British thermal units per square foot per hour (Btu/ft$^2$-hr) incident flux levels for an LNG storage tank impoundment fire. The concrete wall's diameter (254 feet) was used as the pool diameter, with a flame height equal to the top of the concrete wall (137 feet). The target height was set at ground level (0 feet). In addition, the thermal radiation distances were determined for the 1,600-Btu/ft$^2$-hr incident flux level centered on the main impoundment basin.

Table 4.13.4-2 presents the maximum distances for incident flux levels ranging from 1,600 to 10,000 Btu/ft$^2$-hr, as calculated by FERC staff. The 1,600 Btu/ft$^2$-hr incident flux for a design spill from the in-tank pump withdrawal header would extend 300 feet from the main impoundment basin and remain within the facility property line. This would meet the requirement of 49 CFR Part 193.2057. The exclusion zones for the 3,000 and 10,000 Btu/ft$^2$-hr incident fluxes from the storage tanks would extend over water to the south and saturated wetland areas to the east and west of the terminal site. However, on October 30, 2006, Gulf LNG entered into a sublease agreement with the Jackson County Board of Supervisors and the JCPA for the wetland areas. Therefore, this would meet the requirements of 49 CFR Part 193.2057.

TABLE 4.13.4-2

**Thermal Exclusion Zones**

| Source | Exclusion Area NFPA 59A Section 2-2.3.2(a) | Incident Flux ($Btu/ft^2$-hr) [a] | Exclusion Zone (feet) |
|---|---|---|---|
| Main Impoundment Basin | Property line that can be built upon. | 1,600 | 300 |
| LNG Storage Tank Impoundment | Outdoor assembly area occupied by 50 or more people. | 1,600 | 901 |
| LNG Storage Tank Impoundment | Off-site structures used for occupancies or residences. | 3,000 | 712 |
| LNG Storage Tank Impoundment | Property line that can be built upon. | 10,000 | 382 |

[a] The 1,600 Btu/ft2-hr flux level is associated with an exposed person experiencing burns within about 30 seconds. At 3,000 Btu/ft2-hr, an exposed person would experience burns within 10 seconds; however, a wooden structure would not be expected to burn and affords protection to sheltered persons. At 10,000 Btu/ft2-hr, clothing and wood can ignite spontaneously.

The 1,600 $Btu/ft^2$-hr incident flux for a storage tank fire would cross beyond the property currently subleased by approximately 25 feet to the northeast onto the COE's dredged material placement area. The COE has obtained rights to use this area for the sole purpose of placing dredged material. In the event that the placement area is no longer used for its current purpose, Gulf LNG has agreed with the Jackson County Board of Supervisors and the JCPA to become the lessee of all or part of the property as long as Gulf LNG's terminal is in operation. Since the 1,600 $Btu/ft^2$-hr incident flux would remain on properties under the control of a government entity, this would comply with the requirements in Part 193.2057.

### Vapor Dispersion Zone

A large quantity of LNG spilled without ignition would form a flammable vapor cloud that would travel with the prevailing wind until it either dispersed below the flammable limits or encountered an ignition source. Sections 2.2.3.3 and 2.2.3.4 of NFPA 59A and Part 193.2059 require that provisions be made to minimize the possibility of flammable vapors from reaching a property line that can be built upon and that would result in a distinct hazard. Part 193.2059 requires that dispersion distances be calculated for a 2.5 percent average gas concentration (one-half the lower flammability limit (LFL) of LNG vapor) under meteorological conditions which result in the longest downwind distances at least 90 percent of the time. Alternatively, maximum downwind distances may be estimated for stability Class F, a wind speed of 4.5 mph, 50 percent relative humidity, and the average regional temperature. The section allows the use of the DEGADIS Dense Gas Dispersion Model, or the FEM3A model, to compute dispersion distances. Design spills into impounding areas serving LNG containers, transfer systems, and piping are to be determined in accordance with section 2.2.3.5 of NFPA 59A. For its vapor dispersion analysis, Gulf LNG selected the following ambient conditions: stability Class F, 4.5 mph wind speed, 50 percent relative humidity, and an average regional temperature of 66 °F.

In accordance with section 2.2.3.3 of NFPA 59A, an average concentration of methane in air of 50 percent of the LFL cannot cross the property line from a design spill into each tank impoundment. In this case, compliance with section 2.2.3.3 would also meet the requirements of section 2.2.3.4 of NFPA 59A.

Based on Table 4.13.4-1, the largest design spill that would be directed to the main impoundment sump would come from the LNG tank withdrawal header, a 10-minute spill volume of 115,230 gallons. Using this spill and the specifications provided by Gulf LNG for the main impoundment basin, staff

calculated a distance of 312 feet to the 2.5 percent average gas concentration isopleth. Based on this distance, the vapor exclusion zone associated with the main impoundment basin would remain on-site.

Another issue is the lengthy distance from potential spill locations to the sumps. While it is an appropriate design philosophy to direct potential spills away from process equipment to remote impoundments, and it is technically correct to base exclusion zone calculations on these impoundments, it is also relevant to consider the control of vapors produced in the channels or trenches leading to these sumps. Long trenches increase the surface area available for heat transfer and, correspondingly, increase vapor generation. A number of vapor control options are also available including: vapor fences; fixed high expansion foam generators; reduced trench lengths and/or surface area; and additional sumps at intermediate locations along transfer piping. Gulf LNG proposes using continuous 8-inch-high concrete curbs under each of the transfer pipes from the jetty, thus creating multiple small troughs. This would minimize the spill surface area along the jetty and pipe trestle and should reduce vapor production.

### 4.13.5 Marine Safety[3]

The February 2004 Interagency Agreement provides the framework for the participating agencies to work in a coordinated manner to address the full range of issues regarding safety and security at LNG import terminals and the suitability of waterways for LNG marine traffic. The FERC closely coordinates its pre-certificate review of the proposal with the Coast Guard, which has authority over the safety of LNG vessels and the marine transfer area as well as the security of the LNG vessels and the entire LNG facility, and the suitability of waterways for LNG marine traffic.

The hazards associated with the marine transportation of LNG differ from land-based hazards. Whereas the land-based facilities have features to both limit the duration of LNG spills and contain credible spill volumes, an LNG spill on water may be unconfined and may vaporize rapidly due to heat input from the water.

The history of LNG shipping has been free of major incidents, and none have resulted in significant quantities of cargo being released (see section 4.13.5.4). No incidents have occurred at existing LNG terminals during the 50 years of operation that resulted in any significant quantities of cargo being released. However, the possibility of an LNG spill from a ship over the duration of the proposed project must be considered. Historically, the events most likely to cause a significant release of LNG were ship casualties such as:

- a vessel colliding with an LNG ship in transit;
- an LNG ship alliding[4] with the terminal or a structure in the waterway;
- a vessel alliding with an LNG ship while moored at the terminal; or
- a grounding sufficiently severe to puncture an LNG cargo tank.

Since the attacks on September 11, 2001, additional risks are considered due to the possibility of a deliberate attack on an LNG ship by a terrorist group.

[3] This section was written with the cooperation and assistance of the Coast Guard, Sector Mobile.

[4] "Allision" is the action of dashing against or striking upon a stationary object (e.g., the running of one ship upon another ship that is docked) – distinguished from "collision," which is used to refer to two moving ships striking one another.

Any of the above events would have to occur with sufficient impact to breach the LNG ship's double hull and cargo tanks. Previous incidents with LNG ships have primarily involved grounding, and none of these have resulted in the breach of the double hull and subsequent release of LNG cargo.

The following discussion provides a chronology of a conceptual LNG ship voyage, as proposed by the applicant, from the liquefaction facility to the import terminal, disclosing the risks at each step and how they would be managed. Details and analysis are provided in subsequent sections.

**LNG Vessels and Ocean Voyage**

Imported LNG could be obtained from exporting terminals throughout the world and delivered by LNG ships to the proposed terminal. Exporting countries include Algeria, Australia, Brunei, Indonesia, Malaysia, Nigeria, Oman, Qatar, Trinidad, and United Arab Emirates. In 2003, LNG imports to the United States included: 72 percent from Trinidad, 12 percent from Nigeria, 10 percent from Algeria, 3 percent from Qatar, 2 percent from Oman, and 1 percent from Malaysia. At this time, Gulf LNG has not confirmed the source(s) of LNG supplies.

The LNG ships used to import LNG to the United States would be constructed and operated in accordance with the IMO's *Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk*, the SOLAS, and 46 CFR Part 154, which contain the U.S. safety standards for vessels carrying bulk LNG. Foreign flag LNG ships are required to possess a valid IMO Certificate of Fitness and a Coast Guard Certificate of Compliance.

1993 amendments to the IMO's *Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk* require all tankers to have monitoring equipment with an alarm facility, which is activated by detection of over-pressure or under-pressure conditions within a cargo tank. In addition, the cargo tanks are heavily instrumented, with gas detection equipment in the hold and inter-barrier spaces, temperature sensors, and pressure gauges. Fire protection must include the following systems:

- a water spray (deluge) system that covers the accommodation house control room and all main cargo valves;
- a traditional firewater system that provides water to fire monitors on deck and to fire stations found throughout the ship;
- a dry chemical fire extinguishing system for hydrocarbon fires; and
- a $CO_2$ system for protecting machinery, including the ballast pump room, emergency generators, and compressors.

As a result of September 11, 2001, the IMO agreed to new amendments to the 1974 SOLAS addressing port facility and ship security. The International Ship and Port Facility Security Code was adopted in 2003 by the IMO. This code requires both ships and ports to conduct vulnerability assessments and to develop security plans. The purpose of the code is to prevent and suppress terrorism against ships, improve security aboard ships and ashore, and reduce the risk to passengers, crew, and port personnel on board ships and in port areas, for vessels and cargoes. All LNG ships, as well as other cargo vessels 300-gross tons and larger and ports servicing those regulated vessels, must adhere to these IMO and SOLAS standards. Some of the IMO requirements are as follows:

Ships:

- Ships must develop security plans and have a Vessel Security Officer (VSO);

- Ships must be provided with a ship security alert system. These alarms transmit ship-to-shore security alerts to a competent authority designated by the Administration, which may include the company, identifying the ship, its location, and indicating that the security of the ship is under threat or it has been compromised;

- Ships must have a comprehensive security plan for international port facilities, focusing on areas having direct contact with ships; and

- Ships may have certain equipment onboard to help maintain or enhance the physical security of the ship.

Port facilities:

- Port facility security plan;

- Facility Security Officer (FSO); and

- Certain security equipment may be required to maintain or enhance the physical security of the facility.

Both ships and ports must:

- Monitoring and controlling access;

- Monitoring the activities of people and cargo;

- Ensuring security communications and that they are readily available; and

- Completion of a Declaration of Security that is signed by the FSO and VSO.

**LNG Vessel Transit in the Port of Pascagoula**

LNG ships in route to the proposed LNG terminal would transit about 12 nautical miles from the Horn Island "HI" sea buoy to the berth under the direction of a Pascagoula Pilot. The Pascagoula Pilots are presently the controlling body in terms of scheduling, monitoring of weather conditions, establishing working conditions, and declaring channel closure days based on inclement weather. Pilots meet ships, day or night, at the sea buoy located at the southern end of the Horn Island Pass Channel.

If the Coast Guard issues an LOR, as described in section 1.3, finding the waterway suitable for LNG marine traffic with the conditions referenced in section 2.0, LNG ships would access the proposed LNG terminal via the Pascagoula Bar Channel starting at the "HI" sea buoy and traveling approximately 3.3 nautical miles to buoys 11 and 12, which mark the beginning of the Horn Island Pass Channel. From there, vessels would travel northeast for about 1.2 nautical miles, through Horn Island Pass, at which point they would turn north and continue along the Lower Pascagoula Channel for about 3.7 nautical miles to the Bayou Casotte Channel, which branches off from the Lower Pascagoula Channel at a junction commonly referred to as the "Y." From this junction, LNG ships would continue north approximately 3.7 nautical miles to the LNG terminal. Gulf LNG's ships would require three tractor tugs with the appropriate bollard pull to handle an LNG ship. The berth would be designed such that the LNG vessels could be turned by the tugs and backed onto berth or pulled in bow first.

If the Coast Guard issues an LOR finding the waterway suitable for LNG marine traffic with the conditions referenced in section 2.0, the LNG ship would normally transit the waterway during early

daylight hours. Docking, LNG offloading, and undocking would take about 24 hours. The LNG ship would depart during daylight hours on the second day.

If the Coast Guard issues an LOR finding the waterway suitable for LNG marine traffic with the conditions referenced in section 2.0, in addition to the Pascagoula Pilots, the Coast Guard may monitor the transit of the LNG vessel through the harbor and while unloading cargo. Typical Coast Guard requirements for other LNG import terminals include 96- and 24-hour advance notification of the vessel arrival at the sea buoy, at which time Coast Guard personnel may board the LNG vessel for an inspection of the ship safety systems, a security sweep, and a review of the manifest. Other Coast Guard requirements may include: establishment of a moving safety zone around the vessel while en route; a Coast Guard escort through the channel and to the dock; a fixed security zone around the vessel during unloading operations; an inspection of the dock safety systems prior to commencing cargo transfer; and monitoring operations until the vessel departs. Maintaining security of the dock and vessel would be the responsibility of the facility in cooperation with other federal, state, and local agencies as described in the Facility Security Plan (see section 4.13.6).

**LNG Vessel Casualties**

If the Coast Guard issues an LOR finding the waterway suitable for LNG marine traffic with the conditions referenced in section 2.0, the operational controls that would be imposed by the Coast Guard and the Pascagoula Pilots, as well as the characteristics of the Pascagoula Bar, Horn Island Pass, Lower Pascagoula, and Bayou Casotte Channels, would minimize the possibility of an LNG cargo spill from groundings, collisions, and allisions. The Coast Guard may enforce a moving safety zone around the LNG ship that would clear the channel of all vessels in the vicinity of the LNG ship to reduce the likelihood of any collisions, including those of the tonnage and speed required to cause an LNG spill (see section 4.13.5.4).

The Pascagoula Bar Channel is maintained at a width of 450 feet and a depth of 44 feet. The Horn Island Pass Channel is 600 feet wide and 44 feet deep. The Lower Pascagoula and Bayou Casotte Channels are both maintained at a width of 350 feet and a depth of 42 feet. The channels are bordered by shallow water approximately 5 to 18 feet deep, thereby constraining the LNG ships, which have drafts of 38 feet, to operating within the dredged channels. However, the soft nature of the sea bottom in the Mississippi Sound makes an LNG spill from cargo tanks highly unlikely in a grounding incident.

**Deliberate Attack on an LNG Vessel**

In addition to addressing the potential hazards from LNG vessel incidents, the possibility of a deliberate attack on an LNG ship by a terrorist group must also be considered. Security of the LNG vessel would be the responsibility of the owner/operator and the master of the vessel. Security of the LNG facility would be the responsibility of the owner/operator of the facility. If the Coast Guard issues an LOR finding the waterway suitable for LNG marine traffic with the conditions referenced in section 2.0, the Coast Guard may establish a moving safety zone around the LNG vessels in transit and a security zone around the LNG vessels while docked. Protection of the LNG vessel and the import terminal would involve personnel from the Coast Guard, Gulf LNG security staff, and state and local law enforcement. The Coast Guard may also conduct random shoreside and waterside security patrols to include visits/passes of the LNG facility. Only personnel or vessels authorized by the COTP or the District Commander would be permitted in the safety and security zone.

Gulf LNG would provide security for the terminal according to a Facility Security Plan that must be prepared under 33 CFR Part 105. This plan would need to be approved by the Coast Guard COTP (see section 4.13.6). The requirements of this plan may include:

- a Facility Security Assessment to identify site vulnerabilities, possible security threats, consequences of an attack, and facility protective measures;

- a Facility Security Plan with procedures for responding to security incidents;

- a designated FSO responsible for implementing and updating the Facility Security Plan and Assessment;

- scalable security measures to provide increasing levels of security at increasing Maritime Security (MARSEC) levels;

- security exercises at least once each calendar year and drills at least every 3 months; and

- mandatory reporting of all breaches of security and security incidents.

Security at the facility would be provided by both active and passive systems. The entire site would be surrounded by a protective enclosure (i.e., a fence) with sufficient strength to deter unauthorized access. The enclosure would also be illuminated with not less than 2.2 lux between sunset and sunrise. Intrusion detection systems and day/night camera coverage would identify unauthorized access. A separate security staff would conduct periodic patrols of the plant, and screen visitors and contractors. The security staff may also assist in maintaining security of the marine terminal during cargo unloading. Gulf LNG would be required to submit their Facility Security Plan to the COTP for approval 60 days prior to commencement of operations. In order to ensure that the responsibilities of Gulf LNG's security staff enhance overall security, **we recommend that:**

- **<u>Prior to commissioning</u>, Gulf LNG coordinate, as needed, with the Coast Guard to define the responsibilities of Gulf LNG's security staff in supplementing other security personnel and in protecting the LNG tankers and the terminal.**

The DOE released a study by Sandia National Laboratories entitled *Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill over Water* (Sandia Report) December 2004. The report included an LNG cargo tank breach analysis using modern finite element modeling and explosive shock physics modeling to estimate a range of breach sizes for credible accidental and intentional LNG spill events. The analysis of accidental events found that groundings and low speed collisions could result in minor ship damage but not a cargo spill; while high speed collisions could cause a 0.5- to 1.5-square meter ($m^2$) cargo tank breach area. For intentional scenarios, the size of the cargo tank hole depends on the location of the ship and source of threat. Intentional breach areas were estimated to range from 2 to 12 $m^2$. In most cases, an intentional breaching scenario would not result in a nominal hole of more than 5 to 7 $m^2$, which is a more appropriate range to use in calculating potential hazards from spills. These hole sizes are equivalent to circular hole diameters of 2.5 and 3 meters.

The FERC commissioned a study by ABSG Consulting Inc. (ABSG) to search and review the literature on experimental LNG spills and on consequence methodologies that are applicable to modeling incidents of LNG spills on water. The methodology described in the ABSG study, *Consequence Assessment Methods for Incidents Involving Releases from Liquefied Natural Gas Carriers*, and revised in staff's responses to comments on the report (issued June 18, 2004), was used to calculate the thermal radiation and flammable vapor dispersion distances for several holes ranging in diameter from 1 meter to 3.9 meters. Using the methodology, we have estimated distances for a nominal 2.5-meter and 3-meter diameter hole to range from 4,182 to 4,652 feet for a thermal radiation of 1,600 Btu/$ft^2$-hr, the level which is hazardous for persons located outdoors and unprotected; from 3,232 to 3,591 feet for 3,000 Btu/$ft^2$-hr,

an acceptable level for wooden structures; and from 1,934 to 2,143 feet for 10,000 Btu/ft$^2$-hr, a level sufficient to damage process equipment for these size holes, respectively.

These intentional breach scenarios provide guidance to the Coast Guard in developing the operating restrictions for LNG vessel movements in the waterway, as well as in establishing potential impact areas for emergency response and evacuation planning. The entire transit from the Gulf of Mexico through the Pascagoula Bar, Horn Island Pass, Lower Pascagoula, and Bayou Casotte Channels to the LNG berth, has no development or communities adjacent to the channel or within the 4,652 feet transient hazard area. Assuming an LNG vessel would transit through the channel between 3 and 8 knots while under tug assist, areas adjacent to the channel would be exposed to a potential transient hazard for less than 20 minutes. In addition, a temporary hazard would exist around the slip during part of the 24-hour period while the LNG vessel is maneuvering into the slip and at the dock unloading cargo.

If the Coast Guard issues an LOR finding the waterway suitable for LNG marine traffic with the conditions referenced in section 2.0, the operational restrictions that would be imposed by the Pascagoula Pilots on LNG vessel movements through the area, as well as the requirements that the Coast Guard would impose in its *LNG Vessel Transit Management Plan* (see section 4.13.5.2) would minimize the possibility of a hazardous event occurring along the vessel transit.

**Emergency Response and Evacuation Planning**

Prior to commencing service, Gulf LNG would be required to prepare emergency procedures manuals, as required by 49 CFR Part 193.2509 that provide for: a) responding to controllable emergencies and recognizing an uncontrollable emergency; b) taking action to minimize harm to the public including the possible need to evacuate the public; and c) coordination and cooperation with appropriate local officials. Specifically, section 193.2509(b)(3) requires "Coordinating with appropriate local officials in preparation of an emergency evacuation plan…"

While the worst-case scenarios evaluated for the onshore facility in section 4.13.4 and for marine spills in section 4.13.5 provide guidance on the maximum extent of potential hazards, they should not be assumed to represent the evacuation zone for *every* potential incident. As with any other fuel or hazardous material, the actual severity of the incident will determine what area needs to be evacuated, if any, rather than a worst-case maximum zone. It is anticipated that the emergency evacuation plans will identify evacuation distances based upon increasing severity of events.

On several LNG import terminal proposals, a number of organizations and individuals commented on the need to consider emergency response procedures. Subsequently, section 3A(e) of the NGA, added by section 311 of the EPAct of 2005, stipulated that in any order authorizing an LNG terminal, the Commission shall require the LNG terminal operator to develop an Emergency Response Plan in consultation with the Coast Guard and state and local agencies. The FERC must approve the Emergency Response Plan prior to any final approval to begin construction. Therefore, **we recommend that:**

- **Gulf LNG should develop an Emergency Response Plan (including evacuation) and coordinate procedures with the Coast Guard, state, county, and local emergency planning groups; fire departments; state and local law enforcement; and appropriate federal agencies. This plan should include at a minimum:**

  **a. designated contacts with state and local emergency response agencies;**

  **b. scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and severity of potential incidents;**

  **c. procedures for notifying residents and recreational users within areas of potential hazard;**

  **d. evacuation routes/methods for residents and other public use areas that are within any transient hazard areas along the route of the LNG vessel transit;**

  **e. locations of permanent sirens and other warning devices; and**

  **f. an "emergency coordinator" on each LNG vessel to activate sirens and other warning devices.**

  **The Emergency Response Plan should be filed with the Secretary for review and written approval by the Director of OEP <u>prior to initial site preparation</u>. Gulf LNG should notify FERC staff of all planning meetings in advance and should report progress on the development of its Emergency Response Plan at <u>3-month intervals</u>.**

FERC has also received comments on other LNG terminal proposals expressing concern that the local community would have to bear some of the cost of ensuring the security and emergency management of the LNG facility and the LNG vessels while in transit and unloading at the berth. In addition, section 3A(e) specifies that the Emergency Response Plan shall include a Cost-Sharing Plan that contains a description of any direct cost reimbursements the applicant agrees to provide to any state and local agencies with responsibility for security and safety at the LNG terminal and near vessels that serve the facility. To allow the FERC an opportunity to review the plan, **we recommend that:**

- **The Emergency Response Plan should include a Cost-Sharing Plan identifying the mechanisms for funding all project-specific security/emergency management costs that would be imposed on state and local agencies. In addition to the funding of direct transit-related security/emergency management costs, this comprehensive plan should include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. The Cost-Sharing Plan should be filed with the Secretary for review and written approval by the Director of OEP <u>prior to initial site preparation</u>.**

#### 4.13.5.1 Pascagoula Bar, Horn Island Pass, Lower Pascagoula, and Bayou Casotte Channels

The Port of Pascagoula in Mississippi Sound has two principal harbor areas: the Bayou Casotte (East) Harbor and the Pascagoula River (West) Harbor. Cargoes handled at the Port of Pascagoula include general, roll on-roll off, break bulk, and dry bulk, as well as bulk chemicals and crude oil in bulk. The East Harbor has ship repair and drill rig repair facilities, along with general cargo and liquid cargo terminals. The West Harbor has shipbuilding, drill rig repair, and general cargo facilities, along with U.S. Navy, NOAA, and Coast Guard activities.

If the Coast Guard issues an LOR finding the waterway suitable for LNG marine traffic with the conditions referenced in section 2.0, all LNG ships would enter and depart the Mississippi Sound area by the Pascagoula Bar Channel, Horn Island Pass Channel, Lower Pascagoula Channel, and Bayou Casotte Channel. The length of each segment of the channel that would be traversed, and channel characteristics as they relate to marine safety, are summarized in table 4.13.5-1.

TABLE 4.13.5-1

**Channel Characteristics for Route that Would Be Used by LNG Ships Calling on Proposed LNG Terminal**

| Channel Segment | Length (Nautical Miles) | Width (feet) | Depth (feet) |
|---|---|---|---|
| Pascagoula Bar Channel | 3.3 | 450 | 44 |
| Horn Island Pass Channel | 1.2 | 600 | 44 |
| Lower Pascagoula Channel | 3.7 | 350 | 42 |
| Bayou Casotte Channel | 3.7 | 350 | 42 |
| Total Length | 11.9 | | |

Upon reaching the LNG terminal, an LNG ship would be required to turn in a specially constructed turning basin in the Bayou Casotte Channel, adjacent to the LNG berth. Gulf LNG coordinated the design of this basin with representatives of the Port of Pascagoula and the Pascagoula Pilots. Once turned in the basin with tug assistance, the ship would be maneuvered back and onto the LNG berth. The berth was designed to moor the vessels either starboard-side-to (i.e., bow out) or port-side-to (i.e., bow in). We note that at some existing terminals, the Coast Guard has required that the ship is moored so that it points outward towards the channel. This would allow ships to depart the LNG terminal without turning, which provides for a more rapid emergency evacuation from the berth should this be required.

### Current Traffic

Vessel movements in Mississippi Sound are heavily dominated (numerically) by barge traffic, much of which transits to and from Pascagoula ports. Between 2000 and 2003, an average of 5,065 vessels transited the Bayou Casotte Channel each year. Approximately 93 percent of these vessels consisted of vessels with a draft less than 18 feet: tug/tow, tanker, cargo, dry cargo barge, and tanker barge. The number of inbound large vessel transits in the Port of Pascagoula from July 2002 to June 2003 and July 2003 to June 2004 was 485 and 556, respectively, or an average of 521 ships per year. About 80 percent of that traffic went to Bayou Casotte, or an average of about 426 vessels per year. The dominant cargo commodity for vessels entering the port was crude oil calling at Chevron's Pascagoula Refinery, with 303 and 397 ships, respectively, for those periods. Chevron's refinery is located in the Bayou Casotte Channel about 0.5 mile north of the proposed site. The next largest component was bulk carriers calling at the Mississippi Phosphates terminal located just north of the refinery, with 55 and 42 vessel calls, respectively, for the two time periods.

### Future Traffic

The Marine Traffic Assessment performed by Shiner Moseley and Associates, Inc. for Gulf LNG provided data on existing vessel traffic that shows a variable pattern of shipping volume. Assuming that future vessel traffic remains steady, the addition of up to 150 LNG ships per year that would call on the Gulf Clean Energy LNG Terminal would result in an overall increase in large vessel traffic of 29 percent, and a 35 percent increase at Bayou Casotte.

Examining the shipping situation in the Port of Pascagoula with the combined impact of the proposed project (150 ships per year) and the Casotte Landing LNG Project (170 ships per year, based on information available from Chevron, Docket No. CP05-420-000), the total number of LNG carriers expected to call on the Port of Pascagoula would be 320 ships per year. This would result in roughly one LNG carrier per day to one of the respective LNG terminals with a minimum of one transit per day and a maximum of two transits per day. Other shipping activities would be moderately affected by this increase in traffic; however, based on the relatively modest level of shipping activity in the Port of Pascagoula, the impact is not expected to be substantial.

**Ship Traffic in the Navigation Channels**

There are a number of factors that influence the movement of ship traffic in the Mississippi Sound Channels. These include:

- Cross-Current – The COE-designated entrance channel extends from the end of the Horn Island Pass to the sea buoy. The cross-current is variable and can reach a velocity of 4 knots. However, the Pascagoula Pilots indicate a velocity of approximately 1.5 knots flowing west to east is most common. The Pascagoula Pilots have to hold as much as 6 degrees of "leeway" on the vessel to counter the current.

- Day Transit – Existing practice is for vessels with drafts greater than 36 feet to transit the channel only during daylight hours. According to the Pascagoula Pilots and the Coast Guard, LNG ship transit would only be allowed during daylight hours since the proposed LNG traffic would exceed the draft length restrictions.

- One-way Traffic – One-way traffic is currently enforced within the channels that would be transited by the LNG vessels. In addition, a moving safety zone around LNG vessels would prohibit any passing of these vessels.

- Reduced Visibility – Fog has the potential to eliminate all vessel movements. Visibility must be at least 2 nautical miles for vessels to travel inbound or outbound. Visibility is below the operational limits about 6 percent of the time, therefore, resulting in delays.

- Tidal Range – The maximum annual tidal range is approximately 3.6 feet. That maximum range is most common in the face of very strong north winds or when there is a major storm in the Gulf of Mexico. The Pascagoula Pilots consider any conditions that create a tide range of 1.5 feet as something to take seriously.

- Flood Tide/Ebb Tide – In general, flood tides typically set ships to the west, and ebb tides typically set them to the east. However, the set direction is not necessarily constant during the transit. The current changes direction several times as it flows around the islands and along the channel banks.

- Wind – Inside the barrier islands of Mississippi Sound, the current is predominantly wind-driven, often flowing across the channel. The current creates a moderate challenge to holding a ship in the channel, although to a lesser degree than what is experienced at the pass between the barrier islands.

  Prevailing winds are anecdotally reported as being from south/southeast, although long-term wind data do not indicate a single overarching pattern. The Pascagoula Pilots have indicated that wind does not present a significant concern except during strong northers

or coastal storms. Strong east or west winds, which have the most adverse impact on transit through the Pascagoula Channel, occur less than 10 percent of the time; however, when they do occur, they could potentially create a challenging navigation situation in the relatively narrow channel. Under those conditions, large vessel transits would be delayed.

The Pascagoula Pilots have established a 15-knot wind speed limit for drill rig transits. Each transit of self-propelled vessels is evaluated individually and no cutoff has been established.

- Pilot Availability – The Pascagoula Pilots operate with six fully-qualified, Coast Guard-licensed pilots and two apprentices. Apprentice pilots take up to 1 year to be qualified. The Pascagoula Pilots have two pilot boats. The Pascagoula Pilots have stated that their workforce would have to grow by at least two pilots to accommodate the traffic generated by Gulf LNG's operations and that a larger more modern pilot boat would be necessary to allow them to continue to board the LNG vessels offshore under a wider range of operating conditions.

- Tugs – If the Coast Guard issues an LOR finding the waterway suitable for LNG marine traffic with the conditions referenced in section 2.0, it is anticipated that LNG ships delivering cargo to the proposed terminal would have tug support for all maneuvering and berthing operations, at a minimum, and potentially have tug support for other phases of ship arrival and departure as well as standby and fire fighting duties during LNG unloading operations if so dictated by the Coast Guard COTP. There are currently five harbor tugs provided by Colle Towing Company. Two of these are tractor tugs rated at 4,000 hp and the remaining three are conventional tugs, one rated at 5,600 hp and two rated at 3,600 hp. In addition, a 5,600 hp tug is scheduled to join the fleet in the near future. The Pascagoula Pilots have indicated that three tugs would be used for the movement of LNG vessels within the shipping channel, and the current fleet of tugs would not be able to safely accommodate the transit of LNG vessels to the proposed facilities. Gulf LNG has indicated that it would work with other port users and towing companies to ensure that all users' tug needs are met.

#### 4.13.5.2 Requirements for LNG Ship Operations

The Coast Guard exercises regulatory authority over LNG facilities that affect the safety and security of port areas and navigable waterways under Executive Order 10173; the Magnuson Act (50 USC section 191); the Ports and Waterways Safety Act of 1972, as amended (33 USC section 1221, et seq.); and the Maritime Transportation Security Act of 2002 (46 USC section 701). The Coast Guard is responsible for matters related to navigation safety, vessel engineering and safety standards, and all matters pertaining to the safety of facilities or equipment located in or adjacent to navigable waters up to the last valve immediately before the receiving tanks. The Coast Guard also has authority for LNG facility security plan review, approval and compliance verification as provided in Title 33 CFR Part 105, and siting as it pertains to the management of vessel traffic in and around the LNG facility.

The Coast Guard regulations in 33 CFR Part 127 apply to the marine transfer area of waterfront facilities between the LNG ship and the last manifold or valve located immediately before a storage tank. Title 33 CFR Part 127 regulates the design, construction, equipment, operations, inspections, maintenance, testing, personnel training, firefighting, and security of LNG waterfront facilities. The safety systems, including the communications, emergency shutdown, gas detection, and fire protection,

must comply with the regulations in 33 CFR Part 127. Under 33 CFR Part 127.019, Gulf LNG would be required to submit two copies of its Operations and Emergency Manual to the COTP for examination.

Title 33 CFR Part 127 separates cargo transfer operations into three distinct phases: Preliminary Transfer Inspection (section 127.315); Declaration of Inspection (section 127.317); and LNG Transfer (section 127.319). These different sections require specific actions to be completed prior to and during the transfer. Additionally, there are specific actions required in the case of a release of LNG (section 127.321).

As required by its regulations (section 127.009), the Coast Guard is responsible for issuing an LOR as to the suitability of the waterway for LNG marine traffic with respect to the following items:

- environmental impacts of LNG marine traffic from the territorial seas to the LNG ship berth;
- density and character of marine traffic;
- locks, bridges, or other manmade obstructions in the waterway; and
- the following factors adjacent to the facility:
    - depth of water;
    - tidal range;
    - protection from high seas;
    - natural hazards, including reefs, rocks, and sandbars;
    - underwater pipes and cables; and
    - distance of berthed vessels from the channel and the width of the channel.

On June 14, 2005, the Coast Guard published a NVIC 05-05. The purpose of NVIC 05-05 is to provide the Coast Guard COTPs/FMSCs, members of the LNG industry, and port stakeholders with guidance on assessing the suitability of a waterway for LNG marine traffic that takes into account conventional navigation safety/waterway management issues contemplated by the existing LOI/LOR process, but in addition, will also take completely into account maritime security implications. In accordance with this guidance, each LNG project applicant is to submit a WSA to the cognizant COTP. The WSA process addresses the transportation of LNG from an LNG tanker's entrance into United States territorial waters, through its transit to and from the LNG receiving facility, including operations at the vessel/facility interface. In addition, the WSA should address the navigational safety issues and port security issues introduced by the proposed LNG operations. The NVIC 05-05 also provides specific guidance on the timing and scope of the WSA.

The process of preparing the LOR begins when an applicant submits an LOI to the COTP. In accordance with 33 CFR Part 127.007, Gulf LNG submitted an LOI to the Coast Guard on December 3, 2004 (see Appendix H). On November 17, 2005, the Coast Guard issued a notice in the Federal Register, requesting comments pertaining specifically to the maritime safety and security aspects of the proposed LNG facility. In preparation for issuance of an LOR and the completion of certain other regulatory mandates, the comments received were incorporated into a formalized risk assessment process to assess the safety and security aspects of the facility, adjacent poor areas, and navigable waterways. The Coast Guard held a public meeting on December 7, 2005, pursuant to the notice. The Coast Guard's comment period ended on December 14, 2005.

If the Coast Guard issues an LOR finding the waterway suitable for LNG marine traffic with the conditions referenced in section 2.0, the arrival, transit, cargo transfer, and departure of LNG ships in the waterway would be required to adhere to the procedures of an *LNG Vessel Transit Management Plan* to be developed by the Coast Guard Sector Mobile. In addition, Gulf LNG would develop Operations and Emergency Manuals in consultation with the Coast Guard. These procedures would be developed to ensure the safety and security of all operations associated with LNG ship transit and unloading. The *LNG Vessel Transit Management Plan* would contain specific requirements for the LNG ship, pre-arrival notification, transit through shipping channels, the waterfront facility, cargo transfer operations, Coast Guard inspection and monitoring activities, and emergency operations. The Coast Guard Sector Mobile would monitor each LNG ship in accordance with the *LNG Vessel Transit Management Plan*.

Some of the anticipated key provisions of the *LNG Vessel Transit Management Plan* would be the establishment of a moving safety and/or security zone for all inbound and moored LNG ships, and the use of tugs to assist in the channel and to maneuver the ship into the berth. Additional provisions may be necessary given changing circumstances.

**Gulf LNG Waterway Suitability Assessment**

On December 29, 2005, Gulf LNG submitted a WSA for the proposed project to the COTP for Coast Guard Sector Mobile. The Coast Guard, with input from the Pascagoula AMSC, has completed an initial review of Gulf LNG's WSA in accordance with the guidance in NVIC 05-05. The WSA review focused on the navigation safety and maritime security risks posed by LNG marine traffic, and the measures needed to responsibly manage these security risks.

**Coast Guard Letter to FERC**

On March 7 and September 5, 2006, the Coast Guard sent WSR letters to the FERC, based on the above WSA and AMSC review, providing input on the capability of the port community to implement the risk management measures necessary to responsibly manage the risks of LNG marine traffic in the port (see Appendix H). As described in this document, the Coast Guard made a preliminary determination that the Pascagoula Bar, Horn Island Pass, Lower Pascagoula, and Bayou Casotte Channels may be suitable for the LNG marine traffic associated with this project. The Coast Guard also stated that there is sufficient capability within the port community to responsibly manage the safety and security risks of this project. With the completion of this final EIS, the Coast Guard will complete its review and issue an LOR to address the suitability of the waterways for LNG transport.

If the Coast Guard issues an LOR finding the waterway suitable for LNG marine traffic with the conditions referenced in section 2.0, the necessary security measures would be further developed into a detailed *LNG Vessel Transit Management Plan*, which would become the basis for appropriate security measures for each Maritime Security threat level. This plan would clearly spell out roles, responsibilities and specific procedures for an LNG vessel transiting the Pascagoula Bar, Horn Island Pass, Lower Pascagoula and Bayou Casotte Channels up to the proposed LNG terminal, as well as for all agencies involved in implementing security and safety during the operation. It would be required that, prior to the LNG vessel being granted permission to enter the shipping channels, both the vessel and facility be in full compliance with the appropriate requirements of the Maritime Transportation Security Act and International Ship and Port Facility Security Code, and the security protocols to be established by the COTP in the *LNG Vessel Transit Management Plan*. The plan may include security measures such as: Coast Guard and other law enforcement agency vessels to enforce safety and security zones around the LNG vessels while in transit and moored at the terminal; shoreside surveillance and monitoring; and other prevention/mitigation strategies.

We recognize that the *LNG Vessel Transit Management Plan* would be a dynamic document that would be prepared well before import operations would commence, and that the port's overall security picture may change over that time period. New port activities may commence, infrastructure may be added, or population density may change. Improvements in technology to detect, deter and defend against intentional acts may also develop. Therefore, **we recommend that:**

- **Gulf LNG should annually review its WSA relating to LNG marine traffic for the project; update the assessment to reflect changing conditions which may impact the suitability of the waterway for LNG marine traffic; provide the updated assessment to the cognizant COTP/FMSC for review and validation and, if appropriate, further action by the COTP/FMSC relating to LNG marine traffic; and provide a copy to FERC staff.**

**Impact of Vessel and Facility Security Requirements**

The potential impacts of the proposed LNG marine traffic for the LNG Clean Energy Project on other commercial and recreational boaters can be addressed in relation to several general security requirements: 1) a moving safety zone for inbound LNG vessels; 2) a security zone around a moored LNG vessel; and 3) other measures as deemed appropriate.

If the Coast Guard issues an LOR finding the waterway suitable for LNG marine traffic with the conditions referenced in section 2.0, the Coast Guard may promulgate a moving safety zone that would affect other vessels. Pursuant to such a regulation, no vessel would be allowed to enter the safety zone without first obtaining permission from the Coast Guard COTP. If the Coast Guard issues an LOR finding the waterway suitable for LNG marine traffic with the conditions referenced in section 2.0, it is anticipated that the LNG ships would transit about 12 nautical miles from the entrance of the "HI" sea buoy to the proposed LNG terminal. For the majority of this trip, an LNG vessel would travel at an average speed of 10 knots. Based on these assumed speeds, it would take about 1 to 1.5 hours for LNG ships to complete the trip from the sea buoy to the LNG terminal. Additional time would be required to maneuver the LNG ship into the berth. Minimum visibility conditions would have to be satisfied before the LNG ship would be allowed to proceed inbound from the Gulf of Mexico, ensuring that the Coast Guard could adequately monitor the safety zone.

If moving safety zones, security zones at the terminal, and one-way traffic were implemented, they would affect other commercial and recreational traffic using the channel. The magnitude of the effect would also be influenced by other factors, such as the amount of time it takes to obtain a pilot and other competing ship traffic in the federal navigation channel.

The moving safety zones, if implemented, may have the effect of temporarily limiting the channel to one-way traffic. This presently occurs with other large vessels that can sometimes delay other vessels using the waterway. It is expected that if the proposed LNG terminal is constructed, and if the Coast Guard issues an LOR finding the waterway suitable for LNG marine traffic with the conditions referenced in section 2.0, as many as 150 LNG ships for the LNG Clean Energy Project could potentially move in and out of Pascagoula Bar, Horn Island Pass, Lower Pascagoula and Bayou Casotte Channels every year. This is an increase in vessel traffic of 29 percent over the average 521 large vessels per year currently transiting these waterways. Other shipping activities would be moderately affected by this increase in traffic; however, based on the relatively modest level of shipping activity in the Port of Pascagoula, the impact is not expected to be substantial.

The moving safety zone could cause impacts on recreational and other commercial vessels but the impacts would be temporary while the LNG vessel is in transit or moored at the unloading facility. Because the safety zone would be a moving zone around the ship, the impacts would be of short duration

at any given point along the shipping route. A recreational craft attempting to travel in the opposite direction of an LNG ship traveling at 10 knots may need to wait up to 15 minutes for the LNG ship to pass before proceeding on its way. The delay would increase to up to 36 minutes when the LNG ship is traveling at 5 knots and up to 60 minutes when the LNG ship is traveling at 3 knots. For other vessels near or upstream of the facility, an additional 60-minute delay may be experienced while the LNG ship is berthed. It should be noted that the Coast Guard moving safety and moored vessel security zones would not be treated as absolute exclusion zones that would preclude all other vessel movements. Rather, other vessels may be allowed to transit through the moving safety and moored vessel security zones with the permission of the COTP.

Additionally, any moving safety zone regulation that may be promulgated by the Coast Guard would affect a moving zone around the ship, so these impacts would be temporary and of short duration at any given point along the shipping route. In addition, depending on their individual drafts, commercial and recreational vessels might be able to go around the LNG ships at points in the waterway that are sufficiently wide for them to be outside of any moving safety zone. If the Coast Guard issues an LOR finding the waterway suitable for LNG marine traffic with the conditions referenced in section 2.0, to mitigate any adverse impacts of moving safety zone, the Coast Guard may routinely provide Notice to Mariners prior to the arrival and departure of LNG ships. The notification system includes broadcasts on radio frequencies used by mariners. These practices and impacts currently occur in other waterways during LNG vessel transits.

The Coast Guard made a preliminary determination that if appropriate resources were available to implement certain necessary security measures, the Pascagoula Bar, Horn Island Pass, Lower Pascagoula and Bayou Casotte Channels could accommodate the number of LNG carriers that would supply Gulf LNG's proposed LNG terminal. This determination is preliminary because the required NEPA analysis has not yet been completed. This determination is also contingent upon the port security community having the appropriate resources to implement all the measures necessary to responsibly manage the safety and security risks of LNG marine traffic in this area. If the Coast Guard issues an LOR finding the waterway suitable for LNG marine traffic, in addition to the moving safety and security zones around the LNG vessels, the *LNG Vessel Transit Management Plan* to be developed by the Coast Guard Sector Mobile, would minimize impacts on other ship traffic, escorts by armed law enforcement officials, and waterway and shoreline surveillance measures.

The FERC has received comments on other LNG terminal proposals expressing concern about the cost of applying additional security measures and the potential burden on local taxpayers. To meet its anticipated security responsibilities the Coast Guard most likely would need to request additional resources through its internal resource reprogramming process for inclusion in future appropriations. Additional funding for state and local resources would be provided by Gulf LNG to the extent called for by the Cost-Sharing Plan to be developed with the pertinent state and local agencies. In order to precisely determine the additional resources that would be necessary to provide the additional security to ensure safe transit of the LNG vessels, it would be necessary to develop and finalize the Coast Guard's *LNG Vessel Transit Management Plan*. Funding for security and management costs are discussed further in section 4.13.5 "Emergency Response and Evacuation Planning."

While the LOR would address the suitability of the Pascagoula Bar, Horn Island Pass, Lower Pascagoula and Bayou Casotte Channels for LNG ship transportation, it would not constitute a final authority to commence LNG operations. The Coast Guard's recommendation is subject to certain safety and security provisions to be developed in its *LNG Vessel Transit Management Plan*. This plan would be reviewed and updated as necessary to address issues specific to the waterway and the proposed LNG terminal. In addition, the Coast Guard may establish a safety and security zone under 33 CFR Part 165 for LNG vessels in transit and while docked. Only personnel or vessels authorized by the COTP would be permitted in the safety and security zone.

#### 4.13.5.3 Environmental Impacts Associated with Coast Guard Actions

The Coast Guard's issuance of an LOR is a federal action that requires compliance with NEPA, just as the FERC's authorization for construction and operation of an LNG facility requires compliance with NEPA. Alternatives regarding these actions are discussed in section 3.

Some of the potential environmental impacts resulting from LNG vessel activities and transit would not be unique to LNG carriers and may also be addressed by previous Coast Guard NEPA analyses for existing regulations. Per the Coast Guard NVIC 05-05, all required Coast Guard NEPA analysis and documentation must be complete prior to the issuance of any LOR.

Potential impacts on wildlife and aquatic resources are discussed in sections 4.6 and 4.7. The potential impacts that result from LNG vessels in transit would be similar to those resulting from other ships using the navigation channel. Potential impacts include those related to prop wash, invasive species, vessel strikes, and water withdrawal for ballast and cooling. No significant impacts on wildlife or aquatic resources are expected as a result of LNG marine traffic.

LNG ships and support vessels would emit criteria pollutants, VOCs, and HAPS during transit. We have identified the magnitude of these emissions in section 4.12.1. The proposed project would be located in an attainment area. Therefore, the General Conformity requirements do not apply.

The LNG vessel would be operating in federally approved channels en route to the terminal. We believe the use of these channels is consistent with the Mississippi CMP; however, consistency with this plan would be determined by the State of Mississippi. The coastal effects associated with the project, including coastal effects resulting from vessel transit, are addressed in section 4.8.5 to the extent this statute is applicable. As such, consistency with the CZMA is required as appropriate. We have recommended as a condition in section 4.8.5 that Gulf LNG submit documentation of concurrence from the MDMR that the project is consistent with the Mississippi CMP.

The potential impacts associated with a release of LNG are discussed generally in the preceding and following sections. The establishment of temporary safety and security zones by the Coast Guard has been considered as a potential effect on recreational use of the waterway (see section 4.8.3). However, we do not expect these zones to have a significant effect on environmental resources.

The transit corridor for the LNG carriers would traverse open water and estuarine habitats. Approximately 8.6 miles of the transit corridor are within confined waters between the barrier islands and the mainland, where shoreline could be affected by accidental spills. The aquatic and shoreline habitats support a variety of wildlife, which is described in sections 4.6 and 4.7. Figure 4.13.5-1 shows the potential extent of the hazard distance from an accidental spill, the locations of significant parks, refuges, and other public recreation areas along the transit corridor.

LNG is less dense than fresh or seawater, so it floats on the surface. Immediately upon contact with any warmer substance such as water or air, it begins to evaporate. As the LNG vaporizes, a vapor cloud may form that is initially heavier than air and may be dispersed by wind. An LNG vapor cloud cannot explode in the open atmosphere, but it could burn.

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Figure 4.13.5-1 Potential Sensitive Resources Along the Ship Route

Public access for the above information is available only through the Public Reference Room, or by e-mail at public.referenceroom@ferc.gov.

Since LNG is a cryogenic liquid, the greatest threat to aquatic life from an LNG spill would be thermal stress. Any aquatic life (including plankton, fish, birds, sea turtles, marine mammals, and any federally listed species) that came into direct contact with the LNG would probably experience a sudden cold shock and, depending in what context that contact occurred, the exposure could be lethal, especially to non-motile species. Most mobile underwater organisms would detect the temperature change and avoid the area. Wildlife occupying the water's surface near the release could intercept the vapor cloud and suffer asphyxiation. However, the duration of this exposure is short, as noted below. Impacts on shoreline habitats and associated wildlife could occur, primarily through the subsequent ignition of the LNG. The potential damage could involve the combustion of both vegetation and wildlife.

The accident scenarios evaluated in section 4.13.5.4 include release and ignition of natural gas formed by evaporation of spilled LNG. Natural gas combustion typically is not complete in spill scenarios. The products of incomplete combustion of natural gas include criteria pollutants, ozone precursors, toxic air contaminants and soot (carbon particulates). It should be noted that LNG fires typically do not last as long as liquid petroleum fires.

The duration of an ignited accidental LNG spill detailed in section 4.13.5.4 is approximately 48 minutes. For an ignited intentional LNG spill, the duration is approximately 11 minutes. The maximum increases in ambient pollutant concentrations due to the natural gas fire would occur downwind of the LNG spill. Ambient air pollutant concentrations in downwind areas could potentially exceed short-term NAAQS and State Ambient Air Quality Standards over the duration of the fire as well as soot deposition and diminished visibility due to soot transport. Given the distance to shore from a potential fire from most of the transit route along the Port of Pascagoula Channels, it is unlikely that sensitive receptors (i.e., schools, day care centers, hospitals, retirement homes, convalescence facilities, and residences) would be exposed to substantial pollutant concentrations for a significant period. Furthermore, the shoreline areas nearest the transit channels are generally vacant or industrial. If more populated areas were to be exposed to higher pollutant concentrations for the short duration of the fire, the effects would be short term.

The pool formed from an unignited accidental LNG spill would completely evaporate in approximately 94 minutes. For an ignited intentional LNG spill, the pool would completely evaporate in approximately 7 minutes. As natural gas is not a criteria pollutant, no air quality impacts would be expected from the evaporation of the LNG spill. However, methane, the primary component of LNG, is considered a greenhouse gas and may contribute to global warming (Coast Guard, 2005).

However, the history of LNG shipping has been free of major incidents, and none have resulted in significant quantities of LNG being released. No incidents have occurred at existing LNG terminals during the 50 years of operation that resulted in any significant quantities of cargoes being released. Historically, the events most likely to cause a significant release of LNG were ship casualties such as collisions, allisions, or groundings. Any event causing a release of LNG would have to occur with sufficient impact to breach the LNG ship's double hull and cargo tanks. During the 44,000 voyages that have been completed since the inception of LNG maritime transportation, there has not been a serious accident at sea or in a port that resulted in a spill due to rupturing of the cargo tanks. Based on the extensive operational experience of LNG shipping, the structural design of an LNG vessel, and the operational controls that may be imposed by the Coast Guard and local pilots, the likelihood of a cargo containment failure and subsequent LNG spill from a vessel casualty – collision, grounding, or allision – is highly unlikely. However, the possibility of an LNG spill from a ship over the duration of the proposed project must be considered.

Given that an LNG cargo spill is highly unlikely, no significant socioeconomic impact associated with an accidental LNG release along the transit route would be expected. As described below, the duration of an LNG pool fire would be of short duration (i.e., from 1 to 2.5 hours). If an LNG spill occurred along the transit route, ship traffic may be temporarily interrupted in the navigation channel;

however, traffic in the navigation channel would quickly resume normal operations and any economic impact on the maritime industry would be minimal.

If a pool fire occurred where the transit route is closer to shore, businesses within 2,200 feet of the center of a spill could be subject to a long-term loss of use. Vegetation and wooden structures subjected to greater than 3,000 Btu/ft$^2$-hr may ignite.[5] However, because the hazard area surrounding an LNG cargo vessel is transient (moving with the vessel along its route) it is not possible to accurately quantify the economic impact of an incident. Section 4.13.5.4 discusses the effects of an LNG spill in greater detail.

In accordance with section 3A(e) of the NGA, added by section 311 of the EPAct of 2005, we recommend in section 4.13.5 that Gulf LNG develop an Emergency Response Plan in consultation with the Coast Guard and state and local agencies that includes a Cost-Sharing Plan before any final approval to begin construction. Therefore, no long-term impacts related to emergency evacuation of communities would be expected.

As discussed in section 4.13.5, "Deliberate Attack on an LNG Vessel," the December 2004 Sandia Report included an analysis of potential LNG cargo tank breaches due to accidental causes. The report found that accidental groundings, collisions with small vessels, and low speed collisions with large vessels could cause minor ship damage but would not result in a cargo spill. This is due to the protection provided by the double hull structure, the insulation layer and the primary cargo tank of an LNG vessel. We do not believe that these types of accidents would be environmentally significant.

High speed collisions with large vessels striking at 90 degrees were found to potentially cause cargo tank breach areas of 0.5 to 1.5 m$^2$. For the resulting LNG spill and pool fire on water, the Sandia Report determined that the most significant impact on public safety and property would exist within about 800 feet, with minimal impact beyond 2,400 feet. Depending on the actual size of the cargo tank breach, the duration of the spill and ensuing pool fire could range from approximately 1 to 2.5 hours. Using the methodology in the ABSG study, FERC staff determined that the site-specific distance to the 1,600 Btu/ft2-hr transient hazard area for an accidental cargo tank breach in the Pascagoula Bar, Horn Island Pass, Lower Pascagoula, and Bayou Casotte Channels would be approximately 2,790 feet.

However, if the Coast Guard issues an LOR finding the waterway suitable for LNG marine traffic with the conditions referenced in section 2.0, it must also be recognized that the operational controls that would be imposed by the Coast Guard and local pilots, such as a moving LNG vessel safety zone, would be specifically designed to prevent the collision scenarios that could result in an LNG cargo tank breach. As a result, the likelihood of an LNG spill from accidental causes is not considered to be significant.

In the unlikely event of an LNG spill, the physical properties of LNG would limit any potential impacts. If spilled into water, the cryogenic liquid would vaporize rapidly upon contact with the warm air and water over a period of approximately 1 to 2.5 hours. Being less dense than water, LNG would float on the surface prior to vaporizing. Because LNG is not soluble in water and the LNG would completely vaporize shortly after being spilled, there would be no liquid left that could mix with and/or contaminate the water.

In the event of a collision or allision of sufficient magnitude to rupture an LNG cargo tank, it is likely that sparks or flames would ignite the flammable vapors at the spill site. In the unlikely event that

[5] At 3,000 Btu/ft2-hr, an exposed person would experience burns within 10 seconds; however, a wooden structure would not be expected to burn and affords protection to sheltered persons.

ignition did not occur, an LNG spill would rapidly vaporize on water and form a potentially flammable cloud. If the flammable vapor cloud encountered an ignition source, the cloud would burn back to the spill site, rather than outward towards shoreline habitats.

Given these considerations, impacts on shoreline habitats as a result of an accidental LNG spill are unlikely to occur. A spill would be unlikely to result in significant impacts on shoreline habitats and wildlife that occur along the transit route. Hazard distances for intentional breaches are discussed in section 4.13.5.4. Although an intentional breach scenario may result in greater hazard distances, such scenarios are associated with the desire to inflict damage to major infrastructure, population, and commercial centers, rather than to environmentally sensitive areas along the vessel route. Also, given the navigation controls and safety and security procedures in place to specifically prevent such accidents and intentional spill scenarios, the indirect impact associated with Coast Guard actions are not reasonably foreseeable events.

As discussed in section 4.13.5.2, if the Coast Guard issues an LOR finding the waterway suitable for LNG marine traffic with the conditions referenced in section 2.0, the Coast Guard may establish a moving safety zone, moored vessel security zone, and/or a regulated navigation area around the transiting LNG vessels and provide some level of escort as part of finalizing the *LNG Vessel Traffic Management Plan*. The LNG vessels would also undergo safety and security inspections to ensure compliance with United States and international standards. In addition, the LNG facility would submit a facility security plan for review and approval by the Coast Guard. However, due to uncertainty in the scope, frequency, prevailing maritime security levels, and the number of resources that would be dedicated on a recurring or episodic basis, the Coast Guard would ensure the appropriate NEPA environmental documentation for such actions is complete prior to commencement of these activities rather than in this EIS.

#### 4.13.5.4 LNG Ship Safety

Since 1959, LNG has been transported by ship without a major release of cargo or a major accident involving an LNG ship. Starting in 1971, LNG began arriving at the Distrigas facility in Everett, Massachusetts. To date, more than 680 cargoes, with volumes ranging from 60,000 to 125,000 $m^3$, have been delivered into the Port of Boston without incident. During 2005, an estimated total of 631 billion cubic feet (241 cargoes) of LNG was imported into the United States. For 35 years, LNG shipping operations have been safely conducted in the United States. The world's LNG ship fleet currently exceeds 173 carriers.

Over the last 45 years, LNG ships have made over 44,000 voyages. Currently, all of the ships in the LNG fleet operate under a foreign flag with foreign crews. A foreign flag ship must have a Certificate of Compliance inspection by the Coast Guard to ensure compliance with international safety standards.

**History**

During the 44,000 voyages that have been completed since the inception of LNG maritime transportation, there has not been a serious accident at sea or in a port which resulted in a spill due to rupturing of the cargo tanks. However, insurance records, industry sources, and public websites identify a number of incidents involving LNG vessels, including minor collisions with other vessels of all sizes, groundings, minor LNG releases during cargo unloading operations, and mechanical/equipment failures typical of large vessels. Some of the more significant LNG vessel incidents are described below:

- **Pollenger** had an LNG spill onto the steel cover of cargo tank number one during unloading at Everett, Massachusetts in April 1979. The spill caused cracking of the steel plate.

- **El Paso Paul Kayser** grounded on a rock in June 1979 in the Straits of Gibraltar during a loaded voyage from Algeria to the United States. Extensive bottom damage to the ballast tanks resulted; however, the cargo tanks were not damaged, and no cargo was released. The complete cargo of LNG was subsequently transferred to another LNG ship and delivered to its United States destination.

- **LNG Taurus** grounded in December 1980 near the entrance to Taboata Harbor, Japan. The grounding resulted in extensive bottom damage, but the cargo tanks were not affected. The ship was refloated and the cargo unloaded.

- **Isabella** had LNG spill onto its deck due to a cargo tank overflow in June 1985, causing severe cracking of the steelwork. The spill had been attributed to a cargo valve failure during discharging of cargo.

- **Tellier** was blown from its docking berth at Skikda, Algeria in February 1989 during severe winds, causing damage to the loading arms and the ship and shore piping. The cargo loading had been secured just before the wind struck, but the loading arms had not been drained. Consequently, the LNG remaining in the loading arms spilled onto the deck causing fracture of some plating.

- **Mostefa Ben Boulaid** had LNG spill onto its deck during loading operations in Algeria in 2002. The spill, which is believed to have been caused by overflow rather than a mechanical failure, caused significant brittle fracturing of the steelwork. The ship was required to discharge its cargo, after which it proceeded to dock for repair.

- **Khannur** had a cargo tank overfill into the ship's vapor handling system on September 10, 2001 during unloading at Everett, Massachusetts. Approximately 100 gallons of LNG were vented and sprayed onto the protective decking over the cargo tank dome, resulting in several cracks. After re-inspection by the Coast Guard, the Khannur was allowed to discharge its LNG cargo.

- **Norman Lady** was struck by the USS Oklahoma City nuclear submarine while rising to periscope depth near the Strait of Gibraltar in November 2002. The 87,000 $m^3$ LNG tanker, which had just unloaded its cargo at Barcelona, Spain, sustained minor damage to the outer layer of its double hull but no damage to its cargo tanks.

- **Tenaga Lima** grounded on rocks while proceeding to open sea east of Mopko, South Korea due to strong currents in November 2004. The shell plating was torn open and fractured over an approximate area of 20 feet by 80 feet, and internal breaches allowed water to enter the insulation space between the primary and secondary membranes. The ship was refloated, repaired, and returned to service.

- **Golar Freeze** moved away from its docking berth during unloading on March 14, 2006 in Savannah, Georgia. The powered emergency release couplings on the unloading arms activated as designed and transfer operations were shut down.

**Vessel Construction**

In 1980, at the initial peak of LNG import activity in the United States, the Coast Guard published the report *Liquefied Natural Gas and Liquefied Petroleum Gas – Views and Practices – Policy and Safety*. The report summarized the Coast Guard's extensive research into the safety hazards of LNG

and its view that "...the nature of both LNG and LPG presents an acceptable risk for transportation in maritime commerce." This is due to the fact that LNG ships are well constructed, robust vessels designed to withstand low-energy type incidents that are prevalent in harbors and during docking operations. Moreover, safety measures, both equipment and training, are planned and designed into these LNG ships to prevent or control all types of potential incidents.

The insulation of cargo tanks on LNG carriers is a complex assembly of many layers. The relief valve capacity of cargo tanks is designed to compensate for over-pressure caused by fire. The potential that impingement by a cryogenic liquid could cause brittle fracture of the ship's hull was known to the Coast Guard in the mid-1970s when the United States regulations for LNG carriers in 49 CFR Part 154 were being developed. LNG carriers used in waters of the United States must also be constructed in accordance with the IMO's *Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk*. This standard requires that the vessel inner hull adjacent to the cargo tanks be protected against contact from liquid cargo through a combination of proper material selection, adequate insulation, and use of heating systems.

As required by the IMO conventions and design standards, hold spaces and insulation areas on an LNG ship are equipped with gas detection and low temperature alarms. These devices monitor for leaks of LNG into the insulation between primary and secondary LNG cargo tank barriers. In addition, hazard detection systems are also provided to monitor the hull structure adjacent to the cargo tank, compressor rooms, motor rooms, cargo control rooms, enclosed spaces in the cargo area, specific ventilation hoods and gas ducts, and air locks.

LNG carriers are equipped with a firewater system with the ability to supply at least two jets of water to any part of the deck in the cargo area and parts of the cargo containment and tank covers above-deck. A water spray system is also available for cooling, fire prevention, and crew protection in specific areas. In addition, certain areas of LNG carriers are fitted with dry chemical powder-type extinguishing systems and $CO_2$ smothering systems for fighting fires.

Unlike many conventional crude oil tankers, all LNG ships used to deliver LNG to this proposed project would have double-hull construction, with the inner and outer hulls separated by about 10 feet. Furthermore, the cargo tanks are normally separated from the inner hull by a layer of insulation approximately 1-foot thick. As a result, many grounding incidents severe enough to cause a cargo spill on a single-bottom oil tanker would be unable to penetrate both inner and outer hulls of an LNG ship. An earlier Federal Power Commission (FPC, predecessor to the FERC) study estimated that the double-bottom of an LNG ship would be sufficient to prevent cargo tank penetration in about 85 percent of the cases that penetrated a single-bottom oil tanker.

The probability of an LNG ship sustaining cargo tank damage in a collision would depend on several factors: the displacement and construction of both the struck and striking vessels, the velocity of the striking vessel and its angle of impact with the struck vessel, and the location of the point of impact. The previous FPC study estimated the additional protection afforded by the double-hull would be effective in low energy collisions, and overall it would prevent cargo tank penetration in about 25 percent of the cases that penetrated a single-hull oil tanker.

In 1995, to assist the Coast Guard in San Juan, Puerto Rico, EcoEléctrica L.P. prepared an analysis of the damage that could result from an oil tanker striking an LNG ship at berth (FERC, 1996). The analysis assumed a 125,000 $m^3$ LNG ship and an 82,000 dead weight ton tanker carrying number 6 fuel oil without tug assistance. The analysis determined the minimum striking speed to penetrate the cargo tanks of an LNG ship for a range of potential collision angles. The resulting minimum striking speeds are presented in table 4.13.5-2 for the two principal cargo systems.

| TABLE 4.13.5-2<br>**Minimum Striking Speed to Penetrate LNG Cargo Tanks** | | |
|---|---|---|
| | Minimum Striking Speed (knots) | |
| Angle of Impact | Spherical Tanks | Membrane Tanks |
| Greater than 60 Degrees | 4.5 | 3 |
| 45 Degrees | 6.3 | 4 |
| 30 Degrees | 9 | 6 |
| 15 Degrees | 18 | 12 |

For membrane tanks, the critical beam-on striking speed is 3.0 knots, and for spherical tanks, the critical beam-on speed is 4.5 knots. For both containment types, lower angles of impact result in much greater minimum striking speeds to penetrate LNG cargo tanks. In the July/August 2002 issue of the *LNG Journal*, the SIGTTO General Manager provides a table that shows the critical speed necessary for a 20,000-ton vessel to puncture the outer hull of an LNG carrier is 7.3 knots. For a 93,000-ton ship, the impact speed is 3.2 knots. In neither case does such an impact result in damage to the LNG cargo containment system or the release of LNG.

In December 2004, the Sandia Report included an LNG cargo tank breach analysis using modern finite element modeling and explosive shock physics modeling to estimate a range of breach sizes for credible accidental and intentional LNG spill events. The analysis of accidental events found that groundings, collisions with small vessels and low speed (less than 7 knots) collisions with large vessels striking at 90 degrees could cause minor ship damage but would not result in a cargo spill. This is due to the protection provided by the double hull structure, the insulation layer and the primary cargo tank of an LNG vessel. High speed (12 knots) collisions with large vessels striking at 90 degrees were found to potentially cause cargo tank breach areas of 0.5 to 1.5 $m^2$.

**Hazards**

In the event of a collision or allision of sufficient magnitude to rupture an LNG cargo tank, it is likely that sparks or flames would ignite the flammable vapors at the spill site. In a grounding of sufficient magnitude to rupture an LNG cargo tank, the damage would occur under water and the potential for ignition would be less than for collisions or allisions. In this case, an LNG spill would rapidly vaporize from contact with water and form a potentially flammable cloud. If not ignited, the flammable vapor cloud would drift downwind until the effects of dispersion would dilute the vapors below the LFL for methane. The maximum range of potentially flammable vapors (i.e., the distance to the LFL) is a function of the volume of LNG spilled, the rate of the spill, and the prevailing meteorological conditions. If the flammable vapor cloud encountered an ignition source, the cloud would burn back to the spill site.

The final EIS for the Calcasieu LNG Project (Lake Charles, LA) (September 1976) analyzed the maximum range of a flammable vapor cloud and hazardous radiation levels from an instantaneous one-tank spill. As was consistent with risk analyses at that time and for nearly 25 years thereafter, the instantaneous spillage of one cargo tank was considered to be the "worst case" scenario. Physical constraints on maximum vessel speeds and maximum depths of penetration required to rupture one LNG cargo tank render the possibility of an instantaneous release of more than one cargo tank to be implausible. This is not to imply that the loss of multiple cargo tanks could never occur, but that the extent of the hazard would not exceed that of the instantaneous spillage of one tank.

For an instantaneous one-tank spill with ignition, the final EIS for the Calcasieu LNG Project estimated that a hazardous thermal radiation level of 5,300 Btu/$ft^2$-hr would extend 3,595 feet from the

center of the spill. For an instantaneous one-tank spill without ignition, the Final EIS for the Yukon Pacific LNG Project (FERC, March 1995) estimated that potentially flammable vapors could travel up to 3.3 miles with a 10-mph wind and typical atmospheric stability.

In October 2001, the use of a one-tank instantaneous release as the "worst case" scenario was re-examined by Quest Consultants, Inc (Quest) as part of an effort by the DOE to determine the hazards associated with reopening the Distrigas LNG import terminal following the terrorist attacks of September 11, 2001. It was determined that time-release spills through 1-meter and 5-meter diameter holes would more accurately simulate credible "worst case" damage scenarios. Maximum flammable vapor cloud and radiation hazards were calculated for the two spill scenarios. For a spill on water with ignition, the maximum distance to a radiant flux level of 1,500 Btu/ft$^2$-hr was estimated to be 1,770 feet. For a spill on water without ignition, a flammable vapor cloud of 2.5 miles was estimated. In November 2003, in response to comments concerning its October 2001 study, Quest clarified that its study only applied to LNG spills resulting from a collision with a large ship in Boston's Outer Harbor where waves would restrict the spreading of LNG on water.

Since the 2001 Quest study, there has been an emergence of studies by various parties to define the "worst case" scenario that would result from a deliberate, terrorist attack on an LNG vessel and the subsequent release of cargo. Distances have been estimated to range from 1,770 to 4,200 feet for a thermal radiation level of 1,500 Btu/ft$^2$-hr. Part of the reason for the apparent discrepancies is the lack of large-scale historical incidents, and the need to extrapolate small-scale field test data to a worst case event. This inevitably leads to differing conservative assumptions among the various parties. For example, some models calculate a time-release cargo discharge through 1-meter or 5-meter diameter holes, while others assume that the cargo tank empties instantaneously.

As a result, the FERC commissioned a study by ABSG to search and review the literature on experimental LNG spills and on consequence methodologies that are applicable to modeling incidents of LNG spills on water. Further, the goal of the study was to identify appropriate methods for estimating flammable vapor and thermal radiation hazard distances for potential LNG vessel cargo releases during transit and while at berth. The resulting study, *Consequence Assessment Methods for Incidents Involving Releases from Liquefied Natural Gas Carriers*, was released for public comment on May 14, 2004. On June 18, 2004, staff's responses to comments on the consequence assessment methods were issued. As discussed in greater detail in staff's responses, various components of the consequence assessment methodologies were revised based on comments received. In addition, the model was updated to include a lower limit on the characteristic wind speed. The revised study provides the methodology for calculating: 1) the rate of release of LNG from a cargo tank penetration for various sized holes; 2) the spreading of an unconfined LNG pool on water for both continuous spills and rapid (nearly instantaneous) releases; 3) the rate of vapor generation from an unconfined spill on water; 4) thermal radiation distances for LNG pool fires on water; and 5) and flammable vapor dispersion distances.

A detailed evaluation of the consequences of a terrorist attack on a modern membrane LNG tanker was prepared by Lloyds Register North America for the Weaver's Cove LNG Project and filed under CEII. The study evaluated the consequences of attacks on an LNG tanker by missiles and explosives. Finite element analysis was used to evaluate the effect of various sized charges on both the outer and inner hulls. A 1-meter diameter hole of the inner hull at the waterline was found to be the average most probable "worst case" scenario for hazard consequence assessments. This finding is consistent with the attack on the double-hull oil tanker Limberg which caused greater than a 5-meter diameter hole on the outer hull, but only minor damage to the inner hull. A failure modes and effects analysis was used to understand internal LNG release characteristics, and a residual strength analysis was used to investigate damage scenarios for a loaded LNG tanker.

The December 2004 Sandia Report included an LNG cargo tank breach analysis using modern finite element modeling and explosive shock physics modeling to estimate a range of breach sizes for credible accidental and intentional LNG spill events. The analysis of accidental events found that groundings and low speed collisions could result in minor ship damage but not a cargo spill; while high speed collisions could cause a 0.5 to 1.5 $m^2$ cargo tank breach area. For intentional scenarios, the size of the cargo tank hole depends on the location of the ship and source of threat. Intentional breach areas were estimated to range from 2 to 12 $m^2$. In most cases, an intentional breaching scenario would not result in a nominal hole of more than 5 to 7 $m^2$, which is a more appropriate range to use in calculating potential hazards from spills.

The Sandia Report also included guidance on risk management for intentional spills, based on the findings that the most significant impacts to public safety and property exist within approximately 500 meters (1,640 feet) of a spill due to thermal hazards from a fire, with lower public health and safety impacts beyond 1,600 meters (5,250 feet). Large, unignited LNG vapor releases were found to be unlikely, but could extend to 2,500 meters (8,200 feet) for a nominal intentional spill.

Cascading damage due to brittle fracture from exposure to cryogenic liquid or fire-induced damage to foam insulation was evaluated and, while possible under certain conditions, is not likely to involve more than two or three cargo tanks. Cascading events are not expected to increase the overall fire hazard by more than 20 to 30 percent (1,920 to 2,080 meters or 6,300 to 6,825 feet), but would increase the expected fire duration. RPTs are possible for large spills but the effects would be localized near the spill source and should not cause extensive structural damage.

The methodology described in the ABSG study and revised in staff's responses to comments was used to calculate the thermal radiation and flammable vapor dispersion distances for several holes ranging in diameter from 1 meter to 3.9 meters. Based on the penetration of the largest cargo tank of a typical 140,000 $m^3$ LNG ship, a potential spill of 23,000 $m^3$ is estimated for the volume of LNG above the waterline. The estimated pool spread results and thermal radiation hazard distances are identified in table 4.13.5-3 below. Thermal radiation calculations are based on an ambient temperature of 50 °F, a relative humidity of 50 percent, and a 20-mile per hour wind speed.

TABLE 4.13.5-3

**LNG Spills on Water**

| **LNG Release and Spread** | | | | | |
|---|---|---|---|---|---|
| Hole Diameter | 1.0 m | 1.4 m | 2.5 m | 3.0 m | 3.9 m |
| Hole Area | 0.8 $m^2$ | 1.5 $m^2$ | 5 $m^2$ | 7 $m^2$ | 12 $m^2$ |
| Spill Time | 94.0 min | 48.0 min | 15.0 min | 10.4 min | 6.2 min |
| **Pool Fire Calculations** | | | | | |
| Maximum Pool Radius | 341 ft | 476 ft | 817 ft | 938 ft | 1,102 ft |
| Fire Duration | 94.1 min | 48.1 min | 15.2 min | 10.7 min | 6.5 min |
| Distance to: | | | | | |
| 1,600 Btu/ft2-hr | 2,164 ft | 2,790 ft | 4,182 ft | 4,652 ft | 5,250 ft |
| 3,000 Btu/ft2-hr | 1,690 ft | 2,169 ft | 3,232 ft | 3,591 ft | 4,047 ft |
| 10,000 Btu/ft2-hr | 1,031 ft | 1,312 ft | 1,934 ft | 2,143 ft | 2,409 ft |

However, Gulf LNG proposes the potential use of up to a 250,000 $m^3$ LNG ship. The limited information available regarding the design of future 250,000 $m^3$ LNG ships suggests that the draft of the larger ships would remain the same due to the limited draft of the channel, while the length and width of the larger ships would increase. This would in effect increase the length and width of the cargo tanks, but not change the height, therefore no change the hydrostatic head. Preliminary information shows that the

larger class ships would have five cargo tanks instead of four as on the 140,000 $m^3$ ships. For a 250,000 $m^3$ LNG ship compared to the results for a 140,000 $m^3$ LNG ship, the estimated distance to the 1,600 Btu/$ft^2$-hr zone would be less than 5 percent farther and the fire duration would be extended by about 39 percent.

Although Gulf LNG would design the terminal and unloading berth for LNG ships with capacities up to 250,000 $m^3$, detailed dimensions of these future ships and the associated cargo tanks is unavailable. FERC staff was required to make assumptions in order to analyze the LNG spills on water from these larger ships. Therefore, in order to allow the Coast Guard to determine the continued suitability of the waterway for LNG marine traffic, **we recommend that:**

- **<u>Prior to accepting</u> ships greater than 140,000 $m^3$ in capacity, Gulf LNG should provide the necessary information to demonstrate that the transient hazard areas identified in the final EIS are applicable. Gulf LNG should file this information with the Secretary for review and written approval of the Director of OEP. This information should also be provided to the Coast Guard.**

Flammable vapor dispersion calculations were based on an ambient temperature of 70 ºF, 50 percent relative humidity, a 4.5-mph wind speed and atmospheric stability Class F. Based on a 1-meter diameter hole, an unignited release would result in an estimated pool radius of 421 feet. The unignited vapor cloud would extend to 9,776 feet to the LFL and 14,377 feet to one-half the LFL. It is important to identify certain key assumptions of conditions that must exist in order to achieve the maximum vapor cloud distances. First it would be necessary for an event to create a 1-meter diameter hole by penetrating the outer hull, the inner hull, and cargo containment <u>without ignition</u>. Far more credible is that the event creating a 1-meter diameter hole would also result in a number of ignition sources which would lead to an LNG pool fire and subsequent thermal radiation hazards. It is also unlikely that a flammable vapor cloud could achieve its maximum distance over land surfaces without encountering an ignition source, and subsequently burning back to the source. Flammable vapor dispersion for larger holes was not performed since, realistically, the cloud would not even extend to the maximum distance for a 1-meter diameter hole before encountering an ignition source.

The entire transit from the Gulf of Mexico through the Pascagoula Bar, Horn Island Pass, Lower Pascagoula, and Bayou Casotte Channels to the LNG berth, has no development or communities adjacent to the channel or within the 4,652 feet transient hazard area. Assuming an LNG vessel would transit through the channel at a speed between 3 and 10 knots, areas adjacent to the channel would be exposed to a potential transient hazard for less than 20 minutes. In addition, a temporary hazard would exist around the slip during part of the 24-hour period while the LNG vessel is maneuvering into the slip and at the dock unloading cargo.

The operational restrictions that would be imposed by the Pascagoula Pilots on LNG vessel movements through this area, as well as requirements that the Coast Guard would impose in its *LNG Vessel Transit Management Plan*, would minimize the possibility of a hazardous event occurring along the vessel transit.

By focusing on the "worst case" intentional breach scenarios for LNG transportation, there is a tendency to dismiss the potential hazards for other fuels and products commonly transported on our waterways. Some of the previously identified studies that calculate long hazard distances for LNG cargo fires also estimate similarly long distances for gasoline, propane, and jet fuel cargo fires. Also, it should not be assumed that the hazard distances identified are the assured outcome of an LNG vessel accident or attack, given the conservatisms in the models and the level of damage required to yield such large scale releases. Further, these "worst case" intentional breach scenarios should not be misconstrued as defining

an exclusionary zone. Rather the average most probable "worst case" scenarios provide guidance in developing the operating restrictions for LNG vessel movements in the Port of Pascagoula Channels, as well as in establishing potential impact areas for emergency response and evacuation planning.

#### 4.13.5.5 Conclusions on Marine Traffic Safety

The operational safety of LNG ships is under the jurisdiction of the Coast Guard. LNG ships have safely transited another Gulf Coast Waterway, the Calcasieu Ship Channel in Louisiana, for the past 20 years and worldwide for 50 years. If the Coast Guard issues an LOR determining suitability of the waterway for LNG marine traffic with conditions, operational restrictions that may be imposed by the Coast Guard and the Pascagoula Pilots would minimize the potential for a hazardous event occurring in the Port of Pascagoula area and affecting the safety of the nearby public.

The additional LNG marine traffic should have only a minimal impact on other vessel traffic in the Port of Pascagoula channels. With the mitigation measures discussed above, the operation of LNG ships should have similar impact as other large vessels, and should cause no more disruption than the vessel traffic increases planned by other channel users.

### 4.13.6 Terrorism and Security Issues

The security requirements for the onshore component of the proposed project are governed by 49 CFR Part 193, Subpart J - Security. This subpart includes requirements for conducting security inspections and patrols, liaison with local law enforcement officials, design and construction of protective enclosures, lighting, monitoring, alternative power sources, and warning signs. Requirements for maintaining safety of the marine terminal are in the Coast Guard's regulations in 33 CFR Part 127. Requirements for maintaining security of the marine terminal are in 33 CFR Part 105.

In the aftermath of the terrorist attacks that occurred on September 11, 2001, terrorism has become a very real issue for the facilities under the Commission's jurisdiction. The FERC, like other federal agencies, is faced with a dilemma in how much information can be offered to the public while still providing a significant level of protection to the facility. Consequently, the FERC has removed energy facility design plans and location information from its website to ensure that sensitive information filed under CEII is not readily available (RM02-4-000 and PL02-1-000 issued February 20, 2003).

Since September 11, 2001, the FERC has been involved with other federal agencies in developing a coordinated approach to protecting the energy facilities of the United States. The FERC continues to coordinate with these agencies, specifically with the Coast Guard, to address this issue. The Coast Guard now requires arriving ships to provide them with a 96-hour advance notice of arrival that includes key information about the vessel and its crew, which allows the Coast Guard to conduct a terrorism risk assessment and put in place appropriate mitigation before the ship reaches the ship channel. In addition, interstate natural gas companies are actively involved with several industry groups to chart how best to address security measures in the current environment. A Security Task Force has been created and is addressing ways to improve pipeline security practices, strengthen communications within the industry and the interface with government, and extend public outreach efforts.

In September 2002, the DOT's OPS issued non-public guidelines to LNG operators that direct them to develop new security procedures for onshore facilities. Operators were required to prepare a security plan within 6 months that responds to the five threat levels defined by the Office of Homeland Security. The OPS conducts subsequent on-site reviews of the security procedures.

On October 22, 2003, the Coast Guard issued a series of six final rules, which promulgated the maritime security requirements of the Marine Transportation Security Act of 2002: Implementation of National Maritime Security Initiatives; Area Maritime Security; Vessel Security; Facility Security; Outer Continental Shelf Facility Security; and the Automatic Identification System. The entire series of rulemakings establishes a new subchapter H in 33 CFR. In support of the rulemakings, the Coast Guard applied a risk-based decision-making process to comprehensively evaluate the relative risks of various target and attack mode combinations and scenarios for those vessel types and port facilities that pose a risk of a security incident. This approach provides a more realistic estimation of risk than a simple "worst-case outcome" assessment. Risk management principles acknowledge that while risk generally cannot be eliminated, it can be reduced by adjusting operations to lower consequences, threats, or vulnerability, recognizing that it is easier to reduce vulnerabilities by adding security measures.

On December 29, 2003, all terminal owners or operators subject to 33 CFR Part 105 were required to submit a *Facility Security Assessment and Facility Security Plan* to the Coast Guard COTP for review and approval. The Facility Security Plans were required to be implemented no later than July 1, 2004, or for facilities constructed after July 1, 2004, 60 days prior to operations. Some of the principal owner or operator responsibilities include:

- designating a FSO with a general knowledge of current security threats and patterns, risk assessment methodology, and the responsibility for implementing the Facility Security Plan and Assessment and performing an annual audit for the life of the project;

- conducting a Facility Security Assessment to identify site vulnerabilities, possible security threats and consequences of an attack, and facility protective measures;

- developing a Facility Security Plan based on the Facility Security Assessment, with procedures for responding to transportation security incidents; notification and coordination with local, state, and federal authorities; prevention of unauthorized access; measures and equipment to prevent or deter dangerous substances and devices; training; and evacuation;

- implementing scalable security measures to provide increasing levels of security at increasing MARSEC levels for facility access control, restricted areas, cargo handling, vessel stores and bunkers, and monitoring;

- conducting security exercises at least once each calendar year and drills at least every 3 months; and

- reporting of all breaches of security and security incidents.

Increased security awareness has occurred throughout the industry and the nation. President Bush established the Office of Homeland Security with the mission of coordinating the efforts of all executive departments and agencies to detect, prepare for, prevent, protect against, respond to, and recover from terrorist attacks within the United States. The Commission, in cooperation with other federal agencies and industry trade groups, has joined in the efforts to protect the energy infrastructure, including the more than 300,000 miles of interstate natural gas transmission pipeline and associated LNG facilities.

Safety and security are important considerations in any Commission action. The attacks of September 11, 2001 have changed the way pipeline operators as well as regulators must consider terrorism, both in approving new projects and in operating existing facilities. However, the likelihood of future acts of terrorism or sabotage occurring at the proposed LNG import terminal, or at any of the

myriad of natural gas pipeline or energy facilities throughout the United States is unpredictable given the disparate motives and abilities of terrorist groups. The continuing need to construct facilities to support the future natural gas pipeline infrastructure is not diminished from the threat of any such unpredictable acts.

### 4.13.7 Pipeline Facilities

The transportation of natural gas by pipeline involves some risk to the public in the event of an accident and subsequent release of gas. The greatest hazard is a fire or explosion following a major pipeline rupture.

Methane, the primary component of natural gas, is colorless, odorless, and tasteless. It is not toxic, but is classified as a simple asphyxiate, possessing a slight inhalation hazard. If breathed in high concentration, oxygen deficiency can result in serious injury or death.

Methane has an ignition temperature of 1,000 °F and is flammable at concentrations between 5.0 percent and 15.0 percent in air. Unconfined mixtures of methane in air are not explosive. However, a flammable concentration within an enclosed space in the presence of an ignition source can explode. It is buoyant at atmospheric temperatures and disperses rapidly in air.

#### 4.13.7.1 Safety Standards

The DOT is mandated to provide pipeline safety under Title 49, USC Chapter 601. The PHMSA, OPS, administers the national regulatory program to ensure the safe transportation of natural gas and other hazardous materials by pipeline. It develops safety regulations and other approaches to risk management that ensure safety in the design, construction, testing, operation, maintenance, and emergency response of pipeline facilities. Many of the regulations are written as performance standards which set the level of safety to be attained and allow the pipeline operator to use various technologies to achieve safety. The PHMSA ensures that people and the environment are protected from the risk of pipeline incidents. This work is shared with state agency partners and others at the federal, state, and local level. Section 5(a) of the Natural Gas Pipeline Safety Act provides for a state agency to assume all aspects of the safety program for intrastate facilities by adopting and enforcing the federal standards, while section 5(b) permits a state agency that does not qualify under section 5(a) to perform certain inspection and monitoring functions. A state may also act as DOT's agent to inspect interstate facilities within its boundaries; however, the DOT is responsible for enforcement action. The majority of the states have either 5(a) certifications or 5(b) agreements, while nine states act as interstate agents.

The DOT pipeline standards are published in Parts 190-199 of 49 CFR. Part 192 of 49 CFR specifically addresses natural gas pipeline safety issues.

Under a Memorandum of Understanding on Natural Gas Transportation Facilities (Memorandum) dated January 15, 1993 between the DOT and the FERC, the DOT has the exclusive authority to promulgate federal safety standards used in the transportation of natural gas. Section 157.14(a)(9)(vi) of the FERC's regulations require that an applicant certify that it will design, install, inspect, test, construct, operate, replace, and maintain the facility for which a Certificate is requested in accordance with federal safety standards and plans for maintenance and inspection, or shall certify that it has been granted a waiver of the requirements of the safety standards by the DOT in accordance with section 3(e) of the Natural Gas Pipeline Safety Act. The FERC accepts this certification and does not impose additional safety standards other than the DOT standards. If the Commission becomes aware of an existing or potential safety problem, there is a provision in the Memorandum to promptly alert DOT. The

Memorandum also provides for referring complaints and inquiries made by state and local governments and the general public involving safety matters related to pipeline under the Commission's jurisdiction.

The FERC also participates as a member of the DOT's Technical Pipeline Safety Standards Committee which determines if proposed safety regulations are reasonable, feasible, and practicable.

The pipeline and aboveground facilities associated with the LNG Clean Energy Project must be designed, constructed, operated, and maintained in accordance with the DOT Minimum Federal Safety Standards in 49 CFR Part 192. The regulations are intended to ensure adequate protection for the public and to prevent natural gas facility accidents and failures. Part 192 specifies material selection and qualification, minimum design requirements, and protection from internal, external, and atmospheric corrosion.

Part 192 also defines area classifications, based on population density in the vicinity of the pipeline, and specifies more rigorous safety requirements for populated areas. The class location unit is an area that extends 220 yards on either side of the centerline of any continuous 1 mile length of pipeline. The four area classifications are defined as follows:

- Class 1 – Location with 10 or fewer buildings intended for human occupancy.
- Class 2 – Location with more than 10 but less than 46 buildings intended for human occupancy.
- Class 3 – Location with 46 or more buildings intended for human occupancy or where the pipeline lies within 100 yards of any building, or small well-defined outside area occupied by 20 or more people on at least 5 days a week for 10 weeks in any 12-month period.
- Class 4 – Location where buildings with four or more stories aboveground are prevalent.

Class locations representing more populated areas require higher safety factors in pipeline design, testing, and operation. Pipelines constructed on land in Class 1 locations must be installed with a minimum depth of cover of 30 inches in normal soil and 18 inches in consolidated rock. Class 2, 3, and 4 locations, as well as drainage ditches of public roads and railroad crossings, require a minimum cover of 36 inches in normal soil and 24 inches in consolidated rock.

Class locations also specify the maximum distance to a sectionalizing block valve (e.g., 10.0 miles in Class 1, 7.5 miles in Class 2, 4.0 miles in Class 3, and 2.5 miles in Class 4). Pipe wall thickness and pipeline design pressures, hydrostatic test pressures, maximum allowable operating pressure, inspection and testing of welds, and frequency of pipeline patrols and leak surveys must also conform to higher standards in more populated areas. Approximately 2.9 miles of the pipeline route would be in Class 1 areas and the remaining 2.1 miles would be in Class 3 areas. No portions of the pipeline route would be in Class 4 areas.

If a subsequent increase in population density adjacent to the right-of-way indicates a change in class location for the pipeline, Gulf LNG would be required to reduce the maximum allowable operating pressure or replace the segment with pipe of sufficient grade and wall thickness, if required, to comply with the DOT code of regulations for the new class location.

In 2002, Congress passed an act to strengthen the Nation's pipeline safety laws. The Pipeline Safety Improvement Act of 2002 (HR 3609) was passed by Congress on November 15, 2002, and signed into law by the President in December, 2002. No later than December 17, 2004, gas transmission operators must develop and follow a written integrity management program that contains all the elements

described in Part 192.911 and addresses the risks on each covered transmission pipeline segment. Specifically, the law establishes an integrity management program which applies to all HCAs. The DOT (68 Federal Register 69778, 69 Federal Register 18228, and 69 Federal Register 29903) defines HCAs as they relate to the different class zones, potential impact circles, or areas containing an identified site as defined in Part 192.903 of the DOT regulations.

The OPS published a series of rules from August 6, 2002 to May 26, 2004 (69 Federal Register 29903), that defines HCAs where a gas pipeline accident could do considerable harm to people and their property and requires an integrity management program to minimize the potential for an accident. This definition satisfies, in part, the Congressional mandate in 49 USC 60109 for the OPS to prescribe standards that establish criteria for identifying each gas pipeline facility in a high-density population area.

The HCAs may be defined in one of two ways. In the first method an HCA includes:

- current Class 3 and 4 locations,
- any area in Class 1 or 2 where the potential impact radius[6] is greater than 660 feet and there are 20 or more buildings intended for human occupancy within the potential impact circle[7], or
- any area in Class 1 or 2 where the potential impact circle includes an identified site.[8]

In the second method an HCA includes any area within a potential impact circle which contains:

- 20 or more buildings intended for human occupancy, or
- an identified site.

Once a pipeline operator has determined the HCAs on its pipeline, it must apply the elements of its integrity management program to those segments of the pipeline within HCAs. The DOT regulations specify the requirements for the integrity management plan at Part 192.911. Gulf LNG has identified 10 locations as HCAs.

The pipeline integrity management rule for HCAs requires inspection of the entire pipeline in HCAs every 7 years.

Part 192 prescribes the minimum standards for operating and maintaining pipeline facilities, including the requirement to establish a written plan governing these activities. Under section 192.615, each pipeline operator must also establish an emergency plan that includes procedures to minimize the hazards in a natural gas pipeline emergency. Key elements of the plan include procedures for:

- receiving, identifying, and classifying emergency events, gas leakage, fires, explosions, and natural disasters;
- establishing and maintaining communications with local fire, police, and public officials, and coordinating emergency response;

[6] The potential impact radius is calculated as the product of 0.69 and the square root of the maximum allowable operating pressure of the pipeline in psi multiplied by the pipeline diameter in inches.

[7] The potential impact circle is a circle of radius equal to the potential impact radius.

[8] An identified site is an outside area or open structure that is occupied by 20 or more persons on at least 50 days in any 12-month period; a building that is occupied by 20 or more persons on at least 5 days a week for any 10 weeks in any 12-month period; or a facility that is occupied by persons who are confined, are of impaired mobility, or would be difficult to evacuate.

- emergency shutdown of system and safe restoration of service;
- making personnel, equipment, tools, and materials available at the scene of an emergency; and
- protecting people first and then property, and making them safe from actual or potential hazards.

Part 192 requires that each operator must establish and maintain liaison with appropriate fire, police, and public officials to learn the resources and responsibilities of each organization that may respond to a natural gas pipeline emergency, and to coordinate mutual assistance. The operator must also establish a continuing education program to enable customers, the public, government officials, and those engaged in excavation activities to recognize a gas pipeline emergency and report it to appropriate public officials. Gulf LNG would provide the appropriate training to local emergency service personnel before the pipeline is placed in service. No additional specialized local fire protection equipment would be required to handle pipeline emergencies.

#### 4.13.7.2 Pipeline Accident Data

Since February 9, 1970, 49 CFR Part 191 has required all operators of transmission and gathering systems to notify the DOT of any reportable incident and to submit a report on form F7100.2 within 20 days. Reportable incidents are defined as any leaks that:

- caused a death or personal injury requiring hospitalization;
- required taking any segment of transmission line out of service;
- resulted in gas ignition;
- caused estimated damage to the property of the operator, or others, or both, of a total of $5,000 or more;
- required immediate repair on a transmission line;
- occurred while testing with gas or another medium; or
- in the judgment of the operator was significant, even though it did not meet the above criteria.

The DOT changed reporting requirements after June 1984 to reduce the amount of data collected. Since that date, operators must only report incidents that involve property damage of more than $50,000, injury, death, release of gas, or that are otherwise considered significant by the operator. Table 4.13.7-1 presents a summary of incident data for the 1970 to 1984 period, as well as more recent incident data for 1986 through 2005, recognizing the difference in reporting requirements. The 14.5-year period from 1970 through June 1984, which provides a larger universe of data and more basic report information than subsequent years, has been subject to detailed analysis, as discussed in the following sections.[9]

[9] Jones, D.J., G.S. Kramer, D.N. Gideon, and R.J. Eiber, 1986. "An Analysis of Reportable Incidents for Natural Gas Transportation and Gathering Lines 1970 Through June 1984." NG-18 Report No. 158, Pipeline Research Committee of the American Gas Association.

| TABLE 4.13.7-1<br>**Natural Gas Service Incidents by Cause** | | |
|---|---|---|
| | Incidents per 1,000 miles of Pipeline (percentage) | |
| Cause | 1970 - 1984 | 1986 - 2005 |
| Outside force | 0.70 (53.8) | 0.10 (38.5) |
| Corrosion | 0.22 (16.9) | 0.06 (23.1) |
| Construction or material defect | 0.27 (20.8) | 0.04 (15.4) |
| Other | 0.11 ( 8.5) | 0.06 (23.1) |
| Total | 1.30 | 0.26 |

During the 14.5-year period, 5,862 service incidents were reported over the more than 300,000 total miles of natural gas transmission and gathering systems nationwide. Service incidents, defined as failures that occur during pipeline operation, have remained fairly constant over this period with no clear upward or downward trend in annual totals. In addition, 2,013 test failures were reported. Correction of test failures removed defects from the pipeline before operation.

Additional insight into the nature of service incidents may be found by examining the primary factors that caused the failures. Table 4.13.7-1 provides a percentage distribution of the causal factors as well as the annual frequency of each factor per 1,000 miles of pipeline in service.

The dominant incident cause is outside forces, constituting 53.8 percent of all service incidents. Outside forces incidents result from the encroachment of mechanical equipment such as bulldozers and backhoes; earth movements due to soil settlement, washouts, or geologic hazards; weather effects such as winds, storms, and thermal strains; and willful damage. Table 4.13.7-2 shows that human error in equipment usage was responsible for approximately 75 percent of outside forces incidents. Since April 1982, operators have been required to participate in "One Call" public utility programs in populated areas to minimize unauthorized excavation activities in the vicinity of pipelines. The "One Call" program is a service used by public utilities and some private sector companies (e.g., oil pipelines and cable television) to provide preconstruction information to contractors or other maintenance workers on the underground location of pipes, cables, and culverts. The 1986 through 2005 data show that the portion of incidents caused by outside forces has decreased to 38.5 percent.

| TABLE 4.13.7-2<br>**Outside Forces Incidents by Cause (1970-1984)** | |
|---|---|
| Cause | Percent |
| Equipment operated by outside party | 67.1 |
| Equipment operated by or for operator | 7.3 |
| Earth movement | 13.3 |
| Weather | 10.8 |
| Other | 1.5 |

The pipelines included in the data set in table 4.13.7-1 vary widely in terms of age, pipe diameter, and level of corrosion control. Each variable influences the incident frequency that may be expected for a specific segment of pipeline.

The frequency of service incidents is strongly dependent on pipeline age. While pipelines installed since 1950 exhibit a fairly constant level of service incident frequency, pipelines installed before that time have a significantly higher rate, partially due to corrosion. Older pipelines have a higher

frequency of corrosion incidents, since corrosion is a time-dependent process. Further, new pipe generally uses more advanced coatings and cathodic protection to reduce corrosion potential.

Older pipelines have a higher frequency of outside forces incidents partly because their location may be less well known and less well marked than newer lines. In addition, the older pipelines contain a disproportionate number of smaller diameter pipelines, which have a greater rate of outside forces incidents. Small diameter pipelines are more easily crushed or broken by mechanical equipment or earth movements.

Table 4.13.7-3 clearly demonstrates the effectiveness of corrosion control in reducing the incidence of failures caused by external corrosion. The use of both an external protective coating and a cathodic protection system, required on all pipelines installed after July 1971, significantly reduces the rate of failure compared to unprotected or partially protected pipe. The data shows that bare, cathodically protected pipe actually has a higher corrosion rate than unprotected pipe. This anomaly reflects the retrofitting of cathodic protection to actively corroding spots on pipes.

TABLE 4.13.7-3

**External Corrosion by Level of Control (1970-1984)**

| Corrosion Control | Incidents per 1,000 miles per Year |
|---|---|
| None-bare pipe | 0.42 |
| Cathodic protection only | 0.97 |
| Coated only | 0.40 |
| Coated and cathodic protection | 0.11 |

### 4.13.7.3 Impact on Public Safety

The service incident data summarized in table 4.13.7-1 include pipeline failures of all magnitudes with widely varying consequences. Approximately two-thirds of the incidents were classified as leaks, and the remaining third classified as ruptures, implying a more serious failure.

Table 4.13.7-4 presents the average annual fatalities that occurred on natural gas transmission and gathering lines from 1970 to 2005. Fatalities between 1970 and June 1984 have been separated into employees and nonemployees, to better identify a fatality rate experienced by the general public. Of the total 5.0 nationwide average, fatalities among the public averaged 2.6 per year over this period. The simplified reporting requirements in effect after June 1984 do not differentiate between employees and nonemployees. However, the data show that the total annual average for the period 1984 through 2005 decreased to 3.6 fatalities per year. Subtracting two major offshore incidents in 1989, which do not reflect the risk to the onshore public, yields a total annual rate of 2.8 fatalities per year for this period.

TABLE 4.13.7-4

**Annual Average Fatalities - Natural Gas Transmission and Gathering Systems [a, b]**

| Year | Employees | Nonemployees | Total |
|---|---|---|---|
| 1970-June 1984 | 2.4 | 2.6 | 5.0 |
| 1984-2005 [c] | - | - | 3.6 |
| 1984-2005 [c] | - | - | 2.8 [d] |

[a] 1970 through June 1984 - American Gas Association, 1986.

[b] DOT Hazardous Materials Information System.

[c] Employee/nonemployee breakdown not available after June 1984.

[d] Without 18 offshore fatalities occurring in 1989 -- 11 fatalities resulted from a fishing vessel striking an offshore pipeline and 7 fatalities resulted from explosion on an offshore production platform.

The nationwide totals of accidental fatalities from various manmade and natural hazards are listed in table 4.13.7-5 in order to provide a relative measure of the industry-wide safety of natural gas pipelines. Direct comparisons between accident categories should be made cautiously, however, because individual exposures to hazards are not uniform among all categories. Nevertheless, the average of 2.6 public fatalities per year is relatively small considering the more than 300,000 miles of transmission and gathering lines in service nationwide. Furthermore, the fatality rate is approximately two orders of magnitude (100 times) lower than the fatalities from natural hazards such as lightning, tornados, floods, earthquakes, etc.

TABLE 4.13.7-5

**Nationwide Accidental Deaths [a]**

| Type of Accident | Fatalities |
|---|---|
| All accidents | 90,523 |
| Motor vehicles | 43,649 |
| Falls | 14,985 |
| Drowning | 3,488 |
| Poisoning | 9,510 |
| Fires and burns | 3,791 |
| Suffocation by ingested object | 3,206 |
| Tornado, flood, earthquake, etc. (1984-93 average) | 181 |
| All liquid and gas pipelines (1978-87 average) [b] | 27 |
| Gas transmission and gathering lines nonemployees only (1970-84 average) [c] | 2.6 |

[a] All data, unless otherwise noted, reflects 1996 statistics from the U.S. Department of Commerce, Bureau of the Census, "Statistical Abstract of the U.S. 118th Edition."

[b] U.S. Department of Transportation, "Annual Report on Pipeline Safety - Calendar Year 1987."

[c] American Gas Association, 1986.

The available data show that natural gas pipelines continue to be a safe, reliable means of energy transportation. Based on approximately 301,000 miles in service, the rate of public fatalities for the nationwide mix of transmission and gathering lines in service is 0.01 per year per 1,000 miles of pipeline. Using this rate, the LNG Clean Energy Project might result in a public fatality every 20,000 years. This would represent a slight increase in risk to the nearby public.

### 4.13.8 Additional Safety Issues Identified in Scoping

#### Credible Risk Scenarios

One comment suggested the review of risk scenarios such as a Class 5 hurricane making landfall in Pascagoula or the LNG storage tanks being hit by debris from neighboring plant explosions.

Based on the outcome of the impacts of the recent hurricanes on the Gulf coast, Gulf LNG has redesigned its storm surge wall and jetty platform by increasing the elevations to approximately twice that of the original design (i.e., the height of the storm surge wall was increased from an elevation of +15 feet to an elevation of +27 feet and the minimum elevation of the jetty platform and pipe trestle was increased from +13 feet to +34 feet). Gulf LNG has also stated that all critical structures would be designed to withstand a 183 mph, 3 second gust wind and non-critical structures a 150 mph gust wind.

FERC staff considers the possibility of the LNG storage tanks being hit by debris from neighboring plant explosions to be remote. Gulf LNG's proposed terminal incorporates full containment LNG storage tanks consisting of reinforced concrete outer wall, a carbon steel liner, an insulated annular

space, and a 9 percent nickel steel inner tank. All other process equipment and aboveground piping would be surrounded by curbs or trenches that would direct any LNG spill to a remote impoundment. The facility would have a sophisticated hazard detection and control system integrated into the emergency shutdown system to enable a programmed safe shutdown. All LNG impoundments would be sized to contain LNG spills for a duration of 10 minutes as required by regulations. The facility would be required to meet the thermal and flammable vapor exclusion zones as required. In addition, the full containment LNG storage tanks would be within the storm surge wall that would be constructed to an elevation of 27 feet, which would contain a complete storage tank failure.

**Skikda Accident**

One comment requested Gulf LNG to evaluate different failure modes that led to the incident that occurred at the liquefaction facility located in Skikda, Algeria. As stated in section 4.13, there are major differences between the equipment involved in the Skikda accident and those proposed by Gulf LNG. FERC staff has reviewed each new LNG facility proposal, as well as each operating LNG facility under the Commission's jurisdiction for possible similarities that could cause the ignition flammable vapor. As a result of the Cryogenic Design and Technical Review (see section 4.13.2), we have recommended that Gulf LNG provide a technical review of the proposed design that: a) identifies all combustion/ventilation air intake equipment and the distances to any possible hydrocarbon release; and b) demonstrates that these areas are adequately covered by hazard detection devices and indicates how these devices would isolate or shutdown any combustion equipment whose continued operation could add to or sustain an emergency.

**Method Used by Gulf LNG to Perform Risk Analysis**

One comment stated that this section must contain the modeling of potential releases which could occur from a credible scenario as well as additional information about the method used to perform the risk analysis. The DOT regulations, in Title 49 CFR Part 193 – Liquefied Natural Gas Facilities: Federal Safety Standards, mandate prescriptive, definitive requirements for the design, siting, construction and operation of LNG facilities, rather than a risk-based regulatory approach such as used for European facilities. As such, the siting requirements of 49 CFR Part 193, Subpart B, which incorporates NFPA 59A (2001 edition), identifies the specific release scenarios in establishing the thermal radiation and flammable vapor exclusion zones for a facility (see section 4.13.4). Under a risk-based approach, it may be possible to consider less conservative credible spill scenarios such as for a full-containment LNG storage tank fire (see section 4.13.3).

The design and specifications submitted by Gulf LNG for the proposed facility to date are considered to be preliminary but would be the basis for any detailed design to follow. A significant amount of the basic design involving final selection of equipment manufacturers, process conditions, and resolution of some safety related issues would be completed in the next phase of project development if authorization is granted by the Commission. Gulf LNG would conduct HAZOP reviews of the design at certain stages of the detailed design and incorporate the conclusions into the final design. Beyond the federal regulations, Gulf LNG's Engineering, Procurement, and Construction Contractor would design the terminal facilities to be consistent with several other codes and standards.

### 4.13.9 Conclusions on Safety Issues

Much of the recent safety debate has centered on the perceived size of worst case scenarios; the distance to various thermal radiation heat levels for LNG fires; the range of potentially flammable vapors; and the population and infrastructure that are located within the various hazard areas. These are components of a consequence analysis.

However, the evaluation of safety is more than an exercise in calculating the consequences of worst case scenarios. Rather, safety is a determination of the acceptability of risk which considers: 1) the probability of events; 2) the effect of mitigation; and 3) the consequences of events.

Accidental Causes – Based on the extensive operational experience of LNG shipping, the structural design of an LNG vessel, and the operational controls that may be imposed by the Coast Guard and the local pilots, the likelihood of a cargo containment failure and subsequent LNG spill from a vessel casualty – collision, grounding, or allision – is highly unlikely. For similar reasons, an accident involving the onshore LNG import terminal is unlikely to affect the public. As a result, the risk to the public from accidental causes should not be considered significant.

Intentional Attacks – Unlike accidental causes, historical experience provides little guidance in estimating the probability of a terrorist attack on an LNG vessel or onshore storage facility. For a new LNG import terminal proposal, having a large volume of energy transported and stored near populated areas, the perceived threat of a terrorist attack may be considered as highly probable to the local population.

However, at the national level, potential terrorist targets are plentiful, many having national significance, while others have a large concentration of the public (major sporting events, skyscrapers, etc.) or are critical infrastructure facilities. Currently, the United States has over 500 chemical facilities operating near large populations. United States waterways also transport over 100,000 annual shipments of hazardous marine cargo, including LPG, ammonia, and other volatile chemicals. Many of these substances pose a similar hazard to that of LNG.

Risk Management – While the risks associated with the transportation of any hazardous cargo can never be entirely eliminated, they can be managed. For potential targets where the threat is perceived to be high, resources can be directed to mitigate possible attack paths. Such efforts may deter potential attacks on one target, but shift efforts to those that are less protected. As a result, the issue is how to best direct finite resources.

For the proposed project, it may be possible to apply risk management resources to manage realistic threats; however, an even greater level of resources may be required to manage the threats as perceived at the local level. The issue for the decision makers is whether the resources required to manage the risks are justified by the benefits, while recognizing that the risks cannot be entirely eliminated.

## 4.14 CUMULATIVE IMPACTS

Cumulative impacts may result when the environmental effects associated with a proposed project are superimposed on, or added to, either temporary (construction related) or permanent (operation related) impacts associated with past, present, or reasonably foreseeable future projects. Although the individual impact of each separate project may be minor, the additive or synergistic effects of multiple projects could be significant.

Existing environmental conditions in the project area reflect changes based on past activities. The Port of Pascagoula has been a center of trade activity since the early 1800s as commerce and transportation grew along the Pascagoula River system. Operations associated with the Port of Pascagoula began in the 1830s with the dredging of the east branch of the Pascagoula River. The predominant commodity at that time was cotton. Shipyards and sawmills then became established along the river. The channel was dredged deeper and widened in the late 1870s. With the new dredging and the introduction of the steamship, the sawmills were able to meet large demands for lumber in Mexico, the Caribbean, and Europe. At the beginning of the 20$^{th}$ century, Pascagoula was the second largest lumbering port on the Gulf of Mexico. By the 1940s, shipbuilding had become the area's primary industry (JCPA, 2005).

By the late 1950s Bayou Casotte was dredged and a second harbor was opened. Public facilities in the Bayou Casotte Harbor include two public terminal warehouses and four associated deep water berths. Major private industries located in the harbor are Chevron's Pascagoula Refinery, Mississippi Phosphates Corporation, First Chemical Corporation, VT Halter Marine, and Signal International East Yard (JCPA, 2005; McAndrews, 2005).

Major facilities in the Pascagoula River Harbor include Northrop Grumman Ship Systems, Signal International West Yard, NOAA Pascagoula Facility, Naval Station Pascagoula, Coast Guard facilities, and the Port of Pascagoula public facilities (JCPA, 2005; McAndrews, 2005). The Naval Station, which has been operating three ships out of the Port of Pascagoula, is scheduled to close as early as 2007.

Chevron is currently expanding its Pascagoula Refinery to raise output of gasoline by 500,000 gallons per day, a 25 percent increase. This $150 million expansion project was scheduled to begin in July 2005 and be completed in late 2006. However, in the aftermath of Hurricane Katrina, the completion date may be delayed. At the peak of project construction, some 1,300 contactors were expected to be employed on the project (NDTCabin, 2005).

As described in section 3.2.1.2, Bayou Casotte Energy also has proposed an LNG import terminal, which would be constructed adjacent to Chevron's Pascagoula Refinery on the site of the former Corning Glass Works (the project is referred to as the Casotte Landing LNG Project). Should it be approved, the timing of the Casotte Landing LNG Project, as currently proposed, would be similar to the LNG Clean Energy Project.

Aside from the Pascagoula Refinery expansion and the Casotte Landing LNG and LNG Clean Energy Projects, no significant commercial or industrial developments associated with shipping and related port activities are planned in the Port of Pascagoula area (McAndrews, 2005). The closest foreseeable development to the west would be casino projects approximately 20 miles away. Land use between the Northrup Grumann shipyard at the western edge of Pascagoula and the casinos is primarily residential and would be unlikely to include any industrial or major commercial development. The impacts associated with the casino development are primarily related to population growth and would extend only as far eastward as the Ocean Springs area (COE, 2005). Because of the area and types of impacts associated with the casinos, they were not considered as part of the cumulative impacts associated

with the LNG Clean Energy Project. The Grand Bay Reserve extends along the coast to the east from the Destin and Gulfstream pipeline rights-of-way to beyond the Mississippi State Line. The designation of this area for preservation would preclude any development in the foreseeable future. More geographically distant projects were not assessed because their impact would generally be localized and therefore, would not contribute significantly to cumulative impacts in the proposed project area.

In addition to development projects, dredging activities may have a cumulative or additive impact on some of the same resources affected by the LNG Clean Energy Project, particularly soils, sediments, surface water, and aquatic resources. Early historical channel dredging activities are described above. In 1965, the Pascagoula Harbor Project was completed and resulted in deepening of the turning basins and ship channels to -38 feet MLLW, except from the Gulf of Mexico through Horn Pass where the channel was deepened to -40 feet MLLW. The channel widths ranged from 225 to 350 feet and the widths of the turning basins were 950 feet for the Pascagoula Channel and 1,000 feet for the Bayou Casotte Channel (SMA Task Force, 1985). This dredging and subsequent maintenance dredging was carried out by the COE. The JCPA provided dredged material placement areas with retaining dikes, as necessary.

In 2002, the COE deepened Bayou Casotte Channel to -42 feet MLLW and widened the channel to 350 feet. The turning basin at the mouth of Bayou Casotte Channel was also deepened and the Bayou Casotte Inner Harbor Channel was extended and deepened along with the northern turning basin. Additionally, the Horn Island Pass Channel was deepened to -44 feet MLLW and the Lower Pascagoula Channel, which runs between the Horn Island Pass Channel and the Bayou Casotte Channel, was deepened to -42 feet MLLW. In all, 11.5 million $yd^3$ of sediment was dredged for the 2002 project.

Aside from the dredging associated with the LNG import terminal projects, the primary dredging expected to take place in the project area within the foreseeable future would be maintenance dredging of the ship channels and turning basins.

Table 4.14-1 summarizes the present or reasonably foreseeable future projects or activities that may have a cumulative or additive impact on resources that would be affected by construction and operation of the LNG Clean Energy Project. Although it is reasonable to expect that over the next 20 years various industrial, commercial, recreational, or residential developments would occur in the Pascagoula area, without specific proposals to evaluate, the impacts of these developments are not reasonably foreseeable. Therefore, these unplanned projects cannot be included in this EIS.

TABLE 4.14-1

**Existing or Proposed Activities Cumulatively Affecting Resources of Concern for the LNG Clean Energy Project**

| Activity/Project | Description | Timeframe |
|---|---|---|
| Past and Present Activities/Projects | | |
| Channel and Harbor Dredging | Maintenance dredging of the Pascagoula and Bayou Casotte Channels and the Inner Harbor. | Ongoing |
| Pascagoula Refinery Expansion | Expand refinery's gasoline production capacity by 500,000 gallons per day. | Through late 2006 [a] |
| Future Activities/Projects | | |
| Casotte Landing LNG Project | LNG import terminal, including new ship berth to accommodate both LNG ships and crude oil tankers for the refinery, and associated natural gas pipeline interconnections. | 2006-2009 |
| Channel and Harbor Maintenance Dredging | Maintenance dredging of the Pascagoula and Bayou Casotte Channels and the Inner Harbor. | Ongoing |

[a] The completion date for the Pascagoula Refinery may be delayed due to Hurricane Katrina.

### 4.14.1 Geology

Because no significant paleontological or mineral resources have been identified in the project area, the projects would not have a cumulative impact on geological resources. Shoreline erosion is a serious problem in some areas along the Mississippi Coast. In general, shoreline erosion can be caused by ship traffic or by engineered structures, such as levees along beaches or rivers, up to hundreds of miles away from where the erosion problems occur. Natural processes such as tide-induced currents, sea level changes, wind, waves, and hurricanes or other extreme storms also contribute to shoreline erosion. Because the proposed LNG terminal site would be located along the Bayou Casotte Channel just before it enters the harbor, rather than being located within the harbor where the shoreline is close to the channel, the LNG marine traffic associated with the project would not contribute measurably to shoreline erosion along the Bayou Casotte Channel. In addition, rock or concrete units would be installed on the slope parallel to the shoreline of the ship berth area to protect it from erosion.

The increased ship traffic from the LNG import terminals and Chevron's Pascagoula Refinery (see section 4.14.7) could add to any ship traffic-induced shoreline erosion already occurring on Petit Bois and Horn Islands. However, such impacts would be difficult to distinguish from shoreline erosion caused by naturally occurring processes. In addition, LNG ships are restricted to lower speeds and they have a relatively high under-keel clearance (compared to oil tankers), both of which tend to lessen erosional effects.

The Pascagoula Refinery expansion will not directly affect shoreline erosion because it will not disturb the coastline. Bayou Casotte Energy did not identify shoreline erosion as an environmental impact associated with the Casotte Landing LNG Project. In addition, Bayou Casotte Energy has indicated that dredged material associated with the project may be placed in beneficial use areas, which could mitigate shoreline erosion. In the past, some of the dredged material generated by the COE during maintenance dredging of the channels and harbor has gone for beneficial use projects to mitigate shoreline erosion. Such beneficial use projects are expected to continue, as described in the COE Master Plan. Because of various mitigation projects associated with material derived from maintenance dredging activities and possibly from the Casotte Landing LNG Project, the net cumulative impact of the projects considered for this analysis could be beneficial relative to shoreline erosion.

### 4.14.2 Soils and Sediments

Clearing and grading associated with construction of the LNG terminal projects and the Pascagoula Refinery expansion could accelerate the soil erosion process and, without adequate protection, could result in discharge of sediment to adjacent waterbodies and wetlands. Soil loss due to erosion could also reduce soil fertility and impair revegetation. The LNG terminal projects would adopt our Plan to establish a baseline for minimizing the potential for erosion as a result of water or wind action and to aid in reestablishing vegetation after construction. In addition, a site-specific SWPPP would be required as part of the general permit for construction stormwater discharges. The SWPPP would incorporate various BMPs, as well as guidance established in documents developed for erosion control and stormwater management in the State of Mississippi (see section 4.2.1.2). None of the land within the project area is currently under active cultivation, and no prime farmland would be permanently converted as a result of the LNG terminal projects.

Except for the Pascagoula Refinery expansion, all of the activities considered for this cumulative impacts analysis involve dredging activities. Estimated dredging volumes and proposed dredged material placement sites for the projects are provided in table 4.14.2-1.

TABLE 4.14.2-1

**Estimated Volumes of Dredged Material for Current and Proposed Projects**

| Project | Estimated Volume for Construction (million cubic yards) | Proposed Dredged Material Placement Site(s) |
|---|---|---|
| Construction of LNG Clean Energy Project | 2.96 | ODMDS |
| Maintenance Dredging for LNG Clean Energy Project over 20 years | up to 1.2 | BCDMMS |
| Construction of Casotte Landing LNG Project | 3.5 | ODMDS |
| Maintenance Dredging for Casotte Landing LNG Project over 20 years | up to 5.0 | ODMDS |
| Maintenance Dredging of Bayou Casotte Inner Harbor and Turning Basin over 20 years | 3.46 | BCDMMS |
| Maintenance Dredging of Bayou Casotte Harbor Public Ship Berths over 20 years | 0.30 | BCDMMS |
| Maintenance Dredging of Existing Bayou Casotte Harbor Private Industry Ship Berths over 20 years | 0.27 | Private placement sites |

ODMDS Ocean Dredged Material Disposal Site
BCDMMS Bayou Casotte Dredged Material Management Site

All of the dredged material derived from construction of the proposed LNG Clean Energy Project, and the construction and maintenance dredged material associated with the Casotte Landing LNG Project, is proposed to be placed in the ODMDS. This material would not have a significant effect on the capacity of the ODMDS.

The ship berth and maneuvering area associated with the LNG Clean Energy Project would be owned by the JCPA after it is constructed and the JCPA would be responsible for the maintenance dredging. The material associated with maintenance dredging at the proposed facility is proposed to be placed at the BCDMMS. Gulf LNG calculated that the additional material associated with maintenance dredging for the LNG Clean Energy Project would reduce the life of the BCDMMS from 50 years to approximately 39 years, if the maximum potential shoaling rate is assumed. According to Gulf LNG, this impact could be reduced with changes to the current BCDMMS site management program (i.e., allowing greater lift thicknesses for the dredged material). The cumulative impacts of ship traffic-induced shoreline erosion are discussed in section 4.14.1.

### 4.14.3 Water Resources and Wetlands

Construction of the proposed LNG terminal would involve the dredging of a ship berth and maneuvering area. The primary impacts of dredging on water quality are increased turbidity and sedimentation, the release of nutrient-bound contaminants, and decreased dissolved oxygen.

Initial dredging activities during construction and maintenance dredging during operation would result in increased turbidity and sedimentation that would temporarily decrease water quality. If dredging associated with the proposed LNG terminal were to occur concurrently with other dredging projects, the reduction in water quality could be exacerbated. However, because the Mississippi Sound and Bayou Casotte are naturally turbid, noticeable increases in TSS associated with dredging activities for the proposed project would be relatively localized. In addition, specific mitigation measures would be required to reduce the levels of turbidity during dredging. As a result, even if other dredging occurs concurrently, the regions affected by elevated turbidity would not likely overlap and additive effects would not be expected to occur. In addition, if the dredging projects were undertaken concurrently, the time period of increased turbidity would be shortened. In any case, the negative effects of dredging in this substrate would be temporary and water quality would be expected to return to ambient conditions

after completion of these activities. Likewise, increases in turbidity that would occur at the dredged material placement site would be localized and temporary. No long-term cumulative impacts on water quality, either in the marine terminal area or along the LNG ship transit route, would result from the dredging activities.

Propeller wash from LNG ships, oil tankers, and tugboats associated with the LNG terminals and Chevron's Pascagoula Refinery expansion could temporarily increase suspended sediments within the waterway. However, given the naturally high turbidity levels within the Mississippi Sound, such impacts would not be significant.

The area comprising both proposed LNG terminal projects was originally used for dredged material placement. Aside from the Mississippi Sound and Bayou Casotte, the existing waterbodies within the project area consist of shallow intermittent drainage ditches, dredged canals, and retention ponds. The quality of these waterbodies is generally low because of their artificial origin and use for industrial stormwater conveyance. The construction of the proposed natural gas sendout pipeline associated with the proposed LNG Clean Energy Project would require the crossing of two manmade canals. One canal would be crossed by the HDD construction method and the other would be crossed using the open cut method. Impacts on the canals would be minor and short term. The pipeline interconnections for the Casotte Landing LNG Project would cross a canal using the open cut method. Impacts on this canal are also expected to be minor.

Runoff from construction activities near waterbodies could also result in cumulative impacts, although this effect would be relatively minor and would be controlled during each project by implementation of erosion and sediment control measures and by compliance with federal, state, and local requirements. Because the potential impacts on waterbodies would be limited to the period of construction, and each project would be required to implement erosion and sediment control measures to reduce impacts, the collective effects on surface water resources are expected to be minor.

There would be a permanent loss of some existing wetlands as a result of constructing and operating the proposed LNG terminal projects. However, the projects would require, by the terms and conditions of their respective CWA permits, compensatory mitigation for wetland damage or destruction. Therefore, although construction and operation of Gulf LNG's proposed project along with Bayou Casotte Energy's proposed LNG terminal would result in a reduction in the amount of existing wetlands in the vicinity, compensatory wetland mitigation, as required by the CWA, is anticipated to result in a net increase in the regional coastal marsh resource. Table 4.14.3-1 summarizes the acres of wetlands impacted by the proposed projects.

TABLE 4.14.3-1

**Wetland Impacts Associated with the Proposed LNG Terminal Projects (acres)**

| | LNG Terminal Facilities [a] | | Pipeline/Interconnects | | Total Impacts | |
|---|---|---|---|---|---|---|
| Project | Temporary | Permanent | Temporary | Permanent | Temporary | Permanent |
| Casotte Landing LNG Project | 119.3 | 119.3 | 15.3 | 7.9 | 134.6 | 127.2 |
| LNG Clean Energy Project | 5.8 | 4.9 | 14.1 | 2.6 | 20.0 | 7.4 |

[a] Impacts associated with any nonjurisdictional facilities are not included.

As discussed in section 4.4.1, only a small fraction of the wetland impacts associated with construction of Gulf LNG's natural gas sendout pipeline and the Casotte Landing LNG Project would be permanent. Neither waterbodies nor wetlands will be affected by Chevron's expansion of their

Pascagoula Refinery because the expansion will occur within the established limits of the existing refinery. No wetland impacts are anticipated along the LNG ship transit route as a result of any of the projects considered for this cumulative impacts analysis.

### 4.14.4 Vegetation, Wildlife, and Aquatic Resources

#### Vegetation

Construction of the proposed LNG terminal facilities would permanently remove about 42.6 acres of vegetation communities consisting of scrub-shrub uplands, intertidal mudflats, and coastal brackish marsh. Construction of the proposed pipeline and associated aboveground facilities would disturb 68.3 acres of upland vegetation and 14.1 acres of wetland vegetation. Operation of the proposed pipeline facilities would require that about 26.1 acres of vegetation be converted to permanently maintained pipeline right-of-way (24.9 acres) and aboveground facilities (1.2 acres). The proposed Casotte Landing LNG Project site is a previously developed industrial area and the few existing plants are fast-growing, hardy pioneer species. Because the Casotte Landing pipeline interconnections would be collocated to the extent possible with existing structures, permanent impacts on vegetation would be minor.

Although implementation of the LNG terminal projects would permanently remove native vegetation, these impacts are not expected to be significant on a regional scale because areas with similar vegetation characteristics are found on surrounding lands. Because the Pascagoula Refinery expansion will be within the existing, previously disturbed portion of the refinery, no significant impacts on vegetation are anticipated.

#### Wildlife

Habitat within the footprint of the proposed LNG Clean Energy Project terminal would be permanently lost to wildlife. Some smaller, less mobile wildlife, such as small mammals, amphibians and reptiles, would likely experience direct mortality during clearing and grading activities. Other wildlife, such as birds and larger mammals, would likely leave the immediate construction area when construction activities approach, perhaps relocating to the Grand Bay Reserve, which would provide similar and ample habitat to the east of the project area. Gulf LNG would mitigate for the permanent loss of coastal brackish marsh associated with the LNG terminal facilities through compensatory replacement of habitat at a ratio established under the Joint MDMR/COE section 404/10 permit (see section 4.4.3).

Two federally listed threatened and endangered bird species may be present in the Bayou Casotte area. The waters of the Mississippi Sound may provide foraging habitat for bald eagles. Construction activities, including dredging and dredged material placement, may have a temporary impact on foraging habitat. However, due to the high mobility of the bald eagles and the abundance of foraging habitat in the area, bald eagles would not likely be adversely affected by the projects considered for this cumulative impacts analysis.

Brown pelicans are common in estuarine waters around Bayou Casotte. Construction activities, including dredging, may have a temporary impact on loafing and foraging habitat. However, like the bald eagle, the brown pelican is highly mobile. Suitable habitat within the Grand Bay National Estuarine Research Reserve would provide ample habitat for any displaced individuals, and the brown pelican would not likely be adversely affected by the projects considered for this cumulative impacts analysis.

Because Bayou Casotte Energy's proposed LNG terminal would be located on a former industrial site adjacent to a refinery, the existing wildlife habitat at the site is not high quality and only minor impacts on wildlife are anticipated. As with the LNG Clean Energy Project, compensatory replacement

of wetland habitat would be required. Because ample similar upland habitat is available in the area and wetland habitat would be compensated, no adverse cumulative impacts on wildlife would be associated with the proposed LNG terminals.

Most of the sendout pipeline construction areas associated with the LNG terminal projects would revert to preconstruction conditions, and therefore, impacts on most wildlife habitat would be temporary and short term. Because the majority of the pipeline routes for both LNG terminal projects is currently maintained right-of-way or other industrial areas, the cumulative impacts on wildlife and wildlife habitat in the area would likely be negligible. Because the Pascagoula Refinery expansion will be within the existing, previously disturbed portion of the refinery, no significant impacts on wildlife are anticipated.

None of the projects considered for this cumulative impacts analysis is anticipated to affect wildlife habitats along the LNG ship transit route. No significant cumulative impacts on wildlife along the transit route would be expected.

**Aquatic Resources**

Dredging of the ship berth and maneuvering area for the LNG Clean Energy Project would result in the permanent conversion of 61.3 acres of shallow, primarily sandy softbottom habitats to deeper, silty-sand softbottom habitats. Many of the aquatic species that currently inhabit shallow water habitat in the project area also inhabit the deeper water of the adjacent Bayou Casotte Channel and LNG ship transit route. These species are not likely to be negatively affected by the alteration in habitat. Aquatic species that prefer the shallow water habitat would experience a loss of habitat due to dredging; however, the large amount of similar habitat in the vicinity of the project area would provide ample habitat for individuals displaced by construction activities. The ship berth for the Casotte Landing LNG Project would be constructed in an upland area, minimizing impacts on existing aquatic habitat. Maintenance dredging in the Port of Pascagoula would be within existing dredged areas that have already been disturbed. The Pascagoula Refinery expansion would not affect aquatic resources.

As discussed in section 4.14.3, construction dredging for the proposed LNG Clean Energy Project and maintenance dredging for the two LNG terminal projects and the Port of Pascagoula would result in temporary increases in turbidity, which could have impacts on aquatic resources. These impacts would be mostly temporary and localized, and mitigation measures would be required (e.g., silt curtains) to reduce turbidity. Because the dredging activities for the projects would be unlikely to occur at the same time and in close proximity, they would not cause cumulative impacts on aquatic resources.

It is estimated that LNG ships would take on approximately 15 million gallons of water during offloading for ballast and between 15 and 42 million gallons of water for engine cooling while they are at the berth. Ships berthing at the Casotte Landing LNG terminal would be expected to withdraw similar quantities of water while at berth. In addition, ships berthing at the Port of Pascagoula would also take on water for ballast and ship engine cooling.

Water used for engine cooling would be quickly discharged, and the resulting increase in water temperature is expected to be minor. Intake of water can also result in the entrainment of aquatic resources. Early life stages of blue crab; white, brown, and pink shrimp; stone crab; croaker; bay anchovy; black drum; red drum; and seatrout are all dependent on the estuary for nursery habitat and would be most susceptible to entrainment (NMFS, 2006).

The majority of species identified by the NMFS occur in low densities in the project area. In contrast, blue crab and penaeid shrimp occur in high densities in the project area; however, they exhibit naturally high mortality rates. Based on Gulf LNG's calculations, these combined effects account for the

negligible impact to these species. The resulting low numbers removed from these species populations would be expected to have a minimal impact on the ecology in the project area and the surrounding Mississippi Sound, including food chain relationships.

Several federally listed threatened or endangered aquatic species, including whales, sea turtles, smalltooth sawfish, and Gulf sturgeon, are potentially present in the area affected by the LNG terminal projects and the maintenance dredging activities, including the LNG ship transit route. The proposed marine facilities associated with the LNG Clean Energy Project would be within Gulf sturgeon critical habitat and the ship channels servicing the Port of Pascagoula also pass through this critical habitat. The proposed Casotte Landing LNG Project would affect 6.3 acres of Gulf sturgeon critical habitat. To minimize impacts on Gulf sturgeon and its critical habitat, Gulf LNG would implement agency dredging requirements, concurrent scheduling of future maintenance dredging, and its SPCC Plans. In addition, Gulf LNG has agreed to perform a 3-year post-construction prey and habitat assessment survey of the ship berth and maneuvering area and adjacent areas following the protocols used in the 2005 habitat characterization. With the implementation of the above measures, we have determined that the Gulf sturgeon and its designated critical habitat would not likely be adversely affected by construction and operation of the LNG Clean Energy Project. The other listed aquatic species also would not likely be adversely affected by the proposed project.

Both the Casotte Landing LNG and LNG Clean Energy Projects would instruct vessel operators and crews to follow the guidelines list in the Strike Avoidance Procedures when operating their ships in the EEZ to minimize potential impacts from LNG marine traffic on whales and sea turtles. For these reasons, we anticipate minimal adverse cumulative impacts on special status aquatic species.

The proposed LNG Clean Energy Project would have an impact on habitat types that function as EFH. Species with EFH designated in the Mississippi Sound could potentially be impacted by loss/alteration of habitat, dredging, permanent loss of about 5 acres of intertidal wetland, entrainment of benthic invertebrates, and the temporary resuspension of sediments into the water column during construction. Although there would be permanent impacts on EFH as the result of project construction, Gulf LNG's proposed mitigation, in combination with mitigation for intertidal wetland losses, would compensate for these impacts through the creation of habitats. Impacts on EFH from construction of the Casotte Landing LNG Project include disturbance of 6.3 acres of unvegetated benthic habitat needed to connect the proposed marine slip to the ship channel. However, the permanent creation of 49 acres of similar unvegetated benthic habitat in the marine slip area would likely offset this temporary disturbance. Bayou Casotte Energy would also provide compensatory mitigation for wetland loss at the terminal site. Maintenance dredging activities would cause a temporary increase in turbidity, but not significantly above background levels and mitigation measures would be implemented to reduce turbidity. With mitigation, we do not believe cumulative impacts on EFH associated with construction or operation of these projects would have a substantial adverse effect on managed fisheries in the area.

### 4.14.5 Land Use, Recreation, and Visual Resources

#### Land Use

The proposed project and the other foreseeable future projects would result in minor changes to current land uses. Gulf LNG's terminal would be constructed on a tract of land located in an area that was previously used for dredged material placement, has no current structures or access, and is designated for water-dependent industrial use. The conversion of the site from an undeveloped, open area to an industrial use would be consistent with its designated use, as well as with other industrial facilities in the area. The Casotte Landing LNG terminal would be constructed on a former manufacturing site adjacent to a refinery. The Pascagoula Refinery expansion would not involve land use changes. The land use

surrounding these projects consists of industrial properties and dredged material placement. There is no agricultural or residential land in the vicinity that would be affected by the projects. No residential or other developed land is present along the LNG ship transit route. Material generated during maintenance dredging for the port would be placed in approved, previously used placement areas.

**Recreation**

Recreational fishing and boating occur in Bayou Casotte and Mississippi Sound, although existing recreational boating and fishing use in the immediate vicinity of the proposed LNG terminal is limited. The relatively shallow water depths in the vicinity of the proposed LNG terminal (ranging from 0 to 8 feet but generally less than 4 feet deep) preclude many recreational boaters from utilizing this area. The proposed project could potentially negatively affect recreation, primarily during the period of active construction and dredging. However, recreational boating and fishing activities are not expected to be significantly affected during construction of the marine facilities because of the nature of the work site (i.e., shallow water) and the fact that recreational boaters who do currently operate in the area are accustomed to avoiding existing vessel movements similar to those that would be experienced during construction of the project. The construction of the marine berth for the Casotte Landing LNG Project would be within an existing upland area and would have minimal impacts on recreational boating and fishing.

Operation of the LNG Clean Energy Project would affect recreational boating and fishing in the Mississippi Sound during the arrival, unloading, and departure of LNG ships. Gulf LNG anticipates that approximately 150 ships would unload at the LNG terminal each year. Docks in the Port of Pascagoula currently accommodate commercial ships. As a result, marine traffic associated with the project would not introduce any significant new type of impacts on recreational boating or fishing. However, while in transit or docked, LNG vessels would have a security zone enforced around them. Other vessels, including recreational boats, would be prohibited within the security zone during the arrival of LNG ships. These effects would be temporary while the boat is in transit or moored at the ship unloading facility. The maximum delay expected due to the transit of an LNG vessel would be 1.5 hours. The extent of the security zone around the LNG ship while it is unloading would be established by the Coast Guard but is not expected to interfere with traffic along the adjacent Bayou Casotte Channel.

The Casotte Landing LNG Project anticipates 170 LNG ship visits per year and similar security zone restrictions would apply. The potential increase of up to 320 LNG ships per year from the two proposed LNG terminal projects could have a minor affect on recreational activities in the area; however, neither of these projects is located in an area of high recreation value or usage. Recreational vessels that are not constrained to the dredged channel would not be adversely affected by the additional shipping traffic because these smaller vessels can operate outside the confines of the channel and remain clear of the LNG ships. In addition, the LNG terminal projects are located on lands dedicated to industrial uses and are not near beaches, parks, or other recreational areas.

Maintenance dredging for the LNG terminal projects or for other port activities would not have cumulative impacts on recreational boating or fishing because the disturbance associated with a given area would be localized and temporary in nature.

**Visual Resources**

The visual characteristics of the existing landscape are defined by historic and current land uses such as agriculture, recreation, conservation, and development. The visual qualities of the landscape are further influenced by existing linear installations such as highways, railroads, pipelines, and electrical transmission lines, and by the industrial facilities located along the Bayou Casotte Harbor. Within this

context, the proposed LNG storage tanks at the LNG terminals would have the most impact on visual resources in the area. The pipeline portions of the LNG terminal projects would be visually subordinate to the existing landscape character and would contribute only incrementally to overall visual conditions, particularly because the pipeline routes would primarily be within existing rights-of-way. The LNG terminal facilities would be located in an area with several existing industrial facilities, which would lessen their visual impact because their presence would be generally consistent with the current viewshed in the area. Likewise the refinery expansion will be within the limits of the existing refinery. The LNG ships and oil tankers would be operating within established federal navigation channels used by other commercial vessels. Maintenance dredging activities would not have an impact on visual resources. Therefore, the proposed projects would not significantly contribute to cumulative effects on visual resources.

### 4.14.6 Socioeconomics

With the exception of the maintenance dredging activities, present and reasonably foreseeable future projects and activities could have a cumulative impact on socioeconomic conditions in the project area. Employment, housing, infrastructure, and public services could experience both beneficial and detrimental impacts. Based on letters of support that the proposed project has received from state and local officials (i.e., Mayor of the City of Pascagoula, President of the JCPA, Governor of the State of Mississippi) the Pascagoula area has a need for projects such as the proposed LNG terminals to aid in its economic recovery after Hurricane Katrina. Therefore, the present and reasonably foreseeable future projects and activities considered for this analysis are likely to have a positive net socioeconomic impact. None of the projects have environmental justice issues, given the industrial nature of the sites and the absence of nearby residential areas.

#### Economy and Employment

The projects considered in this section would have cumulative effects on employment during construction if construction schedules overlap. During construction, the proposed LNG Clean Energy Project would employ an average workforce of 259, with a peak workforce of 556 at the beginning of the third year of construction. Gulf LNG estimates that 64 percent of the workforce would be local. The proposed Casotte Landing LNG Project would employ 50 to 100 workers during non-peak construction periods with 400 to 600 workers during peak periods, which would occur about 50 percent of the time. Currently, the proposed schedules for the two LNG terminal projects are similar.

The Pascagoula Refinery expansion is expected to employ 1,000 workers at the peak of construction. Based on the original schedule before Hurricane Katrina, the refinery expansion would have been entirely or largely completed before construction of the LNG terminal projects began. The hurricane may have delayed the construction schedule, possibly resulting in more overlap between the project schedules. In this event, more non-local workers may need to be hired temporarily. However, the impacts of this relatively small number of workers temporarily relocating to the area would be minor.

As discussed in section 4.9.2, the Hurricane Katrina reconstruction effort and the specialized construction requirements of the LNG terminal projects are expected to draw from different sectors of the construction workforce. Therefore, construction employment for the proposed LNG terminal projects should not conflict with hurricane reconstruction efforts.

While most of the jobs created by the proposed LNG terminal projects and the refinery expansion are temporary construction jobs, permanent employment would also increase in the project area. The LNG terminal projects would each employ 50 permanent workers. The Pascagoula Refinery currently employs about 300 permanent workers.

In addition to impacts on local employment, these projects would provide an increase in revenue for the State of Mississippi, Jackson County, and the local economies through the payment of payroll tax, sales tax, property tax, and other taxes and fees. During operation, payroll for the LNG Clean Energy Project would be $4,000,000 annually; and annual ad valorem taxes, lease fees, and port fees are anticipated to be $14,809,000. The Casotte Landing LNG Project would have an annual payroll of about $3,000,000 and would pay $13,606,000 annually in taxes and fees to the county. Cumulatively, these projects would have a beneficial impact on Jackson County and local economies and governments.

**Housing**

Temporary housing for the construction workers would be needed for the portion of the workforce not drawn from the local area. An average of 94 non-local workers in any given month would require temporary housing during construction of the LNG Clean Energy Project, with a maximum of 200 workers requiring housing during the peak month of construction. During the 2 years of peak construction activity on the Casotte Landing LNG Project, 180 housing units could be required to house temporary construction workers.

Although Hurricane Katrina has caused a temporary shortage in supply of temporary housing, area motels are expected to be fully operational in 2006. The peak construction period for the LNG Clean Energy Project is expected to occur in 2008 when additional temporary housing facilities would be available if required by project personnel. If adequate temporary housing is not available in Pascagoula or the immediate surrounding area, some workers may be required to commute from areas farther away.

**Infrastructure and Services**

Infrastructure and services may be affected when population increases if existing infrastructure lacks spare capacity. The small incremental demands of several construction projects occurring at the same time could place extra demands on police, fire, and emergency service personnel. However, this problem would be temporary, and could be somewhat offset by addressing additional service staff and shifts. In addition, cumulative impacts on disposal and waste management services would also be minimal, as sufficient space is available in the landfills near the project area and given that the majority of waste generated at the construction site would be Class 3 industrial waste.

The permanent impact of the proposed LNG Clean Energy terminal on the emergency response services (i.e., police, fire, and medical) is discussed in section 4.13. The cumulative impacts on emergency response services are discussed in section 4.14.9.

### 4.14.7 Transportation

**Land Transportation**

As discussed in section 4.10.1, additional vehicle trips associated with construction of the proposed project would result in a 13.5 percent and 17.4 percent increase in traffic on the 4-lane and 2-lane portions of State Highway 611, respectively. To alleviate potential traffic congestion, Gulf LNG would schedule deliveries of construction materials so that they avoid peak traffic periods when possible. In addition, Gulf LNG is planning to have off-site construction parking at its proposed contractor yard and support area on the Port of Pascagoula property. Workers would be ferried from the off-site parking area to the project site via tugs and other small boats already engaged in activities related to the project. If necessary, Gulf LNG would schedule work hours to correspond with times of low traffic flow to further mitigate traffic congestion.

Bayou Casotte Energy has not quantitatively assessed the impacts of construction of the Casotte Landing LNG Project on traffic; however, given its similar location and nature, we assume they would be comparable to the impacts associated with the LNG Clean Energy Project. Given the similar schedules, the two projects combined could increase traffic on State Highway 611 by 27 to 35 percent. However, the mitigation measures proposed above by Gulf LNG as well as staggering shift startup across the construction sites could be used to minimize traffic congestion and reduce potential cumulative impacts to a level that is not significant.

At the peak of construction associated with the Pascagoula Refinery expansion construction, more than twice the number of workers compared to the proposed LNG Clean Energy Project will be employed, resulting in about 2,000 individual vehicle trips per day. Although the completion of the refinery expansion may be delayed due to Hurricane Katrina, the majority of the work is likely to be completed before either of the LNG terminal projects would begin. Therefore, any construction period overlap for all three projects would be brief and the peak workforce would not be present for any of the projects.

Operation of the LNG terminals would each require an estimated 50 employees. The additional traffic generated by these employees on a daily basis would not result in a significant increase in local traffic volume, and would not adversely affect traffic on area roadways. Likewise, the number of employees associated with operation of the expanded Pascagoula Refinery is not likely to generate a significant volume of additional traffic. In addition, the varied work schedules of the employees would reduce any potential for additional traffic congestion.

Where installation of the proposed pipeline occurs at road crossings, road traffic could be temporarily disrupted or delayed. Traffic congestion along the proposed sendout pipeline route is not expected to be a major problem even if several projects are being constructed at once. Moreover, it is unlikely that each project would reach peak traffic conditions simultaneously. Also, because construction workers frequently share rides and travel to and from work during off-peak hours, potential cumulative impacts on traffic from pipeline construction are expected to be temporary and short term. Once pipeline construction is complete, there would be negligible impacts on traffic during operation and maintenance of the facilities.

**Marine Transportation**

The current volume of ship traffic for the Port of Pascagoula, as a whole, is an average of about three one-way transits per day. The average number of ship transits per day for Bayou Casotte Harbor is two, most of which are oil tankers calling at the Pascagoula Refinery.

The two proposed LNG terminals and the Pascagoula Refinery expansion would result in an increase in ship traffic in the port. The combined number of LNG ships for the two facilities would be about 320 vessels. Based on an increased output of 500,000 gallons of gasoline per day at the refinery, and assuming 2.1 gallons of crude oil per gallon of refined gasoline (EIA, 2004c) and an oil tanker capacity of 22 million gallons, 17 additional oil tankers would visit the refinery. For all three projects, the annual increase would be 337 vessels (see table 4.14.7-1), or approximately two one-way transits per day. Each transit would take approximately 2 hours and multiple inbound or outbound ships could use different portions of the Port of Pascagoula channels at the same time. The realistic maximum delay that one ship transiting the channels could pose on another ship transiting the GIWW is roughly 30 minutes. If two ships were traveling one right after another along the Port of Pascagoula channels (an unlikely scenario), the maximum delay for a ship transiting the GIWW would be 1 hour.

| TABLE 4.14.7-1<br>**Estimated Number of Ship Calls for the Proposed LNG Terminal Projects and the Refinery Expansion Project** | |
|---|---|
| Project | Estimated Number of Ship Calls per Year |
| LNG Clean Energy Project | 150 |
| Casotte Landing LNG Project | 170 |
| Pascagoula Refinery Expansion | 17 |
| Total | 337 |

Small vessel traffic (e.g., commercial fishing vessels and recreational vessels that are not constrained to the dredged channel) would not be adversely affected by the additional shipping traffic because these smaller vessels can operate outside the confines of the channel and remain clear of the LNG ships.

In most ports, the greatest constraint on traffic management is the availability of tugs. The Pascagoula Pilots consider the current tug fleet operating in the port to be adequate for current operations; however, additional tugs would likely be required to accommodate the proposed LNG projects. Gulf LNG and Bayou Casotte Energy would provide needed information for ship-assist tug companies to determine the requirement for adequate tugs, with sufficient power rating, to meet the needs of the LNG terminals. The Pascagoula Pilots have also indicated that they would need to add at least two pilots to their workforce to accommodate the increased ship traffic associated with operation of the proposed LNG terminals. Although it takes up to 1 year to become a fully qualified and licensed Pascagoula Pilot, the timeframe involved in permitting and constructing of the LNG terminals would provide ample opportunity to make the necessary workforce adjustments. Overall, the cumulative increase in ship traffic would have minimal impacts on port and waterway operations.

### 4.14.8 Air Quality and Noise

Construction of the proposed project and the reasonably foreseeable projects and activities listed in table 4.14-1 would involve the use of heavy equipment that produces noise, air contaminants, and dust. Operation of the proposed project (including the LNG terminal and ships delivering LNG to the terminal) and the reasonably foreseeable projects would also contribute cumulatively to ongoing air emissions and noise.

Table 4.14.8-1 lists the air emissions associated with construction and operation of the two proposed LNG terminal projects and the Pascagoula Refinery expansion in relationship to existing air emissions in Jackson County. Although the region is currently in attainment with air quality standards, increases in point industrial sources could have a deleterious effect on local and regional air quality. If all of the proposed projects are built, there would be slight increases in CO, $SO_2$, VOCs, $PM_{10}$, and $NO_x$ emissions during construction and operation and somewhat greater increases in $PM_{10}$ during construction. Each of the individual projects would be required to obtain an air quality permit from the MDEQ, which may specify controls to limit the emission of certain criteria pollutants or HAPs. Increases in $PM_{10}$ during construction would be mitigated by BMPs. The permit process would ensure that air emissions from operation of the proposed project and other foreseeable future projects would not cause air quality to deteriorate beyond acceptable levels as specified by air quality regulations (see section 4.12.1.3).

TABLE 4.14.8-1

**Proposed LNG Terminal Projects and the Refinery Expansion Project Emissions Summary**

| Project | Air Emissions | | | | |
|---|---|---|---|---|---|
| | CO | $NO_x$ | VOCs | $PM_{10}$ | $SO_2$ |
| Existing Sources in Jackson County (tons per year) [a] | 68,609 | 35,596 | 28,262 | 12,643 | 38,190 |
| **Construction of Projects (total tons)** | | | | | |
| LNG Clean Energy Project (2006-2009) | 436.9 | 822.6 | 69.8 | 2,721.1 | 124.2 |
| Casotte Landing LNG Project (2006-2009) | 2,464.3 | 488.8 | 146.4 | 62.2 | 39.5 |
| Pascagoula Refinery Expansion (2006) | NA | NA | NA | NA | NA |
| **Total construction (percent of existing sources)** [b] | **1.4** | **1.2** | **0.3** | **7.3** | **0.1** |
| **Operation of Projects (tons per year)** | | | | | |
| LNG Clean Energy Project (>2009) [c] | 389.6 | 670.0 | 50.9 | 22.1 | 605.1 |
| Casotte Landing LNG Project (>2009) [c] | 309.9 | 493.8 | 47.4 | 37.6 | 118.1 |
| Pascagoula Refinery Expansion (>2006) | 98.2 | 39.8 | 31.1 | 14.6 | 38.4 |
| **Total operation (percent of existing sources)** | **1.2** | **3.4** | **0.5** | **0.6** | **2.0** |

[a] Area sources plus point sources; from EPA AIRDATA: http://www.epa.gov/air/data/geosel.html.

[b] Based on a 3-year construction period for both the LNG Clean Energy and Casotte Landing LNG Projects.

[c] Air emissions from mobile and stationary sources.

CO carbon monoxide
$NO_x$ nitrogen oxides
VOC volatile organic compound
$PM_{10}$ particulate matter less than 10 microns in diameter
$SO_2$ sulfur dioxide
NA not available

During operation of the LNG Clean Energy Project, air emissions from LNG ships and other project-related vessels would occur along the entire waterway from the territorial seas to the ship berth. Because of the transitory nature of these sources and the large area covered, these emissions would not have a significant cumulative impact on air quality along waterway.

As discussed in section 4.12.1, detailed modeling was performed to quantitatively evaluate the impacts from operation of the proposed project by its self against Class I and Class II area SILs and the NAAQS. The results of the analysis showed predicted concentrations from the project, which included stationary sources at the terminal, LNG carrier unloading and hotelling emissions while berthing at the terminal, as well as the emissions associated with operation of other marine vessels (i.e., Coast Guard boats and tug boats) supporting the facility, to be below the Class I area SILs and below the Class II area NAAQS. Since the Class I area impacts were predicted to be below the SILs, the project is not considered to be significant and no further Class I area analysis is required.

In order to provide a more thorough evaluation of the potential impacts on air quality, an additional Class I and Class II area modeling analysis was conducted for the LNG Clean Energy Project and Casotte Landing LNG Project combined. The results of this analysis were filed with the Commission on November 8, 2006 under the Casotte Landing LNG Project. Although further Class I area analysis was not necessary, Class I area impacts (including visibility and deposition) were predicted from both projects and were found to be below the NAAQS and applicable air quality-related values. Because the LNG Clean Energy Project impacts were expected to exceed several Class II SILs, an additional cumulative analysis was conducted. The results of the modeling analysis of the two LNG projects combined showed that emissions of $PM_{10}$, $SO_2$, and $NO_x$ would exceed Class II area SILs. However, with

the background concentrations included, the emissions were predicted to be below the NAAQS. The modeled Class II area impacts resulting from both projects are presented in table 4.14.8-2.

TABLE 4.14.8-2

**Summary of Class II Area Impacts Resulting from the Casotte Landing LNG and LNG Clean Energy Projects**

| Pollutants | Averaging Period | Highest Modeled Impact [a] ($\mu g/m^3$) | Significant Impact Level ($\mu g/m^3$) | Background Value [b] ($\mu g/m^3$) | Total Impact (including Background) [c] ($\mu g/m^3$) | NAAQS ($\mu g/m^3$) |
|---|---|---|---|---|---|---|
| $SO_2$ | 3-hour | 199.0 | 25 | 121 | 320.0 | 1,300 |
| | 24-hour | 99.0 | 5 | 52 | 151.0 | 365 |
| | Annual | 4.1 | 1 | 8 | 12.1 | 80 |
| CO | 1-hour | 756.2 | 2,000 | 2,290 | 3,046.2 | 40,000 |
| | 8-hour | 193.9 | 500 | 1,947 | 2,140.9 | 10,000 |
| $PM_{10}$ | 24-hour | 24.5 | 5 | 51 | 87.6 | 150 |
| | Annual | 1.3 | 1 | 20 | 21.3 | 50 |
| $NO_2$ | Annual | 12.6 | 1 | 15 | 48.1 | 100 |

[a] Highest impacts presented in table 3-8 of the "Joint Air Dispersion Modeling Analysis for The Casotte Landing Natural Gas Import Terminal Project and Gulf LNG Clean Energy Project" dated November 7, 2006.

[b] Based on background values presented in table 4.12.1-8.

[c] Total Impact = Highest Modeled Impact + Background Value.

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

At the time of the above modeling analysis, the appropriate data from the Pascagoula Refinery expansion was not available for inclusion. Therefore, to evaluate the impacts of all three projects combined for the pollutants that exceeded the Class II area SILs for the LNG Clean Energy Project alone, the modeled results from both the Casotte Landing LNG Project and the LNG Clean Energy Project (presented in table 4.14.8-2) were conservatively scaled up to include the emissions from operation of the Pascagoula Refinery expansion (presented in table 4.14.8-1). Table 4.14.8-3 presents the scaled cumulative impacts for comparison to the NAAQS. As shown, the total scaled cumulative impacts are well below the NAAQS for all pollutants and averaging times. Based on the modeled results and scaled cumulative values, we do not believe there would be a significant cumulative impact on air quality.

Noise sources during construction of the LNG terminal projects and the Pascagoula Refinery expansion could create temporary impacts, but they would be localized and would attenuate quickly as the distance from the noise source increases. There are no sensitive receptors such as residences or schools nearby. Therefore, cumulative noise impacts associated with construction of all of the projects are not anticipated to be significant. No long-term cumulative noise impacts are anticipated from the facilities or associated ships along the waterway during operation.

TABLE 4.14.8-3

**Summary of Scaled Class II Area Cumulative Impacts**

| Pollutants | Averaging Period | Highest Modeled Impact [a] ($\mu g/m^3$) | Emission Rate Scaling Ratio [b] | Scaled Cumulative Impact [c] ($\mu g/m^3$) | Background Value [a] ($\mu g/m^3$) | Total Scaled Cumulative Impact [d] ($\mu g/m^3$) | NAAQS ($\mu g/m^3$) |
|---|---|---|---|---|---|---|---|
| $SO_2$ | 3-hour | 199.0 | | 209.0 | 121 | 330.0 | 1,300 |
| | 24-hour | 99.0 | 1.05 | 104.0 | 52 | 156.0 | 365 |
| | Annual | 4.1 | | 4.3 | 8 | 12.3 | 80 |
| $PM_{10}$ | 24-hour | 24.5 | 1.24 | 30.4 | 51 | 81.4 | 150 |
| | Annual | 1.3 | | 1.6 | 20 | 21.6 | 50 |
| $NO_2$ | Annual | 12.6 | 1.03 | 13.0 | 15 | 28.0 | 100 |

[a] Based on values listed in table 4.14.8-2.

[b] Emission ratio estimated by dividing the sum of the operating emissions associated with LNG Clean Energy Project, Casotte Landing LNG Project, and the Pascagoula Refinery Expansion by the sum of the operating emissions from the Casotte Landing LNG Project and the LNG Clean Energy Project listed in table 4.14.8-2 for the pollutant of interest.

[c] Estimated by multiplying the highest modeled impact by the listed emission rate scaling ratio.

[d] Total scaled cumulative impact = Scaled Cumulative Impact + Background Value.

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

### 4.14.9 Reliability and Safety

Impacts on reliability and public safety would be mitigated through the implementation of applicable federal, state, and local rules and regulations for each individual project. The specific rules and regulations that apply to each individual project would ensure that the applicable design standards are implemented to protect the public and to prevent accidents and failures. The LNG terminal facilities would be sited, designed, constructed, operated, and maintained in compliance with the federal safety standards summarized in table 2.8.1-1. The pipelines and aboveground facilities associated with the LNG projects would be designed, constructed, operated, and maintained in accordance with DOT Minimum Federal Safety Standards in 49 CFR Part 192. The Coast Guard would assess the suitability of the waterway for LNG marine traffic by issuing an LOR.

Several of the present or reasonably foreseeable future projects, including the proposed project, would involve cargo terminals that could be expected to receive hazardous materials. Accidents involving such materials represent a potential impact on public safety. Continued growth in international commerce is likely to result in increased quantities of hazardous materials being shipped to and from the region.

It is difficult to evaluate the cumulative risk that such growth represents or has represented. In addition, it is difficult to measure the cumulative risk for an intentional attack on the port or the LNG facility. The addition of the LNG Clean Energy facility and its associated LNG ships would not significantly change the risk of an intentional attack in the Port of Pascagoula. It is reasonable to assume that the rate of ship accidents (including those involving the release of hazardous materials) is likely to rise with more vessel traffic, which could cumulatively increase the risk of an accident having an impact on public safety. As discussed in section 4.13.5, the Pascagoula Pilots manage vessel traffic to insure safe transit in the Port of Pascagoula Channels. The Coast Guard would also enforce a moving safety zone and moored vessel security zone around LNG ships. These and other operational controls by the Coast Guard and Pascagoula Pilots would minimize the risk of accidents involving LNG ships. Furthermore, the implementation of federal, state, and local rules and regulations concerning security and the results of

the WSA with its associated operations and Emergency Response Plan would minimize the risk to the LNG ships and terminal.

Emergency response time is a key aspect of public health and safety. No significant cumulative impacts on emergency services are expected because sufficient emergency services and facilities exist in the area to accommodate the cumulative projects. No significant cumulative impacts on emergency services are expected during operation of the proposed project. Section 4.13.5 includes our recommendation that Gulf LNG prepare an Emergency Response Plan and coordinate procedures with local emergency planning groups, fire departments, state and local law enforcement, the Coast Guard, and other appropriate federal agencies to be used in the event of an incident. Gulf LNG would be required to prepare a comprehensive plan that identifies the cost-sharing mechanisms for funding these emergency response costs. With the implementation of the coordination procedures in the Emergency Response Plan and the funding of additional emergency management equipment and personnel, no cumulative impacts would be expected on emergency response services during operation of the proposed project.

### 4.14.10 Conclusions

A determination of significance for the cumulative impacts for a specific resource is problematic because well-defined threshold values are typically undetermined. However, the majority of cumulative impacts we have identified for the proposed LNG Clean Energy Project would be temporary and minor. Consequently, their addition to other reasonably foreseeable impacts in the region does not result in an overall permanent increase of impacts. Construction of the two LNG terminal projects, if done more or less concurrently, could place pressure on local temporary housing supplies for temporary workers. However, these impacts are expected to be minor. The project would cumulatively contribute to increased ship traffic in the Port of Pascagoula. Although the LNG terminal projects would result in the degradation of some wetland and habitats, compensatory mitigation programs for each of these projects would be designed to provide a net benefit to the ecosystem. As many of the project stakeholders have commented on, the project would cumulatively benefit the local economy through job creation and wages, purchases of goods and materials, tax revenues, and by providing a new source of competitively priced natural gas.