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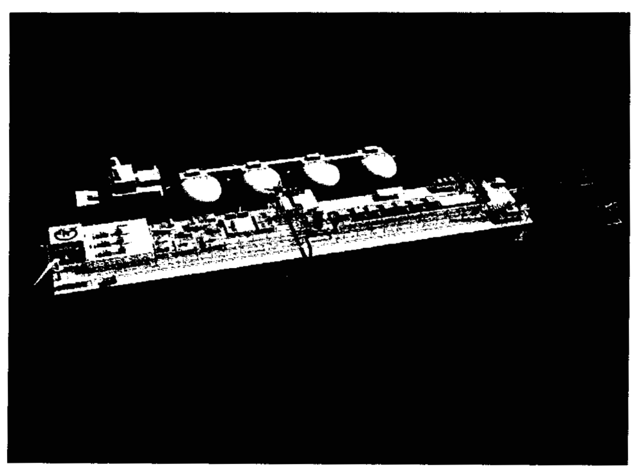
Section 4
Environmental Consequences

USCG-2004-16860-32



As discussed in Section 4.1.2.8, Gulf Landing LLC has prepared and submitted for consideration a National Pollutant Discharge Elimination System (NPDES) permit application for all of the anticipated discharges associated with operation of the proposed Port.

4.1.2.1 Terminal Installation

Short-term direct minor adverse impacts would occur during installation of the proposed Terminal. The proposed Terminal would be in the northern GOM in WC-213, approximately 61 km (38 mi) off the shore of Louisiana (Figure 2-1), in approximately 16.7 m (55 ft) of water. A proposed Safety Zone (500 m, [1,640 ft]) and a proposed Precautionary Zone (extending from the edge of the Safety Zone to approximately 1.6 km (1 mi) from the proposed Terminal) surround the proposed Terminal. Installation of the proposed Terminal and the associated pipeline would occur after the start of GBS fabrication. Approximately 3 to 4 months would be required to install the GBSs at the proposed Terminal site. Pipeline installation could occur during the summer prior to GBS installation. The pipelines would probably be installed during the summer months to take advantage of calm weather (GL 2003a).

The Proposed Action would include the placement of a Terminal consisting mainly of two GBS units. LNG storage tanks would be an integral part of each GBS unit. The two units forming the GBS structure would be constructed in a purpose-built graving dock. Each GBS unit with its associated facilities would be towed from the graving dock to the proposed Terminal location and positioned using several large tow vessels. Additional smaller vessels might be required during the tow from the construction yard to open water and then again during the installation of each GBS unit. Once the GBSs are in place, the remaining operating equipment would be installed, and connections between the GBSs, offloading platforms, and pipeline would be made.

Mooring and breasting dolphins on one side of the adjoined GBSs and an unloading platform would allow LNGCs to dock and offload on the proposed Terminal. Crew quarters would be placed above the ballast areas of the GBS and not above the atmospheric pressure LNG containment system.

During the placement of the proposed Terminal, lay and lift barge anchoring, seafloor leveling, and placement of both GBS units and installation of riprap would result in a localized increase in turbidity due to disturbance of bottom sediments. The increased turbidity from GBS placement alone would immediately affect an area of approximately 64 m (210 ft) by 152 m (500 ft) (approximately 2.47 ac) concentrated near the work site during the installation of each GBS unit and dissipating in the direction of the prevailing current. This impact on water quality is unavoidable. It is anticipated that local turbidity would return to background levels within 24 hours of the emplacement of the GBSs (MMS 2002a).

Currents and waves would be deflected in the immediate vicinity of the proposed Terminal but would regain surrounding offshore characteristics within a short distance of the Terminal. The proposed Terminal would not affect tides.

4.1.2.2 Pipeline Installation

Short-term direct minor adverse impacts would occur during installation of the proposed pipelines to connect the Terminal to an existing offshore pipeline infrastructure (Figure 2-9). Water depths along the proposed pipeline routes range from 12.19 to 18.29 m (40 to 60 ft). The proposed pipelines would support gas delivery for the life of the Port.

The pipelines would be laid on the bottom using a pipelay barge and then buried to a depth required by MMS regulations. The burial process would use a hydrojecting sled to dig the trench into which the pipelines would settle. In this area of the GOM, these types of pipeline trenches naturally refill within a matter of months. The take-away pipelines for the proposed Terminal would be kept dry once they are placed in the water, eliminating the used of biocides to prevent marine growth inside them. Once they are ready to be connected to the proposed Terminal, they would be hydrotested using potable water and then dried with nitrogen. Installation of all five of the natural gas take-away pipelines proposed for the project would take approximately 5 months (GL 2003a).

Since the proposed pipelines would be installed in water depths less than 61 m (200 ft), the Applicant is required to bury the pipelines at least 1 m (3 ft) below the mud line. This is done to prevent impacts on the pipeline potentially caused by high currents and storms, small anchors, and fishing gear, and to minimize interference with other OCS operations (MMS 2002a). Burying the pipelines would require trenching, which would cause unavoidable resuspension of seafloor sediments and temporarily increased turbidity. It is assumed that 5,000 m^3 (176,550 ft^3) of sediment would be resuspended for each 1 km (0.6 mi) of pipeline trenched (MMS 2001). Because the proposed pipelines would be 105.73 km (65.7 mi) long, the installation would cause the resuspension of 528,650 m^3 (19,332,225 ft^3) of sediments. Once trenching is complete, local water turbidity should return to "pretrenching" levels without mitigation (MMS 2002a).

Based on the water depth and pipeline size involved in the proposed Port, it is anticipated that the pipelines would be installed using two barges and a number of support vessels. The crew on the first barge—a conventional lay barge—would weld precoated joints of pipe to the string, radiographically inspect the welds, apply joint coating, and install anodes. The pipe string would then move into the water off the rear of the barge as the barge moves forward. The second barge would be the jet-trenching barge, which would cut the trenches and then cover the pipe in accordance with the requirements of 49 CFR 192.327(g) and 192.612(b)(3). Barges would probably be 107 to 152 m (350 to 500 ft) long and have eight anchor spreads (MMS 1999). The spreads would be reset at approximately 610-m (2,000-ft) intervals. Since the pipeline would be 105.7 km (65.7 mi) long, it is anticipated that there would be 112 anchor relocation efforts along the pipeline routes. Each of these anchor relocations would cause sediment displacement and resuspension, which would cause temporary and local increases in turbidity. Such impacts on water quality would be minor since it is anticipated that water turbidity at any given anchoring site would return to background levels within hours of a given relocation.

Vessels associated with the installation of the proposed pipelines would be equipped with spill containment and clean-up equipment to respond to small accidental releases of fuel oil (ship's bunkers), lubricants, or other chemicals. In the event of a large spill, an emergency response would be mobilized from shore.

4.1.2.3 Integrity Testing of the Take-Away Pipelines and Terminal Piping

If the License is approved, all pipelines including the systems pipelines on the GBS and the five take-away pipelines would undergo a hydrostatic integrity testing after installation and before being placed in operation. The pipelines would be designed to withstand stresses during installation, testing, and operations. The proposed take-away pipelines would be coated with the appropriate concrete weight-coating for undersea stability. The corrosion protection system would include a thin film epoxy external coating and sacrificial anodes.

The systems pipelines, firewater pipelines and riser sections of the pipelines would be pre-installed on the GBS and tested onshore using fresh potable water as the test medium. After completion of the pressure test, the riser sections would be drained and left void prior to the GBS being towed offshore. Potential impacts associated with this testing will be addressed in supplemental NEPA documentation as required for the onshore construction (Section 2.2.8).

The five proposed take-away pipelines would be tested in accordance with the requirements of 49 CFR 192.503, 192.505, and 192.619(a)(2)(ii). The pipelines and risers would be designed for a maximum allowable operating pressure of 1,440 psig (99.28 bar). Hydrostatic testing of the five take-away pipelines would be conducted using raw sea water as the test medium; test pressures would be held for 8 hours.

Hydrostatic testing of the proposed take-away pipelines would involve approximately 41,584 m3 (10,990,000 gal) of sea water drawn from and returned to the GOM. The intake and discharge sites would be the Terminal and the pipeline interconnection sites respectively. No chemicals or biocides would be added to the sea water used for hydrostatic testing.

Initial velocities and flow rates for filling of the pipelines have been estimated based upon Bernoulli's equation and are provided in Table 2-6. Initial velocities and flow rates would be the maximum fill rates of the pipelines. The discharge of hydrostatic test water would be made in accordance with the terms of the general discharge permit governing operations of this type in the GOM. The discharge rate would be limited to approximately 2,000 gallons per minute (GPM).

These initial sea water flow rates would be sufficient to produce both entrainment and impingement impacts on marine species present in the area. The potential for entrainment and impingement impacts would be mitigated somewhat because the initial water velocities would decrease rapidly as the pipelines fill. Placement of the uptake for hydrostatic testing water near the bottom of the sea floor would minimize entrainment and impingement impacts. It in not unlikely that some impinged or entrained organism could survive the testing process.

Dewatering of the proposed take-away pipelines would be performed by "pigs" (mechanical devices used for internal cleaning and inspections of pipelines) placed in the "hot taps" or connecting points of the lines and pushed back toward the platform by the line pack gas. Displaced water would be disposed of per appropriate authority requirements. The velocities and density of this displaced sea water should be insufficient to produce any impacts on marine species in the discharge area. Permits, if required, for disposal of the water would be obtained prior to performing dewatering activities.

No significant impacts are anticipated from the hydrostatic integrity testing of proposed Port's five take-away pipelines. This testing will be done in conformance with a required NPDES permit and all other applicable and appropriate guidelines for the testing of offshore pipelines in the GOM.

4.1.2.4 Routine Terminal Discharges

Six principal, routine discharges from the proposed Terminal via six separate outfalls might be expected to result in long-term direct minor adverse effects on water quality. These are

- ORV-process discharge (treated with sodium hypochlorite) averaging approximately 136 MGD (514,668 m^3/day) with a maximum flow of 152 MGD (575,217 m^3/day) with a discharge concentration of less than 0.5 ppm sodium hypochlorite.
- Wastewater from the utility areas that include power generation, BOG compressor, emergency diesel generator, diesel day tank, and diesel loading areas where there is a potential for the presence of (non-LNG) liquid hydrocarbons contained within skid drain pans. These drain pans can collect rainwater, machine wash down wastewater, or other fluids in the areas. Depending on rainfall, there could be approximately 807,000 gallons per day (GPD) (3,054 m^3/day) discharged.
- Uncontaminated rainfall drainage from the deck outside the utility areas resulting in an estimated discharge of 21,000 GPD (79.5 m^3/day).

- Brine water (40 psu) discharge from the onsite water treatment plant at an approximate rate of 25,400 GPD (96.1 m^3/day).
- Combined domestic water (gray water discharge from shower, laundry, lavatory, scullery, and galley) and sanitary water (black wastewater from urinals and toilets) discharge (two combined treated discharges) averaging approximately 7,500 GPD (28.4 m^3/day) at each treated discharge. The discharge would contain a maximum of 1 milligram per liter (mg/L) of total residual chlorine.
- Water associated with the facility fire protection system used intermittently for testing or emergencies, is discharged at an estimated rate of 20,979 gallons per hour (gph) (79.4 m^3/hr) with a concentration of less than 0.5 ppm hypochlorite (GL 2003a).

ORV Process Seawater Discharge

The ORV-process discharge (treated with sodium hypochlorite) would have several impacts on water quality within 100 m (328 ft) of the proposed Terminal, including decreased water temperature, increased turbidity, increased DO concentration, and residual sodium hypochlorite solution. ORV discharge could contain solids from slough off of organisms growing in the process units and conveyances or from pipe scaling. However, the concentrations of such materials would be expected to be minimal as the ORV water would be treated before circulation to prevent the occurrence of such materials. Furthermore, turbidity increases due to potential erosion of the sea floor by the ORV discharge are expected to be minimal because riprap would be placed on the sea floor near the discharge ports and areas with significant thermal plume-induced velocities near the sea floor. However, it is anticipated that the ORV discharge plume would entrain the turbid water of the nepheloid layer and carry it along its trajectory. As the plume velocity decreases with distance from the discharge point, the nepheloid materials would settle out of the plume. The lifting, transporting, and resettling of the nepheloid materials would increase turbidity in and around the discharge plume (GL 2003a).

Evaporation of water as it travels through the ORV system would be negligible, thus any salinity increase of the discharge water would be negligible. The pH of the ORV discharge might be increased slightly because of the addition of sodium hypochlorite into the ORV pump suction for biofouling control. Neglecting chlorine losses in the ORV process, the chlorine concentration in the ORV effluent would be 0.5 ppm. Note that chlorine losses (e.g., to the atmosphere) that might occur as the sea water flows from the pumps through the ORV and to the discharge point are not accounted for in these chlorine concentration estimates, and therefore the stated chlorine concentrations are conservative estimates (i.e., high) (GL 2003a).

The maximum total water discharge per day from the proposed Terminal would be approximately 154.3 MGD (583,921 m^3/day). The majority (99.9 percent) of the water discharge would be from the ORV. The ORV discharge would be sea water that is passed through the ORV process system, and subsequently returned to the GOM. Sea water from the intake would be screened and treated with sodium hypochlorite at the intake pumps (to control marine growth in the system) before it is distributed to the ORV system. A sodium hypochlorite solution between 2 and 5 ppm would be injected at the suction of the seawater pump to prevent marine growth in the warming water system. The injection concentration would be varied to maintain a maximum diluted sodium hypochlorite concentration in the warming water outfall discharge of not more than 0.5 ppm. The injection concentration that works best at the least cost will require trial and monitoring. In no case will the discharge concentration be allowed to exceed 0.5 ppm.

After treatment, the treated sea water would then flow through independent lines to the top of the ORV and be cooled by a maximum of approximately 10 °C (18 °F) below ambient water temperature. The cooled sea water would then flow from the bottom of the ORV into a basin, where it would then be routed to the seawater outfall and returned to the GOM (GL 2003a).

ORV Discharge Plume Temperature and Induced Velocities. A generic multiport manifold design would have limited impacts on temperature and flow behavior as induced by the discharge of cold water to the GOM from the ORV. This is based on modeling results using the Offshore Operators Committee discharge model and USEPA's Cornell Mixing Zone Expert System (CORMIX) model. USEPA has accepted the application of this model for use in evaluating Gulf Landing LLC's NPDES permit application for the proposed Terminal. LATEX Site 20 lies about 35 NM west of the proposed Terminal site. Owing to the similarity of water depth, distance offshore, and coastal configuration, the LATEX Site 20 data are considered to be representative of conditions at the Gulf Landing site (GL 2003a).

The regasification facility is identified as a GBS and is expected to employ seven seawater lift pumps that would draw their water from an intake cage located at an elevation in the water column that is yet to be determined. The water is to be continuously discharged through two 1.8 m (72 in) discharge lines. At the end of the discharged lines, there would be a diffuser, about 100 m (328 ft) long. The intake cage would be southeast of the facility. The outfall would be southwest of the facility. In the base case used in the CORMIX model, the seawater flow rate is expected to be 20,000 m^3/hr. The discharged sea water would be 10 °C (18 °F) cooler than its temperature at the intake cage (GL 2003a).

Ambient conditions used in the analysis were set based on currents and hydrographic conditions measured in the nearby region. No *in situ* measurements were available. Current discharge peeds exceeded 90, 50, and 10 percent of the time were estimated to be 0.03, 0.097, and 0.218 m/s, respectively. Hydrographic measurements indicated that ambient density gradients ranged from 0.0 kilogram per cubic meter per meter (kg/m^3/m) (unstratified) to about 0.19 kg/m^3/m (strongly stratified). The strong stratification was due almost entirely to the formation of a halocline, little temperature variation was observed in individual temperature profiles (GL 2003a).

Occasionally, when fast currents flow parallel to the diffuser, the diffuser will perform poorly and provide little dilution. If the diffuser axis is oriented north-south, this situation is expected to occur about 1.6 percent of the time. The temperature deficiency predicted when this occurs is about 6 °C (10.8 °F) and the resulting cool water plume thickness will be less than 1 m (3.3 ft). The persistence of such events is expected to be 12 hours or less (GL 2003a).

Distributions of the probability of cool water released from the outfall visiting any location around the outfall within a certain travel-time horizon were calculated. All available near-bottom currents measured at LATEX Site 20 were used for this analysis. The distributions can be represented by closed contours surrounding the outfall. As the travel-time horizon increases, the contours expand. For a travel-time horizon of 36 hours, the 20 percent visitation probability contour extends approximately 3,000 m (9,842 ft) east and west of the outfall and approximately 2,000 m (6,561 ft) north and south of the outfall. This means that there is a 20 percent probability that the cool water plume will visit the intake location within 36 hours after discharge during a 1-year operation of the LNG facility (assuming the intake is less than 2,000 m (6,561 ft) away from the outfall) (GL 2003a).

ORV Discharge Plume Behavior—Temperature. The CORMIX model of the discharge plume demonstrated that the plume temperature would rise from its initial value at the discharge port to near ambient levels with increasing distance from the Port, as measured in the horizontal direction aligned with the plume axis (GL 2003a). The rates at which the temperature of the plume would rise toward ambient temperature for various operating conditions of the same port design are quite similar. Yet designs with a larger number of ports have a somewhat more rapid rise toward ambient conditions. The ORV plume would reach near-ambient temperatures in shorter distances from the discharge manifold when a crosscurrent is present due to increased mixing of plume and ambient water. A detailed discussion of this model and the model results are presented with the Gulf Landing Deepwater Port License Application (GL 2003a) available on the USDOT Docket Management System *<http://dms.dot.gov>*, USCG-2004-16860.

The far-field model (using all available near-bottom data from LATEX Site 20) predicted the distribution around the outfall of maximum temperature deficiencies expected during a 1-year operation of the LNG facility (GL 2003a). The far-field distributions of maximum temperature deficiencies of cool water discharged from the diffuser exhibit an almost uniform maximum temperature deficiency of about 0.5 °C (0.9 °F) within 4,000 m (13,123 ft) of the outfall. Maximum temperature deficiencies occur in the lower one-third to two-thirds of the water column. In effect, the diffuser creates large plumes of water slightly cooler than the ambient water and these plumes wander about near the discharge, decaying very slowly, and in combination covering the entire area within 4 km (2.5 mi) of the outfall during a 1-year operation. This means that entrainment of diluted cool water from the diffuser in the seawater intake will occur regularly during a 1-year operation of the facility. The temperature deficiency, however, will be much less than yearly fluctuations of the natural ambient temperature expected at the Gulf Landing site (GL 2003a).

The diffuser configuration reduces the temperature deficiency to 1.1 °C (1.98 °F) or less at a 100 m (328 ft) distance from the discharge under most ambient conditions. Roughly 1.6 percent of the diffuser will allow a change in temperature to equal 6 °C (10.8 °F) at the 100 m (328 ft) distance. For comparison, the World Bank criterion for thermal discharges from power plants is a change in temperature less than 3 °C (5.4 °F) at a 100 m (328 ft) distance (GL 2003a).

ORV Discharge Plume Behavior—Dilution. The region surrounding the outfall will be subject to strong vertical fluid motions and the cool water effluent will be mixed throughout the water column. Much of this mixing will involve the re-entrainment of previously discharged cool water and this will reduce the effective dilution. Because of the adverse buoyancy of the cool water, it will spread upstream under the slower current speeds expected at the site. At some distance from the outfall, the water column will restratify and the cool water plume will form a layer on the sea floor. The cool water discharge from the proposed Port will behave in this way (GL 2003a).

When operating properly, the diffuser provides its improved dilution by distributing the cool water effluent over a much larger range of depths in the water column. At a distance of 200 m (656 ft), the diffuser plume occupies up to 15 m (49 ft) (88 percent) of the water column. This fact, together with the tendency of discharged water to meander in the vicinity of the outfall suggests that water with a slight temperature deficiency, will unavoidably be taken into the intake cape if the 96-m (314-ft) diffuser configuration is employed. Vertical positioning of the intake cage would not affect this and there is a risk that positioning the cage at the surface will cause trapping of the cool water plume within the water column in stratified conditions. The diffuser plume fills the water column near the diffuser and occupies the lower one-third to two-thirds of the water column at a distance of 500 m (1,640 ft). Upstream intrusions of the cool water lens of about 300 m (984 ft) are possible in slow currents. Temperature deficiencies of 0.1 to 0.6 °C (0.18 to 1.08 °F) are reported at distances of 100 m (328 ft) and up. Corresponding hypochlorite concentrations are expected to be 0.005 to 0.03 ppm (GL 2003a).

ORV Discharge Plume Behavior—Velocities and Entrainment Behavior. The combination of a cool water effluent that wants to sink, the injection of the effluent upward at high velocity into a relatively shallow water column, and the large volume flux of that effluent in comparison with the ambient volume flux will lead to instability, recirculation, and re-entrainment in the region near the outfall.

Modeling results show that horizontal velocities are important due to potential scour when the plume is near the sea floor, while the vertical velocity becomes important to scour in the region where the plume strikes downward onto the sea floor (GL 2003a). Both velocities show an exponential-like decay in the plume. Once the impact region is reached, increased velocities along the sea floor would occur. Without bottom protection (e.g., riprap) scour of the bottom could be excessive over an extended period of time in such areas (GL 2003a).

As the plume diameter increases, so would the volume of water entrained. As a result, large volumes of surrounding sea water would be drawn into the plume as it warms. The amount of living material suspended in the surrounding ambient waters that could be drawn into the plume could, therefore, be considerable. However, whether adverse impacts from such entrainment would be significant would depend on what is entrained and what types of velocities and temperature in the plume could occur without damage to the entrainment matter. Without impacts caused by either temperature or fluid motion in the plume, the net effect of the entrainment would be to merely move suspended matter within the ORV plume (GL 2003a).

ORV Discharge Plume Behavior—Travel Time. Modeling results show that the time for a water particle or a dissolved constituent discharged from a port to reach near-ambient conditions (i.e., within 1.5 °C [2.7 °F] of ambient temperature) would vary but would be in the order of 10 seconds to 1 minute. The estimated travel time for a water particle or a dissolved constituent to reach a 100-m (328-ft) distance along the plume axis would be on the order of 0.5 to 2 minutes (GL 2003a).

ORV Discharge Plume Behavior—Plume Length and Width. The plume's region of impact is defined as the plume area (axial length and width of the plume) at the distance from the discharge manifold when the plume temperature reaches near-ambient (i.e., 1.5 °C [2.7 °F] less than ambient) (GL 2003a). The Applicant's model-computed plume widths were used to estimate the plume lengths for the region of impact. Model results demonstrated that the width and radial distance or length for the region of plume impact were less than 50 m (164 ft) and 26 m (84 ft), respectively, for varying flow rates and numbers of operational ports (GL 2003a).

DO Concentration. Discharges from the proposed Terminal that could potentially affect the DO concentration in the receiving waters would include the ORV discharge, combined domestic water and sanitary water discharge, and storm water discharge (GL 2003a).

Water from the GOM would be circulated through the ORV units. The process would cool the water by approximately 10 °C (18 °F) before it is returned to the GOM. It is also expected that the water would become aerated as it flows over the tubes of the ORV, falls into the concrete trough at the base of the ORV, and flows across the deck to the discharge point. Because of the potential opportunity for aeration and because the saturation concentration of oxygen in water increases with decreased water temperature, the ORV water is expected to be returned to the GOM with an increased DO content (approximate increase of 1.7 to 4.3 mg/L estimated for August 2002, depending on the depth of the seawater intake) (GL 2003a). Year-round estimates of potential local DO concentration changes are not known (GL 2003a).

Hypochlorite Generator Wastewater Discharge

The hypochlorite electrolyzers would be cleaned using hydrochloric acid. The hypochlorite generator wastewater would include the acid, which would be neutralized using hydroxide or lime. After pH adjustment, the waste would be discharged overboard. The waste would be discharged at an approximate rate of 114 L (30 gal) per month. Because the pH would be adjusted before discharge, no impacts on water quality are anticipated.

Domestic Water and Sanitary Water

Sanitary waste generated by the quarters building, the maintenance/control room, lab, warehouse building, and electrical building would be collected and treated. Two sanitary waste systems consisting of a collection system and package sewage treatment units would be provided. These package units would be of the biological treatment type. It is estimated that each combined sanitary and domestic wastewater treatment unit would discharge 7,500 GPD (28.4 m^3/day). Additionally, the tugboats and service/supply vessels would have their own sanitary waste systems that are independent of the Proposed Action (GL 2003a).

Domestic water and sanitary water discharges would be expected to contain suspended solids (less than 150 mg/L) (33 CFR Part 159). Domestic water and sanitary water would be routinely discharged from the proposed Terminal in accordance with the CWA (Section 312), NPDES permits, and USCG regulations to prevent long-term impacts on water quality. Nevertheless, the discharge of domestic water and sanitary water would cause increased turbidity in the receiving water in the immediate vicinity of the proposed Terminal. Further, the discharge from the wastewater treatment plant would contain chlorine. The residual chlorine concentration would be a minimum of 1 mg/L with no floating solids. Wastewater observations would be made on a daily basis, during daylight, in the vicinity of the sanitary waste outfall, following either morning or midday meals, and at the time of estimated maximum discharge (GL 2003a).

Treated water discharges from the proposed Terminal would probably contain some biochemical oxygen demand (BOD). The 5-day BOD in untreated wastewater from sanitary and domestic sources can range from 59 to 109 grams (g) (0.13 to 0.24 lb) per day per person (Tchobanoglous et al. 2002). Assuming a staff of 60 to 100 on board the proposed Terminal, the total BOD from sanitary and domestic sources would range from approximately 6.53 to 10.9 kilograms (kg) (14.4 to 24 lb) per day.

Sanitary and domestic water discharge might introduce additional nutrients into the water column. Discharges of sanitary wastes and domestic wastes would be rapidly diluted and dispersed (i.e., to ambient levels within several thousand meters of the discharge). Therefore, they are not expected to have any significant impact on water quality in the offshore GOM (MMS 2001).

Tugs would discharge approximately 2 m^3 (71 ft^3) of treated effluent per day, consistent with the requirements of 33 CFR 159. Each LNGC would discharge approximately 5 m^3 (177 ft^3) of treated effluent per day meeting the requirements of Marpol Annex IV and MEPC.2 (VI). Supply vessels would not be expected to discharge while at the Port. However, if they are equipped to do so, it is anticipated that the discharge would be similar to the tugs in meeting 33 CFR 159. As they would be on site for less than half a day, their discharge would be approximately 1 m^3 (35 ft^3) per day.

Skidded Equipment Open Drain and Oily Water Treatment

Equipment that has the potential to release hydrocarbons would be designed to be on skids. Skids would include drain pans to hold any potential hydrocarbon and rainwater. The open-drain system would collect any rainwater, wash water, or other fluid and would be pumped to the oily water treatment system. The system would consist of a coalescing plate interceptor (CPI) separator where the water and hydrocarbon would be separated to meet the effluent limitations for the facility. The CPI separator would be able to handle a maximum discharge of approximately 807,000 GPD (3,054 m^3/day). Connections at the utility stations would provide washdown water for the facility. A portable pneumatic washdown unit would allow for high-pressure washdown. The discharge of deck drainage that fails the visual sheen test would be prohibited.

Oil would be removed and stored in a waste oil holding tank for transport to an onshore reclaiming station. The proposed Terminal equipment, including the instrument/utility air unit, diesel fuel system, BOG compressor, power generators, nitrogen generator unit, and fuel gas compressor, containing hydrocarbons would also drain to the open-drain and oily-water treatment system. Open areas of the proposed Terminal not subject to hydrocarbon spills (e.g., around the crew quarters) would flow to a holding basin and drain overboard if no sheen is visible. If oil were present, it would be contained and placed into the CPI system for treatment. The design of the drain system would handle the expected maximum rainfall rate for the area. Based on the limited local rainfall data at present, the peak rainfall for sizing of the CPI separator is based on 2 inch per hour (in/hr) of rainfall for 20 minutes that would yield approximately 24,500 gal per storm event. The peak daily rainfall recorded in Louisiana yielded 22 inches in 24 hours. This is equivalent to 0.92 in/hr, which could result in approximately 807,000 GPD (3,054 m^3/day) (GL 2003a).

The open-drain system described above would effectively prevent impacts on water quality such as hydrocarbon or chemical spills by collecting any rainwater, wash water, or other fluid, and pumping these to the oily-water treatment system.

Firewater Drainage

Firewater pumps draw sea water from the GOM for the fire protection system. The system is used intermittently for testing or emergencies. To control marine growth throughout the system, a sodium hypochlorite solution between 2 and 5 ppm would be added to the sea water. Firewater is discharged at an estimated rate of 20,979 gallons per hour (gph) (79.4 m^3/hr) with a concentration of less than 0.5 ppm hypochlorite (GL 2003a).

Intermittent Storm Water from Deck Drainage

The storm water discharge would come from intermittent, uncontrolled deck drainage and could cause increased turbidity. Storm water affected by hydrocarbons would be routed through an oil-water separator and discharged without sheen. The USEPA Storm Water Multisector General Permit (60 *Federal Register*, No. 189, 1995) lists statistics for selected storm water pollutants reported by oil and gas extraction facilities. The mean grab sample total suspended solids concentration reported was 332 mg/L and the mean grab sample 5-day BOD reported was 13.9 mg/L. Such values might be expected in the storm water discharge of the proposed Terminal. The average daily discharge is estimated at approximately 21,000 GPD (79.5 m^3/day) from the deck area of the GBS (GL 2003a).

Brine Water

Excess and rejected water from the desalination system on board the GBS facility would be discharged in one outfall. The desalination system would consist of two reverse-osmosis water purifiers to produce potable water from the sea water. Sea water would be pumped from the ocean and fed into the units to produce potable water for the facility. The purifiers are designed to process a total of approximately 31,700 GPD of sea water and produce about 6,300 GPD of purified potable water. About 80 percent of the sea water feeding the units (25,400 GPD) would be rejected throughout the process and discharged into the GOM. The potable water would be collected in a storage tank and distributed on demand. The salinity of the discharge water from the purifiers would be approximately 0.04 parts per trillion (ppt) (GL 2003a).

The brine solution discharged from the production of the onsite reverse-osmosis seawater desalination could cause an increase in the salinity and turbidity of the receiving waters in the immediate vicinity of the brine water outfall. No lasting impacts are anticipated from the discharge of desalination plant brine as mixing with ambient sea water would readily dilute the higher salinity brine to that of ambient sea water.

4.1.2.5 Anchoring of LNGCs

LNGCs would use the GOM fairways south and east of the proposed Terminal. Navigational aids are installed along established fairways. The need for additional navigational aids to mark the Applicant's proposed Recommended Route would be reviewed by the USCG and MARAD. A racon (radar signaling) device would be installed on the Terminal. It is assumed that under most circumstances, LNGCs would approach the proposed Terminal from the Calcasieu Pass Fairway located approximately 3.5 km (2.2 mi) east of the proposed Terminal. There are no structures between the fairway and the Terminal; however, new ones might be constructed in the future. The proposed Terminal location has been selected to avoid proximity to such structures. Traffic to the Terminal is expected not to exceed 135 LNGCs per year (approximately 1 LNGC every 2.7 days).

Gulf Landing LLC proposes to designate three Anchorage Areas north and south of the Terminal (Figure 2-3). These Anchorage Areas would be used to stage LNGCs if weather conditions prevented berthing or if unforeseen delays resulted in an LNGC arriving before one has disengaged from the proposed Terminal. Typical Terminal operations would not require LNGCs to anchor.

The Applicant's proposed Anchorage Areas are within the Applicant's proposed Precautionary Area. The Terminal's proposed Precautionary Area would have a radius of approximately 1.6 km (1 mi) from the proposed Terminal.

There are a number of prohibited areas, clearly marked on navigation charts, designated in the GOM. Transiting vessels may cross these areas but under no circumstances may they anchor, drill for oil, or lay a pipeline through them. No such prohibited areas are near the proposed Terminal or the Applicant's Recommended Route to the proposed Terminal. No lasting impacts on water quality are expected from the anchoring. While at anchor, LNGCs would discharge in compliance with existing Federal regulations to prevent impacts on water quality.

4.1.2.6 Decommissioning

Short-term direct minor adverse effects on water quality would be expected in connection with decommissioning of the Terminal.

The proposed Terminal would be designed for a 30-year life. At the end of that period, the proposed Port would be decommissioned. All assets would be designed such that, upon reaching the end of their useful life, they could be decommissioned either by dismantling and removal or by abandonment, in accordance with statutory requirements and existing standards. Structures would be removed; pipelines would be left in place. The site would be left in a safe and environmentally acceptable condition following all requirements listed in MMS GOM OCS Region NTL No. 98-26, *Minimum Interim Requirements for Site Clearance (and Verification) of Abandoned Oil and Gas Structures in the Gulf of Mexico.*

If explosives are used during decommissioning of the proposed Terminal, they would be of a type normally used for decommissioning of facilities in the GOM (i.e., less than 50-pound charges). Prior to decommissioning, the underwater portion of the structures would be evaluated to determine the nature and extent of habitat developed during the operational life of the facility. In consultation with appropriate Federal agencies, a decommissioning plan would be agreed upon. If explosives are used to decommission the proposed Terminal, appropriate agencies would be informed of relevant impact zone models, types and weights of explosives, possible effects on listed species, and actions to be taken to eliminate or reduce effects on listed species. Such activities would cause sediment displacement and the temporary increase of water turbidity.

4.1.2.7 Spills of Hydrocarbons and Other Hazardous Substances

Spills of hydrocarbons (petroleum, oil, and lubricants) might result in direct adverse effects on water quality, which are expected to be minor and short in duration. If the license is approved, the proposed Terminal plans would include the detailed engineering and procedural conditions necessary to minimize the potential occurrence of spills and minimize the potential impacts from spills that might occur. The facility's proposed 850-m^3 (224,500-gal) capacity diesel storage tank, which represents a 7-day supply of diesel oil, would require the Applicant to have an approved Facility Response Plan. The Facility Response Plan, Port Operations Manual, and any other required spill prevention plans would be developed to meet or exceed the requirements of all applicable and appropriate regulations and guidelines.

Protective Measures. Impacts associated with the proposed activity would be avoided or minimized by protective measures including

- Written oil transfer procedures would be required in order to receive diesel oil shipments from supply vessels.
- All equipment and process designs would be previously proven and consistent with industry norms.
- Spill-containment and recovery equipment would be strategically placed on the deck of the GBS.
- The design, construction, and operation of the facility would minimize the use of materials determined to be toxic or hazardous to the environment.
- The preparation of a Facility Response Plan includes training for spill response and spill response exercises.
- The cranes on the intake recovery towers would be electric.

Potential Contaminants. The Port Operations Manual and Facility Response Plan would describe measures to be implemented by personnel and contractors to prevent and, if necessary, control any inadvertent spill of petroleum products and hazardous materials such as fuels, lubricants, and solvents that could affect water quality. The Port Operations Manual and Facility Response Plan would identify typical fuel, lubricants, and hazardous materials stored or used, and the location, quantity, and method of storage. The Port Operations Manual and Facility Response Plan would also describe the preventive and mitigative measures to avoid or minimize impacts of spills of fuel, lubricants, or hazardous materials. In the event of a spill, the Port Operations Manual and Facility Response Plan would identify emergency notification procedures and procedures for collection and disposal of waste generated during spill cleanup or equipment maintenance. The Port Operations Manual and Facility Response Plan would be updated with site-specific information prior to construction.

The nature of these types of facilities suggests that industrial contaminants generally associated with hydrocarbon facilities would be present but at very low volumes. Further, the proposed Terminal would not include ship or helicopter refueling capability (fuel oil, aviation fuel, and diesel oil) or supplies for provisioning vessels. Limited fuel (such as diesel) for support craft and cranes would be stored on the proposed Terminal for its own use during startup and emergency situations. Oil spills from the proposed Terminal are expected to be minimal because of the small quantities stored there. A spill from the proposed Terminal would be expected to produce adverse, but not significant, impacts on water quality (MMS 2001).

4.1.2.8 LNG Spills

No adverse impacts on water quality are anticipated from an accidental spill or release of LNG since the LNG would spread on the surface of the water and rapidly dissipate. When exposed to ambient sea water, LNG would boil rapidly and vaporize due to its low boiling temperature (approximately -162 °C [-260 °F]). The formation of ice is also possible, although this has not been observed in field experiments (GL 2003a). At the proposed Terminal, basic concrete structures would act as the secondary containment barrier for LNG storage tanks, with a proprietary designed and insulated, stainless steel or aluminum primary tank constructed against the concrete interior.

4.1.2.9 Activities Affecting Coastal Waters

Long-term direct minor adverse effects would be expected in connection with activities in coastal waters. Discharges from vessels and onshore facilities would be the primary sources of impacts on water quality in coastal waters. Impacts on coastal water quality resulting from the proposed Port would be minimal, provided that all operations consistently comply with regulatory requirements.

In coastal waters, the water quality could be affected by the discharges of bilge and ballast waters, trash and debris, and sanitary and domestic wastes from the service/supply vessels and tugs in port. Bilge and ballast water can be contaminated by oil leaks from the vessel machinery. All trash and debris that cannot pass through a 25-mm mesh screen must be returned to shore for proper disposal with municipal and solid waste (33 CFR 151.51-77). Marine sanitation devices that comply with 40 CFR Part 140 and 33 CFR Part 149 are required to handle sewage aboard all vessels with toilet facilities. Some states may, however, prohibit the discharge of all sewage within any or all of its waters. Gray water from vessels (dishwater, shower, laundry, bath, and washbasin drains) is not regulated in the GOM.

4.1.2.10 Mitigation

As discussed, Gulf Landing LLC submitted an NPDES permit application in October 2003 for all of the regulated discharges anticipated in associated with operations of the proposed Port. This permit is required under conditions of the CWA and USCG regulations to prevent long-term impacts on water quality. If granted, the permit will describe the conditions and mitigation measures required for compliance. In addition, a Facility Response Plan, Port Operations Manual, and any other required spill-prevention plans would be developed to meet or exceed the requirements of all applicable and appropriate regulations and guidelines.

4.1.3 Alternate Site Location (WC-183)

Siting of the proposed Port in WC-183, approximately 13 km (8 mi) north of the location proposed by Gulf Landing LLC in WC-213, would result in impacts essentially similar to those discussed for the Proposed Action. In WC-183, the proposed Terminal would be in approximately 16.5 m (54 ft) of water; in WC-213 it would be in approximately 16.8 km (55 ft) of water. The moderate difference in depth between the two locations and their essentially equal distances from shore would not be expected to alter materially the nature or quality of the predicted impacts on water quality. Similarly, any discharges associated with operating a deepwater port at this location would be subject to the same NPDES permitting requirements as the Proposed Action. If the Terminal was located in WC-183 the combined length of the five proposed take-away pipelines would be approximately ??? shorter than the combined

4. Environmental Consequences

4.1 Water Quality

4.1.1 Evaluation Criteria

Significant impacts on water quality are those that measurably threaten human health; result in persistent degradation of the environment; or cause an existing Federal, state, or local water quality criterion or a federally recognized international criterion to be exceeded.

4.1.2 Proposed Action

A combination of long- and short-term minor adverse effects on water quality would be expected. These would occur with respect to both marine and coastal waters. The following list identifies discrete activities associated with the proposed Port that could affect marine and coastal water quality:

- Installation of the proposed Terminal
- Installation of the proposed pipelines
- Integrity testing of the proposed pipelines and Terminal piping
- Routine Terminal discharges
- Anchoring of LNGCs
- Decommissioning
- Hydrocarbon spills
- Activities affecting coastal waters

The principal impacts on water quality caused by the proposed activity would be (1) a cool water plume anticipated at a distance of 100 m (328 ft) from the discharge point causing the discharge water temperature along the sea floor to be 1 °C (33.8 °F) or less below the ambient water temperature, (2) sodium hypochlorite concentrations less than 0.05 ppm at a distance of 100 m (328 ft), (3) increased water turbidity caused by routine ORV water discharge and singular events including the emplacement of the proposed Terminal and the pipelines, (4) entrainment of suspended matter into the ORV plume, and (5) routine domestic water and sanitary water discharges.

The proposed Port would result in routine and singular impacts. Routine impacts are those that would have the greatest potential of having lasting and localized impacts on water quality. These include the ORV water discharge, domestic water and sanitary water discharges, and brine discharge from the onsite reverse-osmosis water treatment plant. Singular impacts include activities that would likely have localized and temporary impacts on water quality. There would be five principal activities resulting in temporary and localized sediment displacement and increased turbidity: (1) seafloor leveling and the emplacement/installation of the GBSs, (2) trenching and proposed pipeline installation, (3) anchoring of lift and other support barges during installation of the Terminal, (4) anchoring of barges during the pipeline installation and anchoring of LNGCs waiting to berth at the proposed Terminal, and (5) decommissioning of the proposed Terminal and pipelines.

length of the pipelines proposed for WC-213. This would result in less turbidity impacts from installation and less sea water impacts from hydrostatic testing. Considering the mitigation measures common to either Port location and the uniform conditions anticipated for this region of the GOM, the difference in pipeline impacts is not significant. As noted in Section 2.0, if WC-183 was selected as the preferred site all applicable and appropriate studies would be conducted.

4.1.4 No Action Alternative

Under the No Action Alternative, the Secretary would deny the license application preventing construction and operation of this deepwater Port proposal. If the Secretary pursues the No Action Alternative, the short- and long-term environmental effects on water quality resources identified in Section 4.1.2 of this EIS would not occur. Existing conditions would prevail and there would be no contribution to the Nation's natural gas supply from this source. Because of the existing and predicted demand for natural gas, it would be necessary to find other means to facilitate the importation of natural gas from foreign markets that would equal the contribution from the proposed Port. Strategies to meet this need could include other deepwater port applications, expansion of existing or construction of new onshore LNG ports, or increased use of other energy sources.

4.2 Biological Resources

4.2.1 Evaluation Criteria

This section evaluates the potential impacts on biological resources associated with the Proposed Action (WC-213), Alternate Site location (WC-183), and the No Action Alternative. The biological resources potentially affected by the Proposed Action are described in Section 3.2. The significance of impact on biological resources is based on (1) the legal, commercial, recreational, ecological, or scientific importance of the resource, (2) the proportion of the resource that would be affected relative to its occurrence in the region, (3) the sensitivity of the resource to the proposed activities, and (4) the duration of the ecological ramifications. The impacts on biological resources are considered significant if important resources are adversely affected over areas that are large relative to the species distribution within the ROI. Impacts are also considered significant if disturbances cause reductions in population size or changes in distribution of important species. Impacts on protected species (i.e., threatened or endangered species, marine mammals, migratory birds, or federally managed fisheries), if present, will be discussed under each impact.

4.2.2 Proposed Action

Minor adverse impacts on biological resources might result from the Proposed Action. These impacts would occur in connection with installation and operation of the proposed Port, potential LNG spills, and decommissioning. The following discussions address potential effects on coastal and offshore resources, nonthreatened and endangered marine mammals, threatened and endangered sea turtles, nonthreatened and nonendangered migratory birds, threatened and endangered birds, federally managed commercial and recreational fisheries, and EFH. Based on the evaluation criteria presented in Section 4.2.1, the identified impacts are not expected to be significant.

4.2.2.1 General Construction Impacts

Coastal

Terminal installation, pipeline installation, and hydrostatic testing of take-way pipelines would occur from 23 to 61 km (14 to 38 mi) offshore and would have no direct or indirect effects on coastal protected habitats, coastal barrier beaches and dunes, wetlands, or seagrass beds.

Offshore

Placement of the proposed Terminal and installation of the five take-away pipelines would result in some temporary and unavoidable impacts on offshore biota in the immediate construction area. Under the Proposed Action, the GBSs would be constructed onshore and towed to the proposed Terminal area, where they would be lowered into the specified location. Placement of the proposed Port would involve installing the GBS concrete bases, intake and outfall structures, and five interconnector pipelines– activities that would disturb the sea floor and benthic community. The proposed Terminal would be installed in WC-213 in approximately 16.8 m (55 ft) of water, 61 km (38 mi) off the Louisiana coast. A proposed Safety Zone would have a radius of 500 m (1,640 ft) from the center of the proposed Terminal and would encompass an area of approximately 194.1 ac.

The placement of the GBSs would disturb sediments and cover and displace benthos. The areal extent of seafloor disturbance corresponds to the dimensions of the cement bases of both GBSs (including the GBS skirts); approximately 11 ac for the two GBSs and the scour protection (the intake and outfall structures) would be disturbed.

During installation, sediments would be disturbed around the footprint of the GBSs and in proximity to lay and lift barge anchor sites, displacing fish and covering benthos. Some minor loss of benthic (epifaunal and infaunal) prey might occur. Long term impacts from the footprint of the proposed Terminal would be small (a total area of 11 ac), representing only 0.1 percent of the benthic habitat available in WC-213. Except for the proposed Terminal footprint, faunal benthic communities would also recover from localized damage, including anchor damage, without mitigation.

Approximately 105.7 km (65.7 mi) of pipeline would connect the proposed Terminal with existing pipeline facilities. The proposed pipelines would be buried at least 0.9 m (3 ft) below the sea floor and 3 m (10 ft) under shipping fairways. It would take approximately 5 months to completely install the proposed pipelines. The proposed pipelines would be installed using shallow draft lay barges. Based on the water depth and pipe size involved in the project, it is anticipated that the proposed pipelines would be installed using two barges and a number of support vessels. Installation of this diameter pipe in these water depths would require barges that are 91 to 152 m (350 to 500 ft) long and have eight anchor spreads. The maximum anchor spread is expected to be approximately 7 times the water depth at the construction site. The spreads would be reset at approximately 610 m (2,000 ft) intervals.

The Applicant has proposed a jet sled method to bury the proposed pipelines. These sleds are mounted with high-pressure water jets and towed along the sea floor behind the pipelaying barge. The water jets are directed downward to dig a trench; the sled guides the pipeline into the trench. Typical jet sleds used for pipeline installation are designed to promote refilling of the trench immediately after installation. (MMS 2002a). It is estimated that a total of 1,605 ac of sediment would be disturbed to lay the proposed pipeline. Trenching would cause unavoidable resuspension of seafloor sediment and temporarily increase turbidity. Turbidity refers to the insoluble, suspended particulates that impede the passage of light through water by scattering and absorbing light energy. This reduction in light penetration reduces the depth of the photic zone, in turn reducing the depth at which primary productivity can occur. It is assumed that 5,000 m^3 (176,550 ft^3) of sediment would be resuspended for each 1 km (0.6 mi) of pipeline trenched (MMS 2001). Because the proposed pipelines would total 105.7 km (65.7 mi), the installation would cause the temporary resuspension of approximately 528,650 m^3 (19,332,225 ft^3) of sediments. Sediment disturbance and increase in turbidity would be temporary and limited to the point of operation at any given time. Sediment would resettle within several days at each point of operation. Sediment would be disturbed throughout the entire pipeline corridor over a period of 5 months.

Hydrostatic testing is expected to have minor temporary effects on offshore resources. The proposed pipelines would be hydrostatically tested as each pipeline is connected and would occur over a prolonged period of time. NPDES permit requirements for hydrostatic and integrity testing of the proposed pipelines would limit discharges to comply with USEPA water quality standards. Therefore, no measurable impacts on biological resources are anticipated.

It is expected that the proposed structures and Safety Zone would also result in some long-term positive impacts on fisheries resources and EFH by functioning as an artificial reef and prohibiting fishing within the proposed 194.1 ac Safety Zone. Although the placement of the GBSs on the floor of the GOM would initially displace benthic organisms in the approximately 11 ac footprint, the subsurface structures would provide a large surface area for the new colonization of epifauna marine species. The prohibition of fishing within the Safety Zone would provide fish species and other benthic fauna an area of refuge. The bottom sediments and benthos within the Safety Zone would not be disturbed by fishing gear that might come into contact with the bottom.

The GBS would provide approximately 3.5 ac of hard surfaces in addition to the area on the pilings around the GBSs (GL 2003a). When oil and gas platforms are installed in marine waters, they are colonized by a diverse array of microorganisms; algae; and sessile invertebrates including barnacles, oysters, mussels, soft corals (bryozoans, hydroids, and octocorals), sponges, and hard corals. Organisms that attach and grow on the structures provide habitat and food for many mobile invertebrates and fish. Similar to oil and gas structures, it is expected that the GBSs would attract numerous species. The positive impacts of the proposed Terminal as an artificial reef are expected to last the life of the proposed Port, an estimated 30 years.

Nonthreatened and Nonendangered Marine Mammals

Minor effects on nonthreatened and nonendangered species of marine mammals could result from increased noise levels and traffic, ingestion and entanglement with debris, and a degradation of water quality during installation of the proposed Terminal and pipelines. However, such offshore construction-related impacts are expected to be minor and temporary and would persist only during installation of the proposed Terminal and pipelines.

The only discharges that could occur during the installation of the proposed Terminal are normal discharges from installation vessels, including domestic wastes (e.g., sanitary wastes and gray water), bilge water, and food scraps (MMS 2002a). Currently, the discharge or disposal of garbage and other solid debris from vessels by lessees is prohibited by the MMS (30 CFR 250.300) and the USCG (MARPOL, Annex V, Public Law 100-220[101 Statute 1458]) (33 CFR part 151). The discharge of plastics is strictly prohibited and is never authorized; this includes ashes from burned plastics. All plastics must be returned to shore, and are tracked. Additionally, the USCG would require that the proposed Port have a waste management plan as part of the Port's Operations Manual. USCG enforces MARPOL and the proposed Deepwater Port license and fines or penalties can be assessed where regulations are violated. All discharges would conform to the appropriate regulatory requirements described above. As such, waste and discharge impacts are not expected to negatively affect marine mammals.

Impacts from an increase in noise, vessel traffic, and marine debris associated with the proposed offshore construction are not expected to be significant. Installation activities would be temporary and no direct physical contact with marine mammals would be expected (MMS 2002a). The only marine mammals which are expected in the ROI are the Atlantic spotted and the bottlenose dolphins. Bottlenose dolphins demonstrate tolerance of vessel traffic, as indicated when they approach vessels to ride the wake (MMS 2002a). Noise, vessel traffic, and marine debris impacts are discussed in further detail in Section 4.2.2.2.

Threatened and Endangered Sea Turtles

Minor effects on loggerhead, leatherback, Kemp's ridley, and hawksbill sea turtles could result from increased noise levels and traffic, ingestion and entanglement with debris, and a degradation of water quality during installation of the proposed Terminal and pipelines. However, such offshore construction-related impacts are expected to be minor and temporary and would persist only during installation of the proposed Terminal and pipelines.

The only discharges that could occur during the installation of the proposed Terminal are normal discharges from installation vessels, including domestic wastes (e.g., sanitary wastes and gray water), bilge water, and food scraps (MMS 2002a). All discharges would conform to the appropriate regulatory requirements described above. As such, waste and discharge impacts are not expected to negatively affect sea turtles.

Impacts from an increase in noise, vessel traffic, and marine debris associated with the proposed offshore construction are not expected to be significant. Installation activities would be temporary and no direct physical contact with sea turtles would be expected (MMS 2002a). Noise, vessel traffic, and marine debris impacts are discussed in further detail in Section 4.2.2.2.

Shallow water habitats commonly used by sea turtles for feeding or resting might be affected by the proposed pipeline installation (MMS 2002a). These are expected to be small-scale impacts that temporarily displace sea turtles from the construction area. As such, adverse impacts on sea turtles are not expected to be significant.

Nonthreatened and Nonendangered Bird Species

Minor effects on nonthreatened and nonendangered bird species could result from increased noise levels and traffic, ingestion and entanglement with debris, and a degradation of water quality during installation of the proposed Terminal and pipelines. However, such offshore construction-related impacts are expected to be minor and temporary and would persist only during offshore construction installation of the proposed Terminal and pipelines.

The only discharges that could occur during the installation of the proposed Terminal are normal discharges from installation vessels, including domestic wastes (e.g., sanitary wastes and gray water), bilge water, and food scraps (MMS 2002a). All discharges would conform to the appropriate regulatory requirements described above. As such, wastes and discharges are not expected to negatively affect nonthreatened and nonendangered bird species.

Impacts from an increase in noise, vessel traffic, and marine debris associated with the proposed offshore construction are not expected to be significant. Construction would be temporary and no direct physical contact with birds would be expected (MMS 2002a). Noise, vessel traffic, and marine debris impacts are further discussed in Section 4.2.2.2.

Threatened and Endangered Bird Species

Installation of the proposed Terminal and pipelines would occur from 23 to 61 km (14 to 38 mi) offshore and would have no direct or indirect effects on threatened or endangered bird species that occur in the ROI. These species have a coastal distribution. Installation of the proposed Terminal would also not affect designated critical habitats.

Fisheries Resources and EFH

Minor effects on fisheries resources and EFH would result from sediment and benthos displacement and an increase in turbidity. However, such impacts are expected to be minor and temporary, as described below.

During installation of the proposed Terminal, sediment would be disturbed around the footprint of the GBSs and in proximity to lay and lift barge anchor sites, possibly displacing fish. Deepwater and shelf fish that feed on benthos might be displaced from small areas by seafloor structures such as the GBS. Displaced fish are expected to return to the proposed Terminal area once the sediment is redeposited.The disruption of benthic invertebrate assemblages (benthos) could indirectly affect bottom-feeding fish by reducing the available prey base and feeding behavior of demersal (benthic) species. The disruption of sediment could expose benthos and make them readily available prey for opportunistic fish. Anchors from installation vessels have the greatest potential to affect live bottoms; however, live bottoms do not occur in the vicinity of the proposed Terminal.

Sediment displacement would occur from temporary anchorages and jet-trenching during the installation phase of the proposed pipelines. The areal extent of the seafloor disturbance from anchoring depends on water depth, wind, currents, and chain length, as well as the size of the anchor and chain (MMS 2002a). The disturbed area would be larger if the anchors are dragged due to barge movement. Anchor depressions can be as deep as 2.1 to 2.4 m (7 to 8 ft) (FERC and MMS 2001). The area affected by the anchor chain sweep is expected to be relatively extensive. Anchors from installation vessels have the greatest potential to affect live bottoms; however however live bottoms do not occur in the vicinity of the proposed pipeline corridors. The width of the trench could be from 3.0 to 9.1 m (10 to 30 ft) at the surface. The total temporary pipeline construction impacts would be contained within a corridor with a maximum width of approximately 335.3 m (1,100 ft) (Alvarado 2003).

As discussed in Section 3.4, the area proposed for the pipelines consists predominantly of soft sediment, devoid of vegetation, and would not cross any sensitive benthic resources. Soft sediment, such as silt and sand, are designated as EFH for various life stages of brown shrimp, white shrimp, lane snapper, and red snapper. However, impacts on sediment from the installation of the pipelines would be similar to impacts of the Terminal placement, affecting fish resources and EFH by disturbing sediment and covering or displacing benthos. Although the disturbance area can be large, it comprises only a small portion of the total soft sediment available in the area. Additionally, the impacts on benthic habitat would be short in duration and not permanent. Therefore, impacts on EFH and fisheries resources are expected to be minimal.

Direct and indirect impacts on demersal and pelagic fish, as well as EFH, might result from the resuspension of sediment created by the installation of the GBSs and the proposed pipelines. These include exposing benthic fauna as prey items and an increase in turbidity. Opportunistic fish often will congregate in the immediate area where sediment is suspended and benthic infauna (prey items) are exposed. This temporal variation ceases almost immediately after coarse sediment is redeposited.

Turbidity refers to the insoluble, suspended particulates that impede the passage of light through water by scattering and absorbing light energy. This reduction in light penetration reduces the depth of the photic zone, in turn reducing the depth at which primary productivity can occur. Because the proposed pipelines would total 105.7 km (65.7 mi), the installation would cause the resuspension of approximately 528,650 m^3 (19,332,225 ft^3) of sediment. Turbidity effects are expected to be temporary as the suspended sediment would redeposit after the GBSs have been placed and the pipeline has been laid and buried.

It is anticipated that an increase in turbidity associated with the resuspension of sediment would cause most species of demersal and pelagic fish to avoid construction areas. Resuspended sediment could also clog and obstruct filter-feeding mechanisms and gills of benthic organisms and demersal fish. These expected impacts on fish and EFH should be temporary and minor, resulting in displacement followed by rapid postconstruction recruitment by these organisms. Other effects of turbidity on fish include (1) reducing the growth rate, (2) preventing the successful development of fish eggs and larvae, (3) modifying the migration patterns of the fish, and (4) reducing the abundance of available food (in part due to the reduction in primary production) (USEPA 1976). Redeposition of suspended sediment can also smother demersal eggs and larvae (FERC and MMS 2001).

Turbidity associated with the installation of the GBSs and other subsurface structures would temporarily cause fish to disperse from the area. Although impacts from the proposed pipeline construction could result in mortality to eggs and larvae, the impacts on populations would be minor since spawning occurs over broad areas (FERC and MMS 2001). Increased turbidity is expected to adversely affect soft-bottom species, such as red drum, sand sea trout, and spotted sea trout, that are sought by recreational fishermen. This impact is expected to be temporary and minimal. Impacts can also be minimized by scheduling construction activities to avoid the spawning seasons of indigenous fish species.

4.2.2.2 Operational Impacts

Coastal

The minor potential for accidents and marine debris could have minor indirect effects on nearshore coastal waters, coastal protected habitats, coastal barrier beaches and dunes, wetlands, or seagrass beds throughout the GOM. Onshore support activities would occur at existing facilities. Therefore, no modifications or direct impacts on coastal resources are expected.

Increased Vessel Traffic. The proposed Terminal is planned to be placed approximately 64 km (40 mi) from Cameron, Louisiana, which is 3.2 km (2 mi) inshore. The Applicant estimates that approximately 135 LNGCs would use the proposed Terminal each year. Additionally, support operations would include four tugs making one trip to and from the proposed Terminal each time an LNGC arrives (a total of 540 round-trips per year), one supply vessel making approximately one trip per week (approximately 52 round-trips per year), and four or five helicopter trips per week (approximately 260 round-trips per year). The weekly supply vessel trips do not constitute new trips; typically supply vessels carry supplies to several offshore platforms during a single offshore trip. All support traffic is expected to traverse coastal waters from Cameron, Louisiana, en route to the proposed Terminal. Because Cameron, Louisiana, is a major port of call for the offshore oil and gas industry and supports two menhaden processing plants, this number represents a negligible increase in existing vessel traffic. Therefore impacts of increased vessel trips and the increased likelihood of accidents are negligible. The likelihood of accidents is addressed in Sections 4.7.2 and 4.10.2.

Marine Debris. In recent years, there has been an increasing concern involving man-made debris discarded from offshore and coastal sources and its impact on the coastal and marine environment. Trash and debris, some accidentally lost during oil and gas drilling and production operations, occur, in the GOM. In one study, 40,580 debris items were collected in a 26 km (16 mi) transect made along the Padre Island National Seashore, Texas, from March 1, 1994, to February 28, 1995. Thirteen percent of the trash and debris was attributed to the offshore oil and gas industry. MMS prohibits the disposal of equipment, containers, and other materials into coastal and offshore waters by lessees (30 CFR 250.40) (MMS 2002a).

The discharge or disposal of garbage and other solid debris from vessels by lessees is prohibited by the MMS (30 CFR 250.300) and the USCG (MARPOL, Annex V, Public Law 100-220[101 Statute 1458]) (33 CFR part 151). The discharge of plastics is strictly prohibited and is never authorized; this includes ashes from burned plastics. All plastics must be returned to shore, and are tracked. Additionally, the USCG would require that the proposed Port have a waste management plan as part of its operational manual. USCG enforces MARPOL and the proposed Deepwater Port license and fines or penalties can be assessed where regulations are violated. However, accidental releases of debris from OCS activities are known to occur offshore (MMS 2002a).

Offshore

Impacts on offshore resources, resulting from increased vessel traffic, increased noise, seawater intake, cool water discharge, marine debris, lighting, and the presence of the GBS, associated with the Proposed Action are expected to be minimal.

Increased Vessel Traffic. The Applicant estimates that approximately 135 LNGCs would use the proposed Terminal each year. Additionally, support operations would include four tugs making one trip to and from the proposed Terminal each time an LNGC arrives (a total of 540 round-trips per year), one supply vessel making approximately one trip per week (approximately 52 round-trips supply vessel trips per year), and four or five helicopter trips per week (approximately 260 round-trips per year). The weekly supply vessel trips do not constitute new trips; typically supply vessels carry supplies to several offshore platforms during a single offshore trip. All support traffic is expected to traverse coastal waters from Cameron, Louisiana, en route to the proposed Terminal. However, the increase in vessel traffic associated with the proposed Port would be insignificant when compared to other vessel operations in the GOM (e.g., approximately 315 thousand service trips and 1.7 million helicopter trips per year) (MMS 2002a). In addition, supply vessels, tugs, and LNGCs would be traveling at a low rate of speed while in the vicinity of the proposed Terminal and at a moderate speed while transiting to and from the proposed Port in order to maintain proper steerage, as indicated in Table 4-1. Therefore, adverse impacts on offshore resources are expected to be minimal.

NOAA Fisheries indicates that to determine if this risk is sufficiently high to warrant the issuance of a take permit (a formal consultation is required to issue take), the number of animals that could possibly be at risk from a strike needs to be estimated. The probability of a strike would also depend on the speed and width of the vessels and the density of animals in the area the vessels would be operating. Table 4-1 presents anticipated vessel traffic and speeds during transit to Gulf Landing.

Table 4-1. Anticipated Vessel Traffic and Speeds During Transit to Gulf Landing

Route Section	Distance (km)	Average Speed (knots)	Vessels
Precautionary Area	3.2	5	LNGCs, Escort Tugs, and Supply Vessels
Safety Zone	0.5	3 and less	LNGCs, Escort Tugs, and Supply Vessels
Shipping Fairway Approach	32	8-12	LNGCs

Notes: km – kilometer

The number of vessels calling at the proposed Port is projected to be as many as 135 per year. The following is vessel data for typical LNGCs and tugs.

LNGC Data (125,000–200,000 m^3)

- Length Overall – 268 to 304 m (878 to 999 ft)
- Width – 34 to 47 m (111 to 153 ft)
- Draft – 11 to 12 m (35 to 39 ft)

Tug Data (5,000 brake horsepower [BHP])

- Length Overall – 34 m (110 ft)
- Width – 12 m (40 ft)
- Draft – 5 m (17 ft)

Specific impacts relating to increased vessel traffic are further described under nonthreatened and nonendangered marine mammals, threatened and endangered sea turtles, nonthreatened and nonendangered birds, threatened and endangered birds, and fisheries resources and EFH.

Increased Noise. Noise associated with the operation of machinery on the proposed Terminal, pipelines, and helicopter and vessel traffic can impact offshore biological resources. The increase in noise is further described in Section 4.9.

When underwater objects vibrate they create sound-pressure waves that alternately compress and decompress the water molecules as the sound wave travels through the sea. These sound waves radiate in all directions away from the source. There is no scientific consensus regarding absolute thresholds for significance (MMS 2000a). The impact that a man-made sound can have on sea life depends on its loudness and the specific acoustic frequency pattern at the location where the marine organisms detect the sound, the distance of the animal from the sound source, and the hearing sensitivity of the marine organism. Sound intensity decreases with distance from the noise source, and high-frequency components of the noise decrease more rapidly with distance than do low-frequency components.

Machinery noise generated during the operation of fixed structures would vary in duration and intensity, and be similar to noise generated by fixed oil and gas structures. Underwater noise from fixed oil and gas structures ranges from about 20–40 dB above background levels, and has a frequency spectrum of 30–300 Hz at a distance of 30 m (98.4 ft) from the source (MMS 2002a).

Noise generated from helicopter and service-vehicle traffic is transient and extremely variable in intensity, depending upon the source. Service vessels transmit noise through both air and water. The source of vessel noise is mechanical, from propulsion and generator machinery, and from hull noise generated during transit (MMS 1994). Noise associated with vessels is presented in Table 3-20.

Specific impacts relating to noise are further described under nonthreatened and nonendangered marine mammals, threatened and endangered sea turtles, nonthreatened and nonendangered birds, threatened and endangered birds, and fisheries resources and EFH.

ORV Seawater Intake. Minor adverse effects on offshore pelagic species are expected from the ORV seawater intake. Gulf Landing LLC designed their proposed seawater intake structures (two seawater intake structures are proposed, however only one would be in service at a time) to minimize the potential for the uptake of plankton, ichthyoplankton, or small fish. Specifically proposed mitigation measures include using cylindrical wedgewire intake screens, minimizing intake velocity, and locating the intake structures in the bottom half of the water column (the justification for the mitigation measures is described under the *Fisheries Resources and EFH* subsection). The average intake velocity would be approximately 0.1 m/s (0.32 ft/s) with a maximum of 0.15 m/s (0.5 ft/s). The intake screens would be approximately 36 ft below mean sea level (Figure 2-8). The ORV seawater intake would draw from waters that are hypoxic more than 25 percent of the mid-summer distribution (Figure 3-2).

By locating the seawater intake, approximately 11 m (36 ft) below mean sea level (below the euphotic zone), impacts on phytoplankton are expected to be minimal. Using an estimate of 3.79 million nonfish zooplankton (i.e., mostly copepods) per 1 million gallons of water (Croom 2004), it is estimated that approximately 515 million zooplankton per day or 188 billion zooplankton per year would be entrained without mitigation measures. However, this number is likely overestimated because of the mitigation measures. Copepods are capable of swimming at burst speeds of 0.5 m/s (1.6 ft/s) and have been documented to escape plankton nets (GMA 2004). The use of cylindrical screens would allow copepods to detect the flow field and escape the seawater intake. Additionally, copepods are not evenly spatially distributed throughout the GOM. Copepods are known to make vertical migrations to the surface to feed at night and into deeper waters during the day to avoid predation. Copepod distribution also varies across the GOM continental shelf. For example, copepods are closely associated with the Mississippi River plume (GLOBEC 2000). It is also believed that copepods avoid hypoxic areas (Diaz and Solow 1999).

Copepods are selected as food for larval and juvenile fish, among other marine organisms (e.g., baleen whales). Production of copepods is closely linked with fishery production (GLOBEC 2000). However, the effects of the ORV seawater intakes on copepods are expected to be minimal because of the mitigation measures. Therefore, indirect impacts on higher predators are also expected to be minimal. Direct impacts on fisheries are addressed in the *Fisheries Resources and EFH* subsection.

ORV Discharge Plume. Minor adverse effects on offshore biological resources would occur from the reduced temperature and sodium hypochlorite of the ORV discharge plume. The discharge would be localized and it is anticipated that most mobile species would move out of the discharge because of the reduced temperature, further minimizing adverse effects on protected, managed, or other marine species.

Temperature of the ORV discharge plume might impact benthic communities. This cool water discharge would be a constant factor in the marine environment over the life of the Gulf Landing LNG regasification Terminal (i.e., 30 years). Modeling of the thermal plume from the Gulf Landing LNG regasification Terminal predicts that temperature reductions 1.11 °C (2 °F) below ambient would occur 100 m (328 ft) from the outfall. The worst case temperature difference is expected to be a difference of 0.85 °C (1.5 °F) or less at a distance of 500 m (1,641 ft) from the outfall. The area of sea floor occupied by cool water plumes in both stratified and unstratified conditions depends on current speed. The worst case scenario area of sea floor affected by the reduced temperature 0.85 °C (1.11 °F) in the ORV discharge plume is estimated to range from 0.12 to 5.71 ac, but this depends on prevailing conditions.

Benthic organisms seen in the northern GOM are able to withstand seasonal temperature fluctuations much greater than those expected from the proposed regasification cool water discharge. The proposed discharge is not expected to cause mortality; however, the chronic nature of this cold water exposure could cause a gradual shift in the benthic community in the immediate vicinity of the discharge point. In terms of the overall benthic community in this area, any change in the faunal composition of 5.71 ac of sea floor is insignificant. For the immediate area of the ORV discharge plume, a change in composition of the bottom fauna might have positive environmental effects by providing a more productive habitat (GL 2003a).

Marine organisms have thermal tolerance ranges that determine how the organisms respond to the temperature. Specific impacts relating to seawater intakes are further described under nonthreatened and nonendangered marine mammals, threatened and endangered sea turtles, nonthreatened and nonendangered birds, threatened and endangered birds, and fisheries resources and EFH.

The Applicant proposes to add approximately 2,000 to 5,000 ppb of sodium hypochlorite solution to the ORV intake seawater as a biofouling toxicant. The concentration added would be sufficient in order to maintain a concentration of 500 ppb in the ORV. The proposed concentration is based on what is currently applied at other facilities and is meant to target organisms that would persist in the ORV system. The concentration of sodium hypochlorite at the ORV discharge point is expected to be 500 ppb and dilute rapidly. The sodium hypochlorite concentration is expected to be about 50 ppb on the sea floor.

Available marine toxicity data for sodium hypochlorite and bromoform (a reaction product) are presented in Table 4-2. The concentration of sodium hypochlorite at the discharge point is higher than toxic concentration for the tested saltwater fish species and mysids. However, the duration of the toxicity test ranged from 28 hours to a maximum of 7 days. The time motile organisms would be exposed to the sodium hypochlorite is likely shorter. Motile organisms would move out of the ORV discharge plume because of the reduced temperature, unless the change in temperature is within their temperature range. Additionally, the sodium hypochlorite is expected to dilute rapidly.

Sodium hypochlorite in the discharge plume would be below the toxic level and exposure duration for benthic invertebrates such as American oysters and grass shrimp. Chronic effects on sedentary, benthic organisms could occur in the localized area of the ORV discharge plume. The area of sea floor affected by the cool water plume is estimated to range from 0.12 to 5.71 ac depending on conditions. This area is negligible and represents less than 0.1 percent of the benthic habitat available in WC-213.

The above analysis is limited by uncertainty. The major cause of uncertainty is the inability to identify the concentrations of reaction products that might occur in the discharge water and whether these concentrations are below marine toxicity thresholds. USEPA notes that the reactions of chlorine in fresh and salt water are complex. Thus, it is important that studies regarding the effects of chlorine on aquatic organisms are designed to adequately measure the concentrations of reaction products of chlorine (total residual chlorine [TRC] or chlorine-produced oxidants [CPOs]). It also notes that the half-lives of TRC and CPO are short in most waters (USEPA 1985).

Concentrations of selected halogenated compounds that result from the use of sodium hypochlorite to prevent microbial fouling at power plants can be used to estimate the concentrations and reaction products expected from the proposed Terminal. While the data from the power plants are limited, the studies show that bromoform is the predominant volatile chemical formed in marine receiving waters as a result of chlorination (Grove et al. 1985; Hartwig and Valentine 1983). The maximum concentration reported for bromoform by these studies is 34 ppb. Available marine toxicity data for bromoform are presented in Table 4-2. These data indicate that the maximum concentration reported for bromoform is about 200 times less than the lowest toxicity value (6,400 ppb) reported for bromoform in Table 4-2. While this comparison has a number of limitations (e.g., effects of ammonia and pH, duration of the toxicity test), the data suggest that the concentration of bromoform is well below toxicity thresholds for the tested marine fish, invertebrate, and alga species.

When comparing the toxicity values, it is important to note the duration of the toxicity test, 28 hours, to a maximum of 7 days. The time motile organisms would be exposed to the sodium hypochlorite and reaction products is probably shorter. Larger motile organisms would probably move out of the ORV discharge plume because of the reduced temperature. Therefore, impacts on motile organisms would be minimal. Long-term chronic effects on sedentary, benthic organisms would occur in the localized area of the discharge plume.

The ORV discharge plume would be regulated under an NPDES permit. Specific impacts relating to the ORV discharge plume are further described under nonthreatened and nonendangered marine mammals, threatened and endangered sea turtles, nonthreatened and nonendangered birds, threatened and endangered birds, and fisheries resources and EFH.

Marine Debris. Adverse effects of marine debris on offshore resources are expected to be minimal. Waste-handling practices at the proposed Port would conform to all applicable rules and regulations at the proposed Terminal. The discharge or disposal of garbage and other solid debris from vessels by lessees is prohibited by the MMS (30 CFR 250.300) and the USCG (MARPOL, Annex V, Public Law 100-220[101 Statute 1458]) (33 CFR part 151). The discharge of plastics is strictly prohibited and is never authorized; this includes ashes from burned plastics. All plastics must be returned to shore, and are tracked. Additionally, the USCG would require that the proposed Port have a waste management plan as part of its operational manual. USCG enforces MARPOL and the proposed Deepwater Port license and fines or penalties can be assessed where regulations are violated. However, accidental releases of debris from OCS activities are known to occur offshore (MMS 2002a).

Table 4-2. Marine Toxicity Summary Data for Sodium Hypochlorite and Bromoform

Test Species	Common Name	Concentration (ppb)	Duration	Endpoint
SODIUM HYPOCHLORITE				
Menidia beryllina [1]	inland silverside	143	96 h [a]	LC_{50} [b], survival
Menidia beryllina [2]	inland silverside	128	96 h	LC_{50}, survival
Menidia beryllina [2]	inland silverside	87	7 d [c]	NOEC [d], survival, growth
Menidia penisulae [3]	tidewater silverside	40	28 d	NOEC, survival, growth
Mugil cephalus [4]	striped mullet	212	96 h	LC_{50}, survival (size = 0.3g[e])
Mugil cephalus [4]	striped mullet	607	96 h	LC_{50}, survival (size = 10g)
Mysidopsis bahia [1]	mysid shrimp	62	96 h	LC_{50}, survival
Mysidopsis bahia [2]	mysid shrimp	73	96 h	LC_{50}, survival
Mysidopsis bahia [2]	mysid shrimp	20	7 d	NOEC, growth, maturity, fecundity
Crassostrea virginica [5]	American oyster	120–160	45, 60, 75 d	LOEC [f], gonadal and condition index
Palaemonetes pugio [6]	grass Shrimp	23,700	96 h	LC_{50}, survival
BROMOFORM				
Protothaca staminea [7]	littleneck clam	7,000	28 d	NOEC, survival
Penaeus aztecus [7]	brown shrimp	26,000	96 h	LC_{50}, survival
Mysidopsis bahia [8]	mysid shrimp	24,400	96 h	LC_{50}, survival
Brevoortia tyrannus [7]	Atlantic menhaden	12,000	96 h	LC_{50}, survival
Cyprinodon variegatus [8]	sheepshead minnow	6,400	Not Specified	NOEC
Cyprinodon variegatus [9]	sheepshead minnow	18,000	96 h	LC_{50}, survival
Skeletonema costatum [8]	diatom	12,300	96 h	EC_{50} [g], chlorophyll a
Skeletonema costatum [8]	diatom	11,500	96 h	EC_{50}, cell numbers

Sources: [1] Fisher et al. 1999, [2] Fisher et al. 1994; [3] Goodman et al. 1983; [4] Venkataramiah et al. 1983; [5] Scott and Middaugh 1980; [6] Curtis et al. 1979; [7] Gibson et al. 1980; [8] USEPA 1980; [9] Heitmuller et al. 1981; [10] Buccafusco et al. 1981; [11] Trabalka and Burch 1978; [12] Mattice et al. 1981; [13] LeBlanc 1980; [14] Brooks and Bartos 1984; [15] Stewart et al. 1979; [16] Crecelius 1979

Notes: [a] hours
[b] lethal concentration that kills 50 percent of tested organisms
[c] days
[d] NOEC - no observed effect concentration
[e] grams
[f] LOEC - lowest observed effect concentration
[g] effective concentration that inhibits endpoint at 50 percent of tested organisms

Specific impacts relating to marine debris are further described under nonthreatened and nonendangered marine mammals, threatened and endangered sea turtles, nonthreatened and nonendangered birds, threatened and endangered birds, and fisheries resources and EFH.

Terminal Lighting. Adverse effects of lighting on the proposed Terminal are expected to be minimal. Specific impacts relating to proposed Terminal lighting are further described under nonthreatened and nonendangered marine mammals, threatened and endangered sea turtles, nonthreatened and nonendangered birds, threatened and endangered birds, and fisheries resources and EFH.

Presence of the Terminal. Beneficial effects resulting from the presence of the proposed Terminal are expected to be minimal. Specific effects relating to the presence of the proposed Terminal are further described under nonthreatened and nonendangered marine mammals, threatened and endangered sea turtles, nonthreatened and nonendangered birds, threatened and endangered birds, and fisheries resources and EFH.

Nonthreatened and Nonendangered Marine Mammals

Increased Noise. Effects of increased noise on marine mammals are expected to be minimal. Noise is associated with the operation of machinery on the proposed Terminal, pipelines, and helicopter and vessel traffic. The increase in noise is further described in Section 4.9.

Airborne sounds from helicopters might affect marine mammals at the surface. Levels of underwater sounds from passing or hovering helicopters vary widely depending on the specific engine type and size, number of rotors, altitude and relative angle of the aircraft, depth of the receiver, and water depth (Richardson et al. 1995). Reactions of cetaceans might range from apparent indifference to evasive behavior (e.g., turns, diving). Documented observations of sperm whales to low-flying helicopters showed no obvious reactions (Richardson et al. 1995).

Ships and boats are considered a prominent source of waterborne noise in the GOM because of the relatively large numbers (e.g., approximately 315 thousand service vessel trips and 1.7 million helicopter trips per year) and Gulf-wide distribution of vessels (MMS 2002a). Port of New Orleans is also one of the largest cargo ports in the U.S., which can accommodate 2,000 vessels a year. It is estimated 6,000 ocean vessels move through the Port of New Orleans on the Mississippi River each year (PONO 2003). Increase in vessel and helicopter traffic would be negligible relative to the existing traffic. The Applicant estimates that approximately 135 LNGCs would use the proposed Terminal each year. Additionally, support operations would include four tugs making one trip to and from the proposed Terminal each time an LNGC arrives (a total of 540 round-trips per year), one supply vessel making approximately one trip per week (approximately 52 round-trips per year), and four or five helicopter trips per week (approximately 260 round-trips per year). The weekly supply vessel trips do not constitute new trips; typically supply vessels carry supplies to several offshore platforms during a single offshore trip. All support traffic is expected to traverse coastal waters from Cameron, Louisiana en route to the proposed Terminal. Noise associated with vessels is presented in Table 3-20.

The reactions of marine mammals to vessel traffic appear to be primarily a result of noise, though there might be visual or other cues as well. Toothed whales and dolphins demonstrate tolerance of vessel traffic. Many dolphin species are attracted to vessels, and spend periods of time following them or swimming within these vessels' bow pressure waves (MMS 2002a).

The passage of helicopters and support vessels close to cetaceans can elicit a startle response with subsequent avoidance or evasive behavior (MMS 2002a). The behavioral responses to noise might affect group structure and local populations by interfering with communication between group members.

Navigation and feeding might also depend on sound reception and be affected by high levels of artificial ambient noise. Animals might avoid or abandon important feeding areas in response to vessel and aircraft noise. Such noise might cause stress, making the animals more vulnerable to parasites and disease. However, noise related to helicopter and vessel traffic is transient and generally not at levels that would prevent rapid recovery of marine mammals once the noise dissipates. It is expected that noise impacts on marine mammals would be manifested primarily as avoidance behavior. It is assumed that behavior would return to normal once a vessel or aircraft has passed (MMS 2002a).

The increase in noise due to vessel traffic, helicopter traffic, and the new machinery associated with the proposed Port would be negligible when compared to ambient noise levels in the GOM (see Section 3.9). The only marine mammals expected to occur in the ROI are bottlenose dolphins and Atlantic spotted dolphins. Therefore, noise impacts from vessel and helicopter traffic would be minor.

Increased Vessel Traffic. Effects of increased vessel traffic on marine mammals are expected to be minimal. Vessels can collide with marine mammals regardless of vessel size and type. However, most collisions occur over or near the continental shelf and most lethal or severe injuries are caused by ships that are 80 m (262 ft) or longer, and are unable to avoid whales before the collision (MMS 2002a). Expected vessel speeds in the ROI are presented in Table 4-1. Major or fatal wounds on cetaceans have been reported for bottlenose dolphins in the GOM (MMS 2002a). Debilitating injuries might have adverse effects on a population through impairment of reproductive output. Most vulnerable cetaceans include slow-moving cetaceans (e.g., northern right whale) or those that spend extended periods of time at the surface to restore depleted tissue oxygen levels after deep dives (e.g., sperm whale). Dolphins often change their behavior in response to vessels. They approach vessels to ride the wake, extend interbreath intervals, decrease interanimal distance, change heading, or increase swimming speed. Dolphins might be struck by vessels due to inattentiveness, age or health, or voluminous vessel traffic (MMS 2002a).

Disruption of cetacean behavior in response to vessel traffic might be long or short term (MMS 2002a). Short-term disruptions are not expected to impact growth or survival. Some whale species might reduce their use of certain areas heavily used by ships, including avoiding or abandoning important feeding areas, breeding areas, resting areas, or migratory routes. However, various cetacean species are continually present in areas with heavy boat traffic, indicating a considerable degree of tolerance to vessel disturbance (MMS 2002a).

The increase in vessel traffic and helicopter traffic associated with the proposed Port would be insignificant when compared to other vessel operations in the GOM (e.g., approximately 315 thousand service vessel trips and 1.7 million helicopter trips per year). Under normal circumstances, the LNGCs are expected to use the established Safety Fairways when calling at the proposed Port (Figure 2-9). It should be noted that there is no mechanism to regulate the movement on the high seas. A condition of the license, if issued, would require the Applicant to adhere to the provisions set forth in MMS Notice to Lessees No. 2003-G10, *Vessel Strike Avoidance and Injured/Dead Protected Species Reporting.* Adherence to these provisions would further reduce the risk associated with vessel strikes or disturbance of protected species that might result from the proposed Port's operations. The only marine mammals expected to occur in the ROI are bottlenose dolphins and Atlantic spotted dolphins, species which are tolerant of vessel traffic.

ORV Seawater Intake. The ORV seawater intake would have no effect on marine mammals. The Applicant has proposed two intake structures, of which only one would operate at a time (Figure 2-7). The intake velocity would be approximately 0.1 m/s (0.32 ft/s) up to 0.15 m/s (0.5 ft/s) and intake screens would be centered at 11 m (36 ft) below mean sea level (Table 2-6). Therefore, marine mammals are unlikely to encounter the ORV seawater intake, and if a chance encounter were to occur, marine mammals could swim faster than the intake velocity.

ORV Discharge Plume. Minor adverse effects on marine mammals would occur from the reduced temperature and sodium hypochlorite of the ORV discharge plume. However, it is unlikely that marine mammals would encounter the ORV discharge plume. The ORV discharge would be localized and it is anticipated that marine mammals would avoid the plume. The thermal discharge could possibly be considered harassment for marine mammals under the MMPA, as interaction with the plume can cause these animals to change their location or behavior. However, marine mammals are mobile and can readily move or swim out of the cooler water, causing no physiological impact. Furthermore, as homeothermic (warm-blooded) animals, marine mammals can regulate their internal body temperature and would experience no effect from the difference in water temperature. Additionally, marine mammals of the central GOM are exposed to seasonal temperature fluctuations. They feed on motile resources, which are capable of avoiding the thermal plume if necessary. Therefore, effects of the chilled water discharge plume on marine mammals near the LNG Terminal are not expected to be significant.

Marine Debris. Minor adverse effects on marine mammals could result from marine debris. Death or serious injury of marine mammals is caused by entanglement in and ingestion of debris (MMS 2002a). Net fragments and monofilament line from commercial and recreational fishing boats, and strapping bands and ropes from all types of vessels are most often found entangling marine mammals. Plastic bags and small plastic fragments are commonly reported in the digestive tracts of cetaceans and manatees (MMS 2002a).

The discharge or disposal of garbage and other solid debris from vessels by lessees is prohibited by the MMS (30 CFR 250.300) and the USCG (MARPOL, Annex V, Public Law 100-220[101 Statute 1458]) (33 CFR part 151). The discharge of plastics is strictly prohibited and is never authorized; this includes ashes from burned plastics. All plastics must be returned to shore, and are tracked. Additionally, the USCG would require that the proposed Port have a waste management plan as part of its operational manual. A condition of the license, if issued, would be that all offshore personnel attend annual training on elimination of marine debris. USCG enforces MARPOL and the proposed Deepwater Port license and fines or penalties can be assessed where regulations are violated. However, accidental releases of debris from OCS activities are known to occur offshore (MMS 2002a). Overall, ingestion of marine debris by marine mammals and engtanglement would not be expected to increase as a result of the Proposed Action.

Terminal Lighting. Terminal lighting would have no effect on marine mammals.

Presence of the Terminal. The presence of the proposed Terminal would have no effect on marine mammals.

Threatened and Endangered Marine Mammals

Threatened and endangered species of marine mammals are not expected to occur in the ROI. The endangered sperm whale can be encountered almost anywhere on the high seas, but shows a preference for continental margins, sea mounts, and areas of upwelling where food is abundant (NMFS 2002a). Because they generally occur in waters greater than 180 m (590 ft) deep, it is unlikely that sperm whales would occur in the ROI. Sperm whales could be impacted by increased noise, marine debris, and increased vessel traffic associated with the Proposed Action. Impacts would be identical to the impacts listed under *Nonthreatened and Nonendangered Marine Mammals* (above). The number of LNGCs associated with the Proposed Action (about 135 per year) represents an insignificant increase in the amount of vessel traffic approaching and exiting the GOM annually. Under normal circumstances, the LNGCs are expected to use the established Safety Fairways to get within approximately 2 miles of the proposed Port (Figure 2-9). It should be noted that there is no mechanism to regulate the movement on the high seas. A condition of the license, if issued, would require the Applicant to adhere to the provisions set forth in MMS Notice to Lessees No. 2003-G10, *Vessel Strike Avoidance and Injured/Dead Protected Species Reporting.* Adherence to these provisions would further reduce the risk associated with vessel strikes or disturbance of protected species that might result from the proposed Port's operations. Therefore, the Proposed Action would not be expected to cause a significant increase in the frequency of vessel collisions with sperm whale.

Sea Turtles

Increased Noise. Negligible adverse effects on sea turtles would result from increased noise. The machinery noise generated by helicopters as well as service and construction vessels might affect sea turtles (NRC 1990). Sounds from helicopters and vessels would originate from coastal ports and travel through broad areas of the continental shelf and slope. The most likely impacts would be short-term behavioral changes such as diving and evasive swimming, disruption of activities, or departure from the area of disturbance. Areas with heavy vessel traffic might be avoided by sea turtles, although generally most species appear to exhibit considerable tolerance to noise.

Noise related to helicopter and vessel traffic in the GOM is transient and generally not at levels that would prevent rapid recovery of sea turtles once the noise ceased. The increase in noise due to vessel traffic, helicopter traffic, and the new machinery noise associated with the proposed Port is negligible when compared to ambient noise levels in the GOM (see Section 3.9). Therefore, noise impacts on sea turtles associated with the Proposed Action would be minor.

Increased Vessel Traffic. Negligible adverse effects on sea turtles would result from increased vessel traffic. Vessel traffic has caused sea turtle mortality in the GOM (MMS 2002a). About 9 percent of living and dead stranded sea turtles had boat strike injuries in the GOM, Atlantic Coast, Puerto Rico, and the U.S. Virgin Islands from 1986 through 1993. However, in the GOM and Atlantic Coast, vessel-related injuries were noted in 13 percent of stranded turtles examined in 1993. It is possible that some of these turtles might have been struck by boats postmortem. In Florida, 18 percent of the sea turtle strandings documented between 1991 and 1993 were attributed to vessel collisions. Annually, large numbers of loggerhead and Kemp's ridley turtles are estimated to be killed by vessel traffic (MMS 2002a).

The increase in vessel traffic and helicopter traffic associated with the proposed Port would be negligible when compared to other vessel operations in the GOM (e.g., approximately 315 thousand service trips and 1.7 million helicopter trips per year). Under normal circumstances, the LNGCs are expected to use the established Safety Fairways to get within approximately 2 miles of the proposed Port (Figure 2-9). It should be noted that there is no mechanism to regulate the movement on the high seas. A condition of the license, if issued, would require the Applicant to adhere to the provisions set forth in MMS Notice to Lessees No. 2003-G10, *Vessel Strike Avoidance and Injured/Dead Protected Species Reporting.* Adherence to these provisions would further reduce the risk associated with vessel strikes or disturbance of protected species that might result from the proposed Port's operations. Therefore, the Proposed Action would not be expected to cause a significant increase in the frequency of vessel collisions with sea turtles.

Seawater Intake. The ORV seawater intake would have no effect on sea turtles or sea turtle hatchlings. The proposed maximum through-screen velocity for the ORV seawater intake would be 0.1 m/s (0.32 ft/s) to 0.15 m/s (0.5 ft/s). This through-screen velocity is slower than the average swimming speeds for hatchling sea turtles, which range from 0.436 m/s (1.43 ft/s) for green sea turtles and 0.36 m/s (1.17 ft/s) for loggerhead sea turtles to 0.25 m/s (0.83 ft/s) for leatherback sea turtles. Although the proposed Port would be more than 322 km (200 mi) from the Chandeleur Islands (the closest known sea turtle nesting site), hatchling sea turtles are known to drift at or near the surface passively with ocean currents during their pelagic stage (Witherington 2002; Wyneken 2003). If a sea turtle hatchling were to encounter the area of the proposed Port, it would be expected to be floating on the surface. The ORV seawater intake would be centered at 11 m (36 ft) below the mean sea level. Thus, impingement of sea turtle hatchlings is not expected to occur.

ORV Discharge Plume. The reduced temperature and sodium hypochlorite of the ORV discharge plume would have minor adverse effects on sea turtles. In the unlikely event that a sea turtle would encounter the ORV discharge plume, it is unlikely that sea turtles would suffer lethal impacts from the reduced temperature or sodium hypochlorite. Although sea turtles are poikilothermic animals, they are mobile and can readily escape or move out of the cold-water plume by swimming away from it. Sea turtles can suffer from potentially lethal cold shock when they are exposed to low water or air temperatures from which they cannot escape. The ORV discharge represents an entirely different situation and thus, the thermal water discharge would not be expected to physiologically affect or disrupt sea turtles. The effects are designated as minor because the discharge would be localized, and it is anticipated that most sea turtles would avoid the discharge because of the reduced temperature.

Marine Debris. Minor adverse impacts on sea turtles could result from marine debris. Death or serious injury of marine mammals is caused by entanglement in and ingestion of debris (MMS 2002a). Net fragments and monofilament line from commercial and recreational fishing boats, and strapping bands and ropes from all types of vessels are most often found entangling marine mammals. Plastic bags and small plastic fragments are commonly reported in the digestive tracts of cetaceans and manatees (MMS 2002a).

Sea turtles might also become entangled and ingest fragments of marine debris, causing death or serious injury (MMS 2002a). Turtles might drown, incur impairment of foraging or predator avoidance, sustain wounds and infections, or exhibit altered behavior from entanglement of marine debris. Tar is the most common item ingested by sea turtles. Plastics are also ingested causing impaction of the alimentary canal. Leatherback sea turtles are believed to misidentify translucent films as jellyfish. Ingested debris might block the digestive tract or remain in the stomach for extended periods, thereby lessening the feeding drive, causing ulcerations and injury to the stomach lining, or providing a source of toxic chemicals. Ingested debris might weaken sea turtles, causing a greater susceptibility to predators and disease, and reducing fitness for migration, breeding, or nesting success (MMS 2002a).

One study indicated that the GOM had the second highest number of sea turtle strandings resulting from marine debris (35.9 percent) (MMS 2002a). Kemp's ridley was the second most commonly stranded turtle, but seemed less susceptible to the adverse impacts of debris than the other sea turtle species. A study of post-hatchling loggerheads in drift lines 8 to 35 NM east of Cape Canaveral and Sebastian Inlet, Florida, indicated that 17 percent had plastic or other synthetic fibers in their stomachs or mouths (MMS 2002a).

The discharge or disposal of garbage and other solid debris from vessels by lessees is prohibited by the MMS (30 CFR 250.300) and the USCG (MARPOL, Annex V, Public Law 100-220[101 Statute 1458]) (33 CFR Part 151). The discharge of plastics is strictly prohibited and is never authorized; this includes ashes from burned plastics. All plastics must be returned to shore, and are tracked. Additionally, the USCG would require that the proposed Port have a waste management plan as part of its operational manual. A condition of the license, if issued, would be that all offshore personnel attend annual training on elimination of marine debris. USCG enforces MARPOL and the proposed Deepwater Port license and fines or penalties can be assessed where regulations are violated. However, accidental releases of debris from OCS activities are known to occur offshore (MMS 2002a). Overall, ingestion of marine debris by sea turtles and engtanglement would not be expected to increase as a result of the Proposed Action.

Terminal Lighting. The proposed Terminal lighting would have no adverse effect on sea turtles. Light pollution on nesting beaches is detrimental to sea turtles because it alters critical nocturnal behaviors such as nest-site selection, return to sea post nesting, and hatchlings entry to the sea (Witherington and Martin 1996). However, the proposed Terminal site would be more than 322 km (200 mi) from the Chandeleur Islands, the closest known sea turtle nesting site. As a result, sea turtle hatchlings would not be expected to encounter the Terminal (Witherington 2002).

Presence of the Terminal. The presence of the proposed Terminal would have no effect on sea turtles.

Nonendangered and Nonthreatened Bird Species

Increased Noise. The effect of increased noise on nonendangered and nonthreatened bird species is expected to be minor. Noise resulting from helicopter and service vessel traffic could periodically disturb individuals or groups of coastal or marine birds, especially in sensitive coastal habitats (including nesting areas). The increase in noise due to vessel traffic, helicopter traffic, and the new machinery noise associated with the proposed Port is negligible when compared to ambient noise levels in the GOM (see Section 3.9). Impacts such as displacement from active nests are not expected to occur.

FAA guidelines and corporate helicopter operatives request that pilots maintain a minimum altitude of 213 m (700 ft) while in transit offshore, 304 m (1,000 ft) over unpopulated areas or across coastlines, and 610 m (2,000 ft) over populated and sensitive areas. Vessel operators are required to maintain posted slow, wake-free speeds while transiting across most sensitive inland waterways. Compliance with Federal and corporate regulations regarding helicopter altitudes and vessel speeds when entering or departing coastal waterways would further minimize noise impacts on nesting or roosting birds within coastal areas. It is assumed that relatively small proportions of the populations of species would be exposed to noise resulting from the Proposed Action. In addition, it is likely that birds would experience only short-term, nonlethal effects (primarily temporary displacement behavior) from noise generated by helicopters and vessels associated with the Proposed Action. Such impacts are expected to be minor (MMS 2002a).

Increased Traffic. Other than the noise effects described, increased vessel traffic would have no effects on nonthreatened or nonendangered bird species.

ORV Seawater Intake. The ORV seawater intake would have no effect on nonthreatened or nonendangered bird species.

ORV Discharge Plume. The ORV discharge plume would have no effect on nonthreatened or nonendangered bird species.

Marine Debris. The discharge or disposal of garbage and other solid debris from vessels by lessees is prohibited by the MMS (30 CFR 250.300) and the USCG (MARPOL, Annex V, Public Law 100-220[101 Statute 1458]) (33 CFR part 151). The discharge of plastics is strictly prohibited and is never authorized; this includes ashes from burned plastics. All plastics must be returned to shore, and are tracked. Additionally, the USCG would require that the proposed Port have a waste management plan as part of its operational manual. A condition of the license, if issued, would be that all offshore personnel attend annual training on elimination of marine debris. USCG enforces MARPOL and the proposed Deepwater Port license and fines or penalties can be assessed where regulations are violated. However, accidental releases of debris from OCS activities are known to occur offshore (MMS 2002a). Overall, ingestion of marine debris by nonthreatened or nonendangered bird species and engtanglement would not be expected to increase as a result of the Proposed Action.

Terminal Lighting. Terminal lighting would have minor adverse effects on trans-Gulf migratory birds. Many neotropical birds migrate from Mexico to North America by crossing the GOM nonstop over 925 km (575 mi) of open water in the spring (and the reverse in autumn). The proposed Terminal would be in the heart of this migratory pathway; thus many of these trans-Gulf migrants could encounter the proposed Terminal. These birds are known to be attracted to artificial lighting on offshore facilities (Gauthreaux 2002; Witherington 2002), which can seriously disrupt bird migration patterns. For example, migrating birds have been observed circling artificial lights until they become exhausted and drop into the water (Barrow 2002).

Based on the guidance provided by the USFWS in Appendix C, the Applicant proposes to take all measures possible to minimize the amount of total lighting used on the proposed Terminal. The minimal lighting required for safety would be utilized. The USFWS suggests that, for aviation safety, white (preferable) or red strobe lights be used on towers taller than 61 m (199 ft), unless the FAA has otherwise requirements. The use of solid red or pulsating red lights (which attract night migrating birds) should be avoided. Additionally, the amount of light should be minimized during the height of the transmigratory period. To reduce the disruptive effects of lighting, all lighting on the Terminal superstructures (except on the heliport) should be down-shielded to prevent the lights from shining skyward, instead directing the light to shine only on work areas. Such shielded lighting has resulted in significant reductions in bird mortality. This is the only guideline that the USFWS suggests for on-ground facilities and equipment. A heliport is proposed for the Terminal; the Applicant would install lighting on the heliport in accordance with USFWS guidelines for aviation safety lights (Watson 2003). These guidelines specify that only white or red strobe lights should be used at night and these strobes should be minimal in number, intensity, and number of flashes (Watson 2003).

Presence of the Terminal. The proposed Terminal might have minor beneficial effects on trans-Gulf migratory birds. Birds migrating over the GOM might encounter adverse weather, particularly rain or headwinds, and especially tropical storms and hurricanes. Birds that seek shelter from such adverse conditions, or simply are exhausted, might temporarily land on offshore facilities such as the proposed Terminal.

Threatened and Endangered Bird Species

Increased Noise. The effect of increased noise on threatened or endangered bird species is expected to be minor. The threatened or endangered bird species have a coastal distribution in the GOM. Tug trips, helicopter trips, and service vessel trips to support proposed Gulf Landing Terminal operations would originate from Cameron, Louisiana. Piping plover habitat is located in Cameron Parish, Louisiana. Noise resulting from helicopter and service vessel traffic could periodically disturb individuals or groups of coastal birds, especially in sensitive coastal habitats (including nesting areas and critical habitats). The increase in noise due to vessel traffic, helicopter traffic, and the new machinery noise associated with the proposed Port is negligible when compared to ambient noise levels in the GOM (see Section 3.9). Impacts such as displacement from active nests are not expected to occur.

FAA guidelines and corporate helicopter operatives request that pilots maintain a minimum altitude of 213 m (700 ft) while in transit offshore, 304 m (1,000 ft) over unpopulated areas or across coastlines, and 610 m (2,000 ft) over populated and sensitive areas. Vessel operators are required to maintain posted slow, wake-free speeds while transiting across most sensitive inland waterways. Compliance with Federal and corporate regulations regarding helicopter altitudes and vessel speeds when entering or departing coastal waterways would further minimize noise impacts on nesting or roosting birds within coastal areas. It is assumed that relatively small proportions of the populations of species would be exposed to noise resulting from the Proposed Action. In addition, it is likely that birds would experience only short-term, nonlethal effects (primarily temporary displacement behavior) from noise generated by helicopters and vessels associated with the Proposed Action. Such impacts are expected to be minor (MMS 2002a).

Increased Traffic. Other than the noise effects described, increased vessel traffic would have no effects on threatened or endangered bird species.

ORV Seawater Intake. The ORV seawater intake would have no effect on threatened or endangered bird species. These species have a coastal distribution; the seawater intake would be 61 km (38 mi) offshore.

ORV Discharge Plume. The ORV discharge plume would have no effect on nonthreatened or nonendangered bird species. These species have a coastal distribution; the seawater intake would be located approximately 61 km (38 mi) offshore.

Marine Debris. Marine debris could have a minor adverse effect on threatened or endangered bird species, specifically on piping plover critical habitat. Piping plover critical habitat occupies coastal portions of Cameron, Louisiana, from MLLW to where densely vegetated habitat begins. Marine debris could degrade piping plover critical habitat.

The discharge or disposal of garbage and other solid debris from vessels by lessees is prohibited by the MMS (30 CFR 250.300) and the USCG (MARPOL, Annex V, Public Law 100-220[101 Statute 1458]) (33 CFR part 151). The discharge of plastics is strictly prohibited and is never authorized; this includes ashes from burned plastics. All plastics must be returned to shore, and are tracked. Additionally, the USCG would require that the proposed Port have a waste management plan as part of its operational manual. A condition of the license, if issued, would be that all offshore personnel attend annual training on elimination of marine debris. USCG enforces MARPOL and the proposed Deepwater Port license and fines or penalties can be assessed where regulations are violated. However, accidental releases of debris from OCS activities are known to occur offshore (MMS 2002a). Overall, adverse impacts on piping plover critical habitat are expected to be minor.

Terminal Lighting. Terminal lighting would have no effect on threatened or endangered species that are not trans-Gulf migrants in the ROI.

Presence of the Terminal. The proposed Terminal may have no effect on threatened and endangered species that are not trans-Gulf migrants in the ROI.

Fisheries Resources and EFH

Increased Noise. Increased noise would have negligible effects on fisheries resources and EFH. It is presumed that all fish species in the northern GOM can hear, with varying degrees of sensitivity, within the frequency range of sounds produced by oil and gas exploration, production, and decommissioning activities. Noise from these activities can mask sounds important to fish. In particular, loud noise might cause fish to change their behavior and movements and might temporarily affect the usual distribution of fish, disrupting commercial fishing activities. Continuous, long-term exposure to high sound pressure levels above 180 dB has been shown to cause damage to the hair cells in the ears of some fish. Sound pressure levels of this magnitude are not associated with the Proposed Action. These effects were thought not to be permanent since damaged hair cells are repaired or regenerated in fish. However, recent research indicates that hair cell damage regeneration might not counteract permanent damage (Ternes 2003). As the distance between the fish and the source increases, the probability of hearing impairment would decrease as sounds attenuate with distance from a source (MMS 2002a).

Noise from the Proposed Action would not result in hair cell damage in fish. The increase in noise due to vessel traffic, helicopter traffic, and the new machinery noise associated with the proposed Port is negligible when compared to ambient noise levels in the GOM (see Section 3.9). Therefore, the noise associated with the Proposed Action would not result in significant impacts on fish.

Increased Vessel Traffic. Other than the noise effects described, increased vessel traffic would have no effects on fisheries resources and EFH.

ORV Seawater Intake. Minor adverse direct and indirect effects on fisheries resources and EFH are expected from the ORV seawater intake. However, these effects are not expected to be significant. Gulf Landing LLC designed their proposed seawater intake structures to minimize the potential for the uptake of ichthyoplankton. Specifically, proposed mitigation measures include using cylindrical wedgewire intake screens, minimizing intake velocity, and locating the intake structures in the bottom half of the water column. A detailed diagram of the ORV seawater intake structure is presented in Figure 2-7. The average intake velocity would be approximately 0.1 m/s (0.32 ft/s) with a maximum of 0.15 m/s (0.5 ft/s). The intake screens would be centered approximately 11 m (36 ft) below mean sea level. The ORV seawater intake would draw from waters that are hypoxic for more than 25 percent of the mid-summer distribution (Figure 3-2).

Indirect effects on fisheries resources and EFH could result from the impingement and entrainment of prey species. The prey species of fish with EFH in the ROI are presented in Table 3-6. Generally, these species are represented by zooplankton, phytoplankton, various fish species (larval and adult), benthic infauna (e.g., polychaetes and bivalves), benthic crustaceans (e.g., crabs and shrimps), other benthic fauna (e.g., sea cucumbers and sea stars), and squids. The entrainment of phytoplankton and zooplankton (other than ichthyoplankton) are discussed above (under the section on Operational Impacts - Offshore). Based on the mitigation measures proposed by Gulf Landing LLC impacts on zooplankton and phytoplankton are not expected to be significant. Impacts on forage fish are discussed below.

To estimate the potential unmitigated direct impact of the proposed regasification system on fish eggs and larvae (ichthyoplankton), SEAMAP data were examined (GL 2003a). In this analysis, the mean density of fish eggs and larvae in 1 million gallons (3,785.4 m^3) of sea water at the Preferred Site (in the WC-213 samples presented in Table 3-6) were multiplied by the typical ORV sea water intake rate of 136 MGD (515,000 m^3/day). Under the Proposed Action, approximately 1.5 million fish eggs and 575 thousand larvae could potentially be entrained per day at the preferred location, WC-213. Based on these numbers approximately 540 million eggs and approximately 210 million larvae would be entrained per year at WC-213.

While representing the best available data, the SEAMAP data have limitations resulting from the limitations of the sampling methods and lack of invertebrate data. Limitations of the sampling method include a lack of data on the vertical distribution of ichthyoplankton, a lack of data throughout the year, and a sampling gear mesh size that can underestimate smaller eggs and larvae. This is discussed in further detail below.

Despite the data limitations, SEAMAP data are the best available data for the purposes of this assessment. The data are a readily available data set, have been collected consistently for 15 years, and are available near the location of the proposed Terminal. Thus, SEAMAP data can be used to estimate number of larvae that could potentially be entrained by unmitigated ORV operations. The larvae in the WC-213 samples represent a total of 126 taxa (i.e., larvae identified to the lowest taxon possible) (GL 2003a). These taxa, as well as their density in 1 million gallons of seawater (based on WC-213 samples), are presented in Table F-5, in Appendix F. The 10 most abundant taxa represented in the WC-213 samples, in order of decreasing abundance, are red drum (*Sciaenops ocellatus*), star drum (*Stellifer lanceolatus*), Atlantic bumper (*Chloroscombrus chrysurus*), silversides (Family Atherinidae), puffer (Family Tetraodontidae), Atlantic thread herring (*Opisthonema oglinum*), Spanish mackerel (*Scomberomorus maculatus*), silver perch (*Bairdiella chrysoura*), tonguefish (*Symphurus sp.*), and anchovies (Family Engraulidae).

Most of the eggs and larvae potentially entrained in the ORV system would not be expected to survive to age-1, primarily because natural mortality is highest for the early life history stages of fish and varies among species (USEPA 2002a). In general, only a few percent of newly hatched eggs and larvae would be expected to survive to adulthood (Comyns 2003). Natural mortality can be as high as 96 percent for larvae and as high as 99 percent for eggs (Houde 1987; Lasker 1987). Predation is likely to be major cause of natural mortality of fish eggs and larvae; starvation is an additional source for larval natural mortality (Bailey and Houde 1989).

In a letter dated April 12, 2004, regarding the Notice of Intent to prepare to prepare an EIS and request for public comment for the Gulf Landing LLC Deepwater Port license application, NOAA Fisheries expressed concerns that the proposed LNG facility would have a dramatic adverse effect on economically important fish stocks. NOAA Fisheries requested that information necessary to complete a traditional stock assessment to determine impacts from impingement and entrainment be included in the EIS. This assessment would require

a) Numbers of eggs, larvae, and juveniles that are expected to be entrained or impinged (and killed) by species.
b) Daily natural mortality estimates by life stage during the first year of life by species, including hatching success. This allows an estimation of survival from viable egg to age of entrainment.
c) Age-structured population model estimates of recruits to age 1 and population fecundity. This allows stock-level estimates of egg production (viable eggs) and overall survival from viable egg to recruitment at age 1.

The following constitutes an analysis of age-1 equivalent losses for key species of eggs and larvae potentially entrained by the ORV seawater intake. Age-1 equivalent losses are estimates of the number of entrained larvae that would be removed from the population, that would otherwise have survived to age 1. Because natural mortality of fish is highest during the egg and larval stages (i.e., more than 90 percent of eggs and larvae would not survive to age 1, mostly due to predation), age-1 equivalents would create a better basis to judge potential impacts of entrainment on fish stocks, relative to using the estimates of number of eggs and larvae potentially entrained.

For the purposes of this EIS, age-1 equivalent loss estimates limited to key species or species groups. These species were identified based on three criteria:

- Commercial, recreational, and ecological (i.e., prey species) importance
- The availability of age-specific life history data
- The presence and abundance in the WC-213 samples (see Table F-5 in Appendix F)

Based on these criteria, the key species or species groups that were selected are bay anchovy, menhaden, red drum, and red snapper. An attempt was made to estimate the age-1 equivalent losses for Atlantic bumper (a highly abundant and important forage fish) but appropriate life history information was not available (Comyns 2004). The number of larvae potentially entrained has been estimated by taxon using SEAMAP data and the methods described above. These numbers are based on the density of larvae in 1 million gallons (3,785.4 m3) of sea water in samples taken near the proposed Terminal (the WC-213 samples). Average larval density, by taxon, in 1 million gallons (3,785.4 m3) of sea water is presented in

Table F-5 in Appendix F. These numbers are used to estimate age-1 equivalent losses for the following taxa: red drum (Sciaenops ocellatus), drum (Family Sciaenidae), anchovies (Anchoa sp.), anchovies (Family Engraulidae), anchovies and herring (Order Clupeiformes), herring (Family Clupeidae), menhaden (Brevoortia sp.), snappers (Lutjanus sp.), red drum (Lutjanus campechanus), and snappers (Family Lutjanidae). Available instantaneous natural mortality estimates by life stage during the first year of life for certain species were used to calculate the age-1 equivalent losses for these species.

Table 4-3 presents the age-1 equivalent losses of larvae potentially entrained by ORV operations and the species life history tables that were used for the estimates. All calculations are shown in detail in Table F-8, Appendix F. The methods used to obtain the age-1 equivalent losses are described below. The age-1 equivalent loss estimates must be viewed with an understanding of the limitations of the SEAMAP data and the assumptions used create the life history tables. Limitations in the life history tables result from a lack of ealy life history characteristics of individual species. An effort was made to report all such assumptions in the description below and in Table F-8, Appendix F.

Table 4-3. Age-1 Equivalent Losses of Larvae Potentially Entrained by ORV Operations

Scientific Name	Life History Table Used to Estimate Age-1 Equivalent Losses	Annual Mean Number of Larvae Potentially Entrained by ORV Operations	Annual Adjusted Mean[1]	Age-1 Equivalent Losses (Individuals)		
				Yolk-Sac[2] Larva Estimate	Post Yolk-Sac[2] Larva Estimate	Other[3]
Sciaenops ocellatus	Croaker, Louisiana	26,749,151	80,247,452	7,998	23,057	--
Sciaenidae	Croaker, Louisiana	9,726,964	29,180,892	2,908	8,384	--
Anchoa sp.	Bay Anchovy	9,726,964	29,180,892	5,232	30,222	--
Engraulidae	Bay Anchovy	14,590,446	43,771,337	7,848	45,333	--
Clupeiformes	Bay Anchovy[4]	12,158,705	36,476,114	6,540	37,778	--
Clupeiformes	Menhaden[4]	12,158,705	36,476,114	--	--	9,368
Clupeidae	Menhaden	12,158,705	36,476,114	--	--	9,368
Brevoortia sp.	Menhaden	12,158,705	36,476,114	--	--	9,368
Lutjanus sp.	Red Snapper	9,726,964	29,180,892	78	881	--
Lutjanus campechanus	Red Snapper	7,295,223	21,885,669	59	661	--
Lutjanidae	Red Snapper	4,863,482	14,590,446	39	441	--

Sources: Rose 2004; EPRI 2004; adapted from USEPA 2002b

Notes: [1] Adjusted mean = mean multiplied by 3

[2] Calculations assumed that 100% of the larva were either at the yolk-sac or the post yolk-sac stage of development.

[3] The mortality rate of only one larval stage was available for menhaden, so an yolk-sac and post yolk-sac limit of larvae is not available.

[4] Equivalent losses of larvae from the Order Clupeiformes were calculated using both the bay anchovy model and the menhaden model. This taxon could contain anchovies or menhaden. These numbers should not be added together or they would be double-counted.

The model that was used to estimate age-1 equivalent losses is the Equivalent Adult – Forward Projection Approach (EPRI 2004). This model uses life stage-specific natural mortality or survival fractions to scale entrainment losses to numbers that would have survived to age 1. Losses at any given age are multiplied by the fraction of fish at that age that would be expected to survive to age 1. The model also utilizes an adjustment factor to account for underestimation of mortality based on the assumption that all larvae entrained are entrained at the beginning of a life history stage. This is important because mortality rates are high for early life history stages (egg and larval stages). Organisms entrained at the end of a life stage have survived most of the mortality risk imposed on that stage and have a higher probability of surviving into the next stage. The basic model is reported as:

E = SAN (EPRI 2004).

E = equivalent adult loss

N = number of fish lost due to impingement or entrainment

SA = fraction of fish expected to survive from the age at which they are impinged or entrained to the age of equivalence (in this case age 1).

Given the limitations on readily available data and time constraints associated with the Deepwater Port Act process, it is not practical for this evaluation to go beyond age-1 equivalents (e.g., population dynamics, stock-level estimates of egg production [viable eggs] and overall survival from viable egg to recruitment at age 1). This evaluation will only include age-1 equivalent losses.

It is assumed that juveniles would not be entrained or impinged. The use of the cylindrical wedgewire screen and the low intake velocity (< 0.12 m/s [0.4 ft/s]) proposed by the Applicant would allow most free-swimming juveniles to escape the ORV intake.

Limitations of the age-1 equivalent losses would be largely due to the limitations of the SEAMAP data and the availability of daily natural mortality estimates by life stage during the first year of life by species. As noted earlier, the SEAMAP data have limitations, but they appear to be the best available data for the purposes of this assessment. The data are readily available data set, have been collected consistently for 15 years, and are available near the location of the proposed Terminal. The following are limitations of the SEAMAP data:

- Sampling gear mesh size is large enough such that smaller eggs and larvae could be underestimated (some studies indicate as much as 5 to 8 times)
- Larval data is inherently variable or patchy (i.e., there is low sample size associated with the WC-213 sample)
- Eggs are not identified by taxon and larvae are identified to lowest possible taxon
- Larvae are not measured or aged
- There is a lack of data on the vertical distribution of ichthyoplankton
- Ichthyoplankton were sampled primarily from spring and summer when larvae are most abundant

Each limitation is discussed below. How the data were adjusted to account for these limitations and how these limitations might affect age-1 equivalent estimates are also discussed.

Bongo nets used to sample ichthyoplankton data for the SEAMAP survey have a mesh size of 0.333 mm (0.13 in). This mesh size could potentially undersample fish eggs and larvae (Lyczkowski-Shultz 2003b).

For example, comparison of ichthyoplankton samples taken with 0.333- and 0.202-mm (0.13- and 0.08-in) mesh nets indicate that the smallest red drum larvae sampled were 5 to 8 times more numerous when collected with the finer mesh net. These results are expected to be applicable to larvae of other species (Lyczkowski-Shultz 2003b). Therefore, all estimates of potentially entrained ichthyoplankton were multiplied by 3 to account for gear inefficiency and ineffectiveness, as suggested by NOAA Fisheries (Thompson 2004).

The WC-213 samples are highly variable or patchy, which is typical of ichthyoplankton data (Table 3-6). The patchiness of plankton distribution is a result of a number of factors such as water temperature, spawning events, hydrographic features, and diel migrations. How these factors affect ichthyoplankton distribution is described above. The abundance of ichthyoplankton in the area of the proposed Port depends on these factors. Thus, the number of fish eggs and larvae that could be entrained is highly variable and also depends on these factors.

To account for the variability of the data, the range of all eggs potentially entrained by ORV operations was calculated by using the upper and lower confidence limits. The confidence limits were calculated using the adjusted mean (mean number of eggs potentially entrained in a year multiplied by 3) and an adjusted measure of variability (adjusted standard error=standard deviation multiplied by 3 divided by the square root of the sample size). The range of eggs potentially entrained by ORV operations is reported in Table 4-4. This range will be used to calculate age-1 equivalent losses of eggs potentially entrained by ORV operations (Table 4-4). Not enough information on the larvae samples is available to construct the same range for larvae of each taxon. Therefore, estimates of larvae (potentially entrained by ORV operations) used to calculate age-1 equivalent losses by taxon are the adjusted mean for each taxa (mean larvae potentially entrained in a year in the WC-213 samples multiplied by 3) (Table 4-3).

Table 4-4. Age-1 Equivalent Losses for Eggs Potentially Entrained by the ORV Warming Water System

Confidence Limits [a]	Eggs Potentially Entrained by ORV Operations[a]	Age-1 Equivalent Losses	
		Low Mortality Species (Bay Anchovy)	High Mortality Species (Red Snapper)
Upper	2,708,438,254[a]	152,851	4,351
Lower	530,707,025	29,950	853

Notes: [a] The calculations in this table used the baseline estimate annual mean of 540,000 eggs in the WC-213 samples taken directly from the SEAMAP data. The baseline estimate was multiplied by three to provide the adjusted mean. This adjusted mean was used to calculate the upper and lower confidence limits (adjusted standard error=standard deviation multiplied by 3 divided by the square root of the sample size). These limits are presented to account for the large variability inherent in plankton data.

Taxa of eggs are not identified in the SEAMAP data. Additionally, there is no reasonable way to assign the eggs in the WC-213 samples to specific taxa (Lyczkowski-Shultz 2004). Because we do not know which taxa are represented by the eggs, a range of age-1 equivalent losses that result from potentially entrained eggs was calculated using the red snapper table for the lower estimate and the bay anchovy table for the upper estimate. The red snapper table represents species with higher natural mortality from egg to age 1 and results in the lowest number of age-1 equivalent losses. The bay anchovy table represents species with lower natural mortality from egg to age-1 and results in the highest number of age-1 equivalent losses.

The number of total age-1 equivalent losses for eggs potentially entrained by ORV operations is reported in Table 4-4. These numbers indicate the eggs potentially entrained by ORV operations could result in an annual loss of 29,950 to 152,851 age-1 fish with low natural mortality, like bay anchovies or a loss of 853 to 4,351 age-1 fish with high natural mortality, like red snappers.

Larvae in the SEAMAP data are identified to the lowest taxon possible. In some cases lowest taxon reported is species, while in other cases genus, family, or order is reported. For example, in the SEAMAP data, anchovy larvae are identified to the genus level (*Anchoa sp.*) and family level (Engraulidae), and could also be included in the Order Clupeiformes. To determine the age-1 equivalent losses for *Anchoa sp.*, Engraulidae, and Clupeiformes, the bay anchovy life history table was used. The life history table that was used to estimate age-1 equivalent losses for each taxon is reported in Table 4-3. The Order Clupeiformes is a large order that includes herring and anchovies (important forage fish). Therefore, age-1 equivalents were estimated for Clupeiformes using both the bay anchovy life history table and the menhaden life history table. This shows a range of impacts for the order, but these should not be double counted. It was important to provide age-1 equivalent losses for red drum, because it is an important commercial and recreational fish with EFH in the ROI and it is also the most abundant taxa in the WC-213 samples. However, a life history table for red drum was not readily available. Therefore, the life history table for Atlantic croaker was used as a surrogate for red drum (Rose 2004).

Larvae lengths or age are not recorded by the SEAMAP data. Larvae can have different natural mortality rates depending on their age. The larval stage immediately following hatching from the egg is called the post yolk sac larvae. It is named for the attached yolk sac which is being absorbed for nutrition. Once the yolk sac is absorbed the larvae is known as a post yolk sac larvae. If natural mortality rates were available for both larval stages, age-1 equivalent losses were estimated for both reported larval stages. This is true for the bay anchovy, red drum, and red snapper life history tables, but not the menhaden life history table. Because the lengths and ages are not recorded, age-1 equivalent losses were calculated for all of the larvae for the taxa (adjusted mean). These numbers are not to be added because, these larvae are yolk sac larvae or post yolk sac larvae, but because we don't know which, this would be a conservative approach that results in upper and lower estimates of age-1 equivalent losses (Table 4-3).

Oblique tows (samples collected from the bottom to the top of the water column) used in the SEAMAP survey provide an estimate of ichthyoplankton that occur throughout the water column. However, oblique tows do not provide an indication of whether densities of ichthyoplankton are stratified or different throughout the water column. Stratified tow samples are used provide information on where an organism is the water column (Wolff and Wormuth 1984).

SEAMAP ichthyoplankton data are collected from June through November, when spawning and recruitment of fish species are seasonally high. However, some species spawn in other months and different larvae are caught in different abundances throughout the year (see Table 3-4). For example, menhaden (*Brevoortia* spp.) spawn in the winter (Wolff and Wormuth 1984).

Indirect impacts can be judged by the minimal age-1 equivalent losses of bay anchovy and menhaden. Bay anchovy and menhaden are highly abundant and important forage fish. Losses due to potentially entrained larvae likely to be in the forage fish category range from approximatedly 5,000 to approximately 45,000 age-1 fish.

Red drum and red snapper are important commercial and recreational fish. Age-1 equivalent losses estimated for potentially entrained red drum larvae range from 8,000 to 23,000 age-1 fish and for potentially entrained red snapper larvae range from 59 to 661 age-1 fish. Based on the age-1 equivalent losses estimated for these species, it is unlikely that eggs and larvae potentially entrained by the ORV would have affect fishing or have an adverse economic impact on these recreational and commercial fisheries. The number of annual age-1 equivalent losses of menhaden as a result of potentially entrained larvae is approximately 14,000 age-1 fish. This is a relatively small number compared to the range of recruits to age-1 menhaden in the 1990s (13 to 23 billion) (GSMFC 2002). Similar trends are expected for other species of eggs and larvae that are potentially entrained by the ORV seawater intake associated with the proposed action. .

Additionally, the entrainment estimates presented in this section assumed that 100 percent of estimated icthyoplankton concentration in the seawater was entrained and no exclusion credit for mitigation measures was used. Mitigation measures proposed by the Applicant would likely result in a further reduction of the numbers of eggs and larvae potentially entrained. Specifically, proposed mitigation measures include using cylindrical wedgewire intake screens, minimizing intake velocity, and locating the intake structures in the bottom half of the water column. A detailed diagram of the ORV seawater intake structure is presented in Figure 3-2. The average intake velocity would be approximately 0.1 m/s (0.32 ft/s) with a maximum of 0.15 m/s (0.5 ft/s). The intake screens would be centered approximately 11 m (36 ft) below mean sea level (below mid-depth). The ORV seawater intake would draw from waters that are hypoxic for more than 25 percent of the mid-summer distribution (Figure 3-2).

Siting the intake screens below the lower half of the water column would result in a reduction of entrainement of most organisms. Alternatively, siting the seawater intake too low in the water column might result in an increase in entrainment or impingement of eggs that are collected near the bottom (e.g., sand sea trout) and demersal brown and white shrimp eggs. Data are not currently available to quantify the differential impacts of siting the seawater intakes. However, available data indicate that some species are stratified at shallow depths. One study sampled larvae throughout the water column in an area that was located at a water depth of 10 to 12 m (33 to 40 ft). The study made some general conclusions about the distribution of larvae species throughout the water column. Most anchovy (Engraulidae) larvae were collected at mid-depth, with 11 percent collected at the bottom. From the family Sciaenidae, most Atlantic croaker (*Micropogonias undulatus*) were collected at mid-depth and sand sea trout (*Cynoscion arenarius*) were collected near the bottom. From the family Clupeidae, scaled sardines (*Harengula jaguana*) were collected near the surface, menhaden (*Brevoortia spp.*) were collected at all depths, and Atlantic thread herring (*Opisthonema oglinum*) were collected at mid-depth. From the family Carangidae, Atlantic bumper (*Chloroscombrus chrysurus*) were most abundant near mid-depth. From the family Scombridae, Spanish mackerel (*Scomberomorus maculatus*) were collected at mid-depth (Ditty 1986).

Additionally, the low through-screen velocity would allow most fish and even some zooplankton and older larvae to swim away from the screen current within the flow field (the three-dimensional area around the cylindrical intake screen from where water is drawn). The screen's cylindrical configuration ensures that the flow field is quickly dissipated, allowing organisms to escape (Weisberg et al. 1984). Local velocity would decrease as an organism moves away from the central point of extraction, such that within one screen diameter or less the screen has no observable impact on flow (USCG and MARAD 2003b). These hydraulic characteristics allow mobile organisms to sense and easily escape the screen's flow field-eliminating impingement and entrainment for adult and juvenile fish. Smaller sized, non-motile larvae and eggs might not be able to utilize the same hydraulic characteristics and thus might be more susceptible to entrainment.

Another factor related to screen hydraulics is the screen orientation in relation to the ambient current (Hanson et al. 1977). If screens are oriented perpendicular to the ambient current, contact time is minimal; however, the probability of contact is relatively large. If screens are oriented parallel with the ambient current, contact time is greater; however, the probability of contact is lower. In the case of the proposed Terminal, which is oriented east to west, the ambient current is generally east to west.

When designing passive intake screen systems, cost is also a factor. The overall system cost varies inversely with slot width. The cost increases dramatically with slot width less than 2 mm (0.08 in). Smaller slot width yields lower fractional open area and as such requires a larger screen surface area. This can be accounted for either by an increase in screen size or in the number of screens. There is a point at which fabrication of larger screens is not feasible and the number of screens must be varied. Increasing the size of a screen is a more cost-effective method of increasing screen surface area compared to adding additional screens. An increase in the number of screens requires additional feed lines for the air backwash system, valving, and power supply. As slot width increases, system cost decreases.

The Applicant proposed a marine life exclusion system with cylindrical wedgewire screens with a gap size of 6.35 mm (0.25 in), an average intake velocity of approximately 0.1 m/s (0.32 ft/s) (a maximum of 0.15 m/s [0.5 ft/s]), and intake screens would be centered approximately 11 m (36 ft) below mean sea level (below mid-depth). This system is based on the overall cost and that no GOM performance data are available to compare the cost of any of the marine life exclusion systems with the benefit of potential impact reduction. While a smaller mesh size may decrease entrainment of smaller organisms, impingement would increase. An increase in impingement does not translate into an increase in survivability.

The primary mitigation measure, which would reduce both impingement and entrainment, would be to locate the seawater intake in the lower half of the water column, where ichthyoplankton is less abundant. Additionally, the low through-screen velocity would allow most fish and even some zooplankton and older larvae to swim away from the screen current within the flow field (the three-dimensional area around the cylindrical intake screen from where water is drawn). The screen's cylindrical configuration ensures that the flow field is quickly dissipated, allowing organisms to escape (Weisberg et al. 1984). Local velocity would decrease as an organism moves away from the central point of extraction, such that within one screen diameter or less the screen has no observable impact on flow (USCG and MARAD 2003b). These hydraulic characteristics allow mobile organisms to easily escape the screen's flow field-eliminating impingement and entrainment for adult and juvenile fish. Smaller sized, non-motile larvae and eggs might not be able to utilize the same hydraulic characteristics and thus might be more susceptible to entrainment. To be conservative these mitigation measures were not in the evaluation of ichthyoplankton entrainment developed for this EIS.

Because of the data uncertainty and limitations, the Applicant is also proposing a plankton monitoring plan. The Applicant would establish and implement a monitoring plan to evaluate the impact of the Proposed Action on ichthyoplankton. Information obtained from the monitoring program will be important in furthering the knowledge base on the use of impingement and entrainment technology in deep offshore waters, as well as the impact of temperature reductions and the biofouling toxicants on ichthyoplankton. The monitoring plan is further described in Section 4.2.4.2 Mitigation.

ORV Discharge Plume. The ORV discharge plume would have minor adverse impacts on fisheries resources and EFH as a result of the temperature reduction and concentration of sodium hypochlorite.

The cool water discharge will be a constant factor in the marine environment over the life of the proposed Terminal. Modeling of the thermal plume from the proposed Terminal shows that under the Preferred Alternative, temperature reductions below ambient 100 m (328 ft) from the outfall, are predicted to be 1.1 °C (2 °F) or less. Worst case temperature deficiencies are expected to be 0.85 °C (1.5 °F) or less at a distance of 500 m (1,641 ft) from the outfall.

Although fish are poikilothermic (cold-blooded) animals that are affected by the temperature of their environment, adult fish are mobile and readily capable of moving away from an external source, such as the cold-water discharge plume that might affect their physiology or health. Because of the location of the discharge, demersal species of fish would most likely be affected by the thermal discharge.

In general, most fish larvae are concentrated in the upper half of the water column, with the larvae of a few species, such as Atlantic croaker and spotted sea trout, found concentrated in the lower half of the water column (Lyczkowski-Shultz and Steen 1991). Research indicates that some larval fish and other zooplankton are concentrated higher in the water column during daylight and in deeper waters at night. Species of fish larvae that undergo these vertical diurnal migrations are exposed to a wide range in water temperatures, resulting in an increased level of thermal tolerance (Myers et al. 1986). Even larvae with a high thermal tolerance might be immobilized or killed by a sudden exposure to cold temperature (Table F-2, Appendix F) (Myers et al. 1986). Overall, the impact on fish larvae from the thermal discharge plume is expected to be minimal.

Data are available on the optimal hatching temperatures for eggs but available data on lethal temperatures for fish eggs are sparse (Table F-2, Appendix F). Review of the data indicates that temperature differential in the discharge plume might be sufficient to cause lethal effects on at least some species of fish eggs. However, because the eggs that are likely to be affected would represent only a small portion of the total eggs available, this effect is not expected to be ecologically significant.

The Applicant proposes to add approximately 2,000 to 5,000 ppb of sodium hypochlorite solution to the ORV intake seawater as a biofouling toxicant. The concentration added would be sufficient to maintain a concentration of 500 ppb in the ORV. The proposed concentration is based on what is currently applied at other facilities and is meant to target organisms that would persist in the ORV system. The concentration of sodium hypochlorite at the ORV discharge point is expected to be a maximum of 500 ppb and dilute rapidly. The sodium hypochlorite concentration is expected to be about 50 ppb on the sea floor.

Available marine toxicity data for sodium hypochlorite are presented in Table 4-2. The concentration of sodium hypochlorite at the discharge point is higher than toxic concentration for the tested saltwater fish species and mysids. However, the duration of the toxicity test ranged from 28 hours to a maximum of 7 days. The time motile organisms would be exposed to the sodium hypochlorite is likely shorter. Motile organisms would move out of the ORV discharge plume because of the reduced temperature. Additionally, the sodium hypochlorite is expected to dilute rapidly.

The expected concentration of 50 ppb of sodium hypochlorite on the sea floor is less than toxic concentrations of sodium hypochlorite for benthic invertebrates such as American oysters and grass shrimp. Chronic effects on sedentary benthic organisms could occur in the localized area of the ORV discharge plume. The area of sea floor affected by the cool water plume is estimated to range from 0.12 to 5.71 ac depending on conditions. This area is negligible and represents less than 0.1 percent of the benthic habitat available in WC-213.

The above analysis is limited by uncertainty. The major source of uncertainty is identifying the concentrations of reaction products that might occur in the discharge water and whether these concentrations are below marine toxicity thresholds. USEPA notes that the reactions of chlorine in fresh and salt water are complex. Thus, it is important that studies regarding the effects of chlorine on aquatic organisms are designed to adequately measure the concentrations of reaction products of chlorine, TRC, or CPOs. It also notes that the half-lives of TRC and CPO are short in most waters (USEPA 1985).

Some power plants use sodium hypochlorite to prevent microbial fouling. The concentrations of reaction products that could be expected from the use of sodium hypochlorite at the proposed Terminal might be similar to the concentrations of halogenated compounds that result from power plants that use sodium hypochlorite. While the data from the power plants are limited, two studies indicate that bromoform is the predominant volatile chemical formed in marine receiving waters as a result of chlorination (Grove et al. 1985; Hartwig and Valentine 1983). The maximum concentration reported for bromoform by these studies is 34 ppb. Available marine toxicity data for bromoform are presented in Table 4-2. These data indicate that the maximum concentration reported for bromoform is about 200 times less than the lowest toxicity value (6,400 ppb) reported for bromoform in Table 4-2. While this comparison has a number of limitations (e.g., effects of ammonia and pH, duration of the toxicity test), the data suggest that the concentration of bromoform is well below toxicity thresholds for the tested marine fish, invertebrate, and alga species.

When comparing the toxicity values, it is important to note the duration of the toxicity test, 28 hours to a maximum of 7 days. The time motile organisms would be exposed to the sodium hypochlorite and reaction products is probably shorter. Motile organisms would probably move out of the ORV discharge plume because of the reduced temperature. Therefore, impacts on motile organisms would be minimal. Long-term chronic effects on sedentary, benthic organisms would occur in the localized area of the discharge plume. The area of sea floor affected by the cool water plume is estimated to range from 0.12 to 5.71 ac depending on conditions. This area is negligible, representing less than 0.1 percent of the benthic habitat available in WC-213.

Marine Debris. The discharge or disposal of garbage and other solid debris from vessels by lessees is prohibited by the MMS (30 CFR 250.300) and the USCG (MARPOL, Annex V, Public Law 100-220[101 Statute 1458]) (33 CFR part 151). The discharge of plastics is strictly prohibited and is never authorized; this includes ashes from burned plastics. All plastics must be returned to shore, and are tracked. Additionally, the USCG would require that the proposed Port have a waste management plan as part of its operational manual. USCG enforces MARPOL and the proposed Deepwater Port license and fines or penalties can be assessed where regulations are violated. However, accidental releases of debris from OCS activities are known to occur offshore (MMS 2002a). Therefore, impacts on fisheries resources and EFH are expected to be insignificant.

Terminal Lighting. Proposed Terminal lighting would have minor adverse impacts on ichthyoplankton, juvenile, and small fish. Ichthyoplankton, juvenile fish, and small fish species might be attracted to the proposed Terminal lighting (Lyckowski-Schultz 2003a). Nighttime light-fields at platforms are thought to attract different fish species at night, potentially affecting feeding intensities of predatory species (Stanley and Scarborough 2003). Some predatory fish species that normally forage visually during the day could take advantage of nighttime Terminal lighting to forage at night (Stanley and Scarborough 2003). Thus, the lights from the proposed Terminal area might attract free swimming ichthyoplankton as well as larger predatory fish species, making them more vulnerable to predation. Because no subsurface lighting is planned for the proposed Terminal area, impacts on ichthyoplankton, juvenile fish, and small fish are expected to be minor.

Presence of the Terminal. As an artificial reef, the proposed Terminal might have long-term positive impacts on fish resources and EFH as it provides an optimal artificial reef substrate for colonization, where fishing and its associated adverse impacts are excluded.

The location of the proposed Terminal (present in Figure 2-1) would be on the topographic high in the west-central portion of WC-213. As indicated in Figure 3-1, the addition of the proposed Terminal to the topographic high in WC-213 would not adversely impact this topographic relief. As a matter of fact, it is expected that the GBS would enhance the topographic high in WC-213. Research efforts relating fish populations with habitat type have increased with the popularity of artificial reefs, beginning in the 1970s. Results suggest that fish are attracted to structures primarily for refuge and foraging opportunities. Smaller fish are attracted to a structure, and larger predatory individuals seek the smaller fish (prey items) at the structure. Benthic environments containing structure show increased species diversity and total numbers of fish compared to locations devoid of structures. Naturally occurring undulating bathymetric peaks (such as the topographic high in WC-213) lack the sharp angles, overhangs/ledges, and interstices, and do not provide refuge for smaller fish, and, correspondingly, do not attract larger fish seeking prey. However, other naturally occurring bathymetric peaks, such as coral reefs, limestone outcroppings, or vermetid reefs, provide sharp changes in bathymetry and areas of refuge. The presence of refugia attracts smaller fish and the presence of smaller fish attracts larger fish. It is expected that the structures associated with the proposed Port would provide greater refuge and foraging opportunities for fish species indigenous to the GOM, than the existing undulating benthic environment in WC-213.

A description of the fish and other biota attracted to artificial reefs can be found in Section 3.2.5.7. The attraction of biota to artificial reefs and their longevity at particular structures vary depending on the ecological role of the species in question, as well as environmental conditions. Additional refuge for fish resources and EFH would be available within the Safety Zone surrounding the proposed Terminal, where commercial and recreational fishing would be excluded. NOAA Fisheries has expressed concerns regarding increased entrainment due to increased densities of marine fishery species and ichthyoplankton. These concerns are addressed in the *ORV Seawater Intake* subsection.

4.2.2.3 Effects of an LNG Spill

In the unlikely event of an LNG spill, short-term adverse impacts on biological resources would be expected. Potential impacts on marine life include exposure to low-temperature LNG at the water surface and asphyxiation by the natural gas vapors above the surface of the water. The low temperature is sufficient to rapidly cause the equivalent of frostbite or, if enough of the body surface is exposed, death from freezing of the tissue. Asphyxiation could result as the natural gas vapors displace oxygen immediately above the surface of the water, or as flames consume available oxygen. These potential impacts on individuals that are at the spill location could occur within approximately 1 hour of the spill. Information on the area of impact resulting from an LNG spill is presented in Section 4.10. The time frame for these potential impacts is limited. LNG does not dissolve in the water, so no toxic impacts are expected after the LNG has boiled off and the vapors have dispersed.

4.2.2.4 Decommissioning

Impacts are expected to be temporary and would not result in long-term adverse impacts on biological resources. Decommissioning options for the proposed Port are described in Section 2.6.4. If the proposed GBSs remain in place after the life of the project, they would continue to serve as artificial reef providing beneficial impacts on fishery resources. The higher productivity associated with an artificial reef (described in Section 3.2.6.9) would be expected to continue. However, decommissioning of the proposed Terminal would probably involve cutting and removing all platform connections and bridges from the facility before removing main structures on the GBSs. The reverse of the Terminal installation procedure would be undertaken, where the Terminal would be removed from the sea floor via ballast and air injections and floated to a shore-based facility for demolition and disposal. This procedure would result in a short-term increase in turbidity near the decommissioning activities. Turbidity associated with the decommissioning of the GBSs would temporarily cause motile marine organisms to disperse from the area. Increased turbidity is expected to adversely affect demersal organisms.

Historically in the GOM, about two-thirds of the platforms have been removed using explosives. Impacts of an underwater explosion could include both physical damage resulting from pressure effects and noise-related impacts. Should explosives be used, qualified observers would monitor the detonation area for protected species before and after each detonation. The detection of any marine mammal within a predetermined radius from the structure before detonation would, without exception, delay its removal.

Additionally, if explosives were to be used during the decommissioning of the proposed Terminal, the explosives would be of a type normally used for decommissioning of OCS facilities in the GOM. For example, current platform removal activities involve the use of 50-pound charges on an as-needed basis. Prior to decommissioning, the underwater portion of the structures would be evaluated to determine the nature and extent of habitat that has developed during the operational life of the facility. At that time, and in consultation with the appropriate Federal agencies, a plan for decommissioning would be agreed upon. Additionally, the facility operator would, prior to their use, present impact zone models for approval by appropriate agencies. Impact zone models would include specifics of the explosive type and weight, description of possible effects on listed species, and the actions to be taken to eliminate or reduce such effects. As a result, it is expected that other than short-term behavioral disturbances, adverse impacts would be avoided. Thus, impacts associated with the use of explosives would be minor.

The proposed pipelines would be cleaned, filled with seawater, and abandoned in place after all structures above the mud line have been removed. The end of the pipelines would be sealed and recovered to minimize interference with other OCS uses. Therefore, no impacts from its abandonment are expected.

Given that decommissioning would occur 30 years from now, it seems reasonable to expect that the technologies for decommissioning and removal, as well as our understanding of the potential for impact on the marine ecosystem, might be different than under current conditions. This issue will be addressed at the time of decommissioning (i.e., 20plus years hence), at which time it is expected that the owner would adhere to all applicable and appropriate requirements. The owner would consult with the appropriate Federal agencies at that time and submit a decommissioning plan to the Secretary for approval.

4.2.3 Endangered Species Act Consultation Summary

Several federally listed endangered or threatened marine mammal, sea turtle, fish, and migratory bird species occur in or near the ROI. There are no listed threatened or endangered plants in or in proximity to the ROI.

Sperm whales (endangered) generally occur in waters greater than 180 m (590 ft) in depth. Currently there is no critical habitat designated for sperm whales in the GOM, but the area south of the Mississippi Delta might be important habitat for sperm whales. The Mississippi Delta is outside the ROI. However, increased ship traffic could increase the probability of collisions between ships and sperm whales, resulting in injury or death of some animals. A condition of the license, if issued, would require the Applicant to adhere to the provisions set forth in MMS Notice to Lessees No. 2003-G10, *Vessel Strike Avoidance and Injured/Dead Protected Species Reporting*, further reducing the risk associated with vessel strikes or disturbance of protected species that might result from the proposed Port's operations. Therefore, the proposed Port is not likely to adversely affect the sperm whale.

The West Indian manatee is an endangered marine mammal that has been documented to occur within the Lake Pontchartrain Watershed. The onshore support operations would be based out of Cameron, Louisiana, more than 161 km (100 mi) west of Lake Pontchartrain. The occurrence of the West Indian manatee in the northern GOM is considered rare (Würsig et al. 2000). The West Indian manatee is not expected to interact with support vessels associated with the proposed Port. Therefore, the proposed Port is not likely to adversely affect the West Indian manatee.

Threatened or endangered sea turtles which occur in the GOM and might occur in the ROI include the loggerhead sea turtle (threatened), Kemp's ridley sea turtle (endangered), leatherback sea turtle (endangered), hawksbill sea turtle (endangered), and green sea turtle (threatened). There are no designated critical habitats or migratory routes for sea turtles in the northern GOM. However, NOAA Fisheries recognizes many coastal areas as preferred habitat (i.e., important sensitive habitats that are essential for the species within a specific geographic area) for sea turtles. Sea turtle abundance is higher in the eastern GOM than in the western GOM (i.e., east of the Mississippi River) (McDaniel et al. 2000). Increased ship traffic could increase the probability of collisions between ships and turtles, resulting in injury or death of some animals. A condition of the license, if issued, would require the Applicant to adhere to the provisions set forth in MMS NTL No. 2003-G10, *Vessel Strike Avoidance and Injured/Dead Protected Species Reporting*, further reducing the risk associated with vessel strikes or disturbance of protected species that might result from the proposed Port's operations.

The only species of threatened or endangered birds that have the potential to occur in the ROI are the eastern brown pelican (endangered), southern bald eagle (threatened), and piping plover (endangered). Due to the distance of the proposed Port's activities from the coastal locations of the bald eagle and piping plover, the project is not likely to adversely affect either species or its critical habitat. While there could be some limited interaction between the eastern brown pelican and proposed pipeline installation, there is an abundance of foraging habitat in the surrounding areas and eastern brown pelicans would likely move out of the area during installation of the proposed pipelines. Therefore, the project is not likely to adversely affect the continued existence of the eastern brown pelican.

The Gulf sturgeon (threatened) and smalltooth sawfish (endangered) are the only federally listed fish that occur in the GOM (MMS 2002a). Gulf sturgeon and smalltooth sawfish currently occur in the eastern portion of the GOM, distant from the proposed Port area. Therefore, the proposed Port is not likely to adversely affect the continued existence of the Gulf sturgeon and smalltooth sawfish.

Based on the analysis presented throughout Section 4.2, impacts associated with the proposed Port are not expected to be significant. Furthermore, there are no designated critical habitats in proximity to the ROI. Therefore, the proposed Port is not likely to adversely affect the continued existence of listed species that occur in or in proximity to the ROI.

4.2.4 EFH Assessment

Included in this EIS are the components required for an EFH Assessment. The USCG's and MARAD's request for an EFH consultation and NOAA Fisheries' response appear in Appendix D. The required components of this EFH consultation and the sections of this EIS where the EFH discussions and other related material can be located are as follows:

- A description of the Proposed Action is in Section 2.0.
- A description of EFH within the ROI is in Section 3.2.6 and Appendix D.
- Analyses of the effects, including cumulative effects, of the Proposed Action on EFH are throughout Sections 4.2 and 5.1.2, respectively.
- The USCG's and MARAD's assessment and conclusion of the effects of the action on EFH are included at the end of each impact discussion outlined in Section 4.2 and summarized in Section 4.2.4.

Species that are managed by the GMFMC and have EFH in the proposed Port area include brown shrimp, white shrimp, red drum, red snapper, Vermilion snapper, lane snapper, greater amberjack, lesser amberjack, gray triggerfish, king mackerel, Spanish mackerel, cobia, dolphin, bluefish, and little tunny. Species that are managed by NOAA Fisheries—Highly Migratory Species Division and have EFH in the proposed Port area include Atlantic bluefin tuna, bonnethead shark, and Atlantic sharpnose shark (Ruebsamen 2004). The habitat associations and life stages of these species that have EFH within the ROI are presented in Appendix D. While some of these species have habitat associations (i.e., EFH) with habitat types other than the water column (e.g., tidal creeks, oyster reefs), the only types of habitat that currently exist in the proposed ROI include the water column, unvegetated sediments, shoals, and floating *Sargassum*. While these habitat types are essential for the species for which they are designated, these designations are based on distribution (presence/absence) and abundance of these species (GMFMC 1998; NMFS 1999).

Minor adverse effects on the water column, sediments, and would occur as a result of the Proposed Action. All impacts were evaluated by the USCG and MARAD as not significant, based on the significance criteria outlined in Section 4.2.1. EFH for these species include broad areas of the GOM. Additionally, the water column and unvegetated sediments (not ecologically sensitive habitat types) within the ROI would represent only a small fraction of these habitat types available within these species' distributions throughout the GOM. All impacts on the water column and unvegetated sediments are expected to be localized. Additionally, ORV seawater intake was designed to minimize and mitigate adverse impacts on EFH and marine fishery resources, specifically impacts on ichthyoplankton. Thus, none of the potential impacts on EFH are expected to result in population-level effects or a reduction in biomass for any stock.

Long-term minor beneficial effects on the shoal and topographic relief in WC-213 is expected as a result of the Proposed Action. It is expected that the structures associated with the proposed Port would provide greater refuge and foraging opportunities for fish species indigenous to the GOM than the existing undulating benthic environment in WC-213. The proposed Port would provide valuable artificial reef habitat for colonization for many commercially or recreationally important species and the proposed Safety Zone (with an area of approximately 194.1 ac) would provide additional refuge to these species by excluding commercial fishing. No effects on *Sargassum* were identified.

The USCG and MARAD are aware of NOAA Fisheries' concerns regarding the impacts of entrainment and the thermal discharge that would result from the ORV seawater intake. This includes indirect effects on EFH and fisheries resources by entrainment of prey and forage species, including zooplankton, phytoplankton, benthic invertebrates, and ichthyoplankton. Analyses in Section 4.2.2.2 indicate that these impacts are not ecologically significant. The maximum number of eggs and larvae potentially entrained by the proposed ORV operations would be 1.6 billion eggs (adjusted mean) and 629 million larvae (adjusted mean), annually. However, more than 90 percent of the eggs and larvae potentially entrained in the ORV system would not be expected to survive, primarily because natural mortality is highest for the early life history stages of fish. Predation is likely to be major cause of natural mortality of fish eggs and larvae; starvation is an additional source for larval natural mortality (Bailey and Houde 1989). As indicated by the age-1 equivalent losses of eggs and larvae that would be entrained by ORV operation (Tables 4-3 and 4-4), the operation of the ORV would not significantly impact fish populations. As described, Gulf Landing LLC designed the ORV seawater intake structures to minimize impacts of impingement and entrainment. Therefore, this represents a worst-case scenario, in as much as it assumes that all eggs and larvae in the area would be entrained. As indicated in Section 4.2.2.2, not all eggs and larvae in the area would be entrained.

4.2.4.1 Impacts on Commercial and Recreational Fisheries

Potential impacts on fisheries resources were examined in Section 4.2.2. Any potential impacts on commercial and recreational fisheries resources would result from the EFH impacts that are identified in Table F-7 in Appendix F and are not expected to be significant or result in a significant reduction in stock biomass for any commercially or recreationally important species that would occur in the ROI. Additionally, the proposed Port would provide valuable artificial reef habitat for colonization and the proposed Safety Zone (with an area of approximately 194.1 ac) would provide additional refuge to federally managed species by excluding commercial fishing.

4.2.4.2 Mitigation

As described in Sections 4.2.2.1 and 4.2.4, to avoid and minimize the impact of entrainment or impingement the following mitigations would be incorporated into the design and operation of the ORV system and would be expected as a condition of the license should such a license be issued:

1. The center of the seawater intake array would be sited at 11 m (36 ft) below mean sea level.
2. A maximum seawater through-screen intake velocity of 0.15 m/s (0.5 ft/s) would be maintained.
3. A monitoring plan, approved by NOAA Fisheries, would be established and implemented to measure the levels of mortality to marine fisheries species (including ichthyoplankton) associated with the operation of the ORV seawater intake. The monitoring plan would contain the following items:
    a. Sampling at three depths, one below the level of seawater intakes, one at the level of seawater intakes, and one above the level of seawater intakes.
    b. Collected samples would be passed through appropriate mesh sizes to separate three size fractions of organisms:
        - organisms that can avoid entrainment
        - organisms that would be impinged on the screen covering the intake
        - organisms that would be entrained with seawater as it moves through the screening
    c. Samples would occur over a 2-year period to ascertain seasonal and yearly variability.
    d. Organisms would be identified to lowest taxon possible, and amount of each taxon would be calculated per volume of sea water.

The Applicant would coordinate with NOAA Fisheries throughout the development of the monitoring plan.

To minimize potential fisheries impacts associated with the decommissioning of the proposed Terminal facilities, it would be possible to leave some of the facilities' underwater structure in place to function as an artificial reef. All decommissioning activities would be conducted in accordance with approved plans required by the licensing authority, and in compliance with all applicable and appropriate regulations and guidelines in place at the time of decommissioning.

4.2.5 Alternate Site Location (WC-183)

Siting of the proposed Port in WC-183, approximately 12.8 km (8 mi) north of the location proposed by Gulf Landing LLC in WC-213, would result in impacts similar to those discussed for the Proposed Action. In WC-183, the Terminal would be in approximately 16.5 m (54 ft) of water. At the preferred terminal location in WC-213, the water depth is approximately 16.8 m (55 ft). The moderate difference in depth of the two locations, and their essentially equal distances from shore would not be expected to alter materially the nature or quality of the predicted impacts on biological resources. The relatively minor spatial separation between the two locations 12.8 km (8 mi), in the marine environment would not be expected to cause a material difference in the considerations applicable to threatened or endangered species, EFH, or other biological resources.

To estimate the potential unmitigated direct impact of the proposed regasification system on fish eggs and larvae (ichthyoplankton), SEAMAP data were examined (GL 2003a). In this analysis, the mean density of fish eggs and larvae in 1 million gallons (3,785.4 m^3) of sea water at the Preferred and Alternative Sites (in the WC-213 and WC-183 samples, respectively, presented in Table 3-6) were multiplied by the ORV sea water intake rate of 136 MGD (515,000 m^3/day). Under the Proposed Action, approximately 1.07 million fish eggs and 526 thousand fish larvae could potentially be entrained per day at the Alternative Site, WC-183. Based on these numbers approximately 389 million eggs and 192 million larvae per year would be entrained at WC-183. Table F-6 presents the larvae identified by taxon for WC-183.

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

While it might initially appear that impacts would be smaller at WC-183, a crude statistical analysis using the standardized t-test indicates that the average egg and larvae densities at WC-213 and WC-183 are not significantly different (alpha = 0.05). Given the inherent variability in the ichthyoplankton densities and limited samples, we can't discern a difference between the potential for ichthyoplankton entrainment at the different sites.

The lack of significant difference is likely a result of the high variability of the data, which is typical of ichthyoplankton data. Variability of ichthyoplankton data is largely due to the inherent patchiness of plankton distribution. Patchy plankton distribution is a result of a number of factors such as water temperature, spawning events, hydrographic features, and diel migrations. The abundance of ichthyoplankton in the area of the proposed Port depends on these factors. Thus, the number of fish eggs and larvae that could be entrained is highly variable and also depends on these factors.

4.2.6 No Action Alternative

Under the No Action Alternative, the Secretary would deny the license application preventing construction and operation of this deepwater Port. If the Secretary pursues the No Action Alternative, the short- and long-term environmental effects on biological resources identified in Section 4.2.2 of this EIS would not occur. There would be no contribution to the Nation's natural gas supply from this source. Because of the existing and predicted demand for natural gas it would be necessary to find other means to facilitate the importation of natural gas from foreign markets that would equal the contribution from the proposed Port. Strategies to meet this need could include other deepwater port applications, expansion of existing or construction of new onshore LNG ports, or increased use of other energy sources. Other deepwater port applications could result in biological impacts of a similar nature as described in Section 4.2.2, but of unknown intensity. Onshore LNG ports would have different, could possibly increase the impacts on biological resources. For example, threatened or endangered bird species and protected habitats have coastal distributions and would be more likely to be disturbed by construction associated with onshore LNG ports. Increased impacts of LNGCs would be expected because they would have to traverse coastal waters increasing chances of vessel strikes with threatened and endangered sea turtle species and the intake of nearshore and estuarine waters. LNGC ships intake approximately 40 to 50 MGD for cooling systems. Onshore pipelines might have to be constructed increasing the possibility of impacts on wetlands and estuaries. Because estuaries are highly productive and confined impacts on estuaries might be more significant than in the open ocean (Section 4.2.2.1).