3.0 ENVIRONMENTAL ANALYSIS

General Impact Assessment

The environmental consequences of implementing the Broadwater LNG Project would vary in duration and significance among the environmental resources. Four levels of impact duration were considered: temporary, short-term, long-term, and permanent. A temporary impact generally would occur during construction, with the resource returning to preconstruction condition almost immediately afterward. A short-term impact could continue for up to 3 years following construction. An impact was considered long-term if the resource would require more than 3 years to recover, and a permanent impact would continue after the life of the Project. We considered an impact significant if it would result in a substantial adverse change to the environment.

In this environmental analysis section, we describe the affected environment, general impacts, and proposed mitigation for each resource. As part of its proposal, Broadwater identified certain measures to reduce potential impacts. We evaluated Broadwater's proposed mitigation and, in some instances, identified additional measures that would be necessary to avoid or further reduce potential impacts. We recommend that these additional measures be included as specific conditions to authorizations that the Commission may issue to Broadwater.

Impacts are presented for both construction and operation of Project, including the impacts of LNG carriers at berth and in transit through Rhode Island Sound, Block Island Sound, Long Island Sound, and in the Atlantic Ocean. LNG carrier operation would have no measurable impact on various offshore resources such as bottom sediments, scour, and bottom dwelling biota, or on the shoreline and onshore resources such as shoreline soils, wildlife, wetlands, threatened and endangered species, cultural resources, residences, and land use. The potential impacts of LNG carrier transit and operations on other resources such as water resources, biological resources, marine transportation, visual resources, and reliability and safety were incorporated into our review, as described below. The WSR (Appendix D) also addresses impacts of LNG carrier transit.

Conclusions and our recommendations in this EIS are based on our analysis of potential environmental impacts, with the following assumptions:

- Broadwater would comply with all applicable laws and regulations;
- The proposed FSRU and pipeline would be constructed as described in Section 2.0 of this document; and
- Broadwater would implement the mitigation measures included in the application and supplemental filings to FERC.

General Setting

Long Island Sound is the body of water that lies between Long Island, New York and the coastline of Connecticut. From a geologic perspective, the Sound was carved into the Atlantic Coastal Plain by rivers and glaciers (Lewis 1995). The waterbody is approximately 113 miles long and 21 miles across at its widest point. The Sound has a total surface area of 1,320 square miles and a volume of approximately 16 trillion gallons. Its drainage basin totals approximately 16,000 square miles and includes much of New England and Long Island. The general Long Island Sound area is depicted in Figures 2.1-1 and 2.4-1.

Long Island Sound can be divided into three basins: the eastern, central, and western basins (Lee and Lwiza 2005). The eastern basin is generally the deepest and narrowest, with depths exceeding 300 feet in some areas. The eastern end of Long Island Sound connects with Block Island Sound and the Atlantic Ocean through a natural deepwater channel called the Race. A relatively shallow area called the Norwalk Shoal Complex separates the east basin from the central basin. The central basin, the widest basin, has depths up to 126 feet. The central and western basins are separated by Stratford Shoal, a relatively shallow feature that bisects Long Island Sound. The western basin is typically shallower than the other two basins. The terminal end of the western basin, "the Narrows," is a passage to the East River, New York Harbor, Raritan Harbor, and the Atlantic Ocean.

Although there is substantial variability in sediment types throughout the Sound, geologic processes generally have resulted in the surface substrate of Long Island Sound being commonly composed of sand along the Long Island shoreline, silt and marsh peat deposits along the Connecticut shoreline, and thick accumulations of soft muds in the deeper parts of the Sound (Williams 1981).

Marine and freshwater influences have combined with the various substrates in nearshore and offshore areas to result in a wide assortment of natural habitat types around the Sound. Nearshore habitats include freshwater and estuarine wetlands; shellfish beds; and sandy, silty, and rocky intertidal and shallow subtidal habitats. Offshore habitats consist primarily of open water and softbottom habitats, with some more rocky or gravelly areas such as Stratford and Norwalk Shoals. As a result, Long Island Sound supports a wide variety of fish (almost 100 species), birds, marine mammals, sea turtles, and invertebrates (including bivalves, lobsters, crabs, and benthic communities).

The seasonal weather patterns in the area typically include hot summer months and relatively cold and stormy winter months (EPA 2004a). The average precipitation is about 40 inches per year. Long Island Sound occasionally experiences strong winds associated with storms and, on rare occasions, hurricanes. The strongest hurricane to cross over Long Island Sound on record was a Category 3 hurricane in 1938, with winds estimated at 120 mph and tidal surges of 12 to 16 feet.

The Long Island Sound area has been used by humans for at least 9,000 years. European settlers reportedly arrived as early as about 1640. At that time, over 25,000 Native Americans inhabited Long Island and what is now Connecticut (Alter 1997). By 1700, the population on Long Island was about 220,000; during the 18th century, the population grew rapidly, occasionally doubling about every 2 years (APAH 1995).

In the 1800s, the population continued to increase and maritime industries boomed, including whaling, shipbuilding, and shellfishing. The peak industrial activity occurred in the first half of the 20th century, leading up to and including World War II. Following World War II, New York communities began to phase out certain industrial uses, including those on the waterfront, through comprehensive land and water use plans and zoning.

Although the quality of the sediments and water of the Sound have improved, the resources continue to be affected by historical and current industrial, residential, and agricultural activities. The sediments have been affected by both industrial contaminants (such as lead, mercury, and chromium) and human effluence. Inputs of nutrients, especially nitrogen, from sewage outfalls and other human sources advanced the eutrophication (nutrient enrichment) of the Sound. Eutrophication depletes oxygen levels in the water below levels needed to sustain aquatic organisms (hypoxia). Over time, hypoxia can adversely impact fish and benthic animals, such as lobsters, and alter the resident biotic communities.

The EPA, New York, and Connecticut sponsor the Long Island Sound Study (LISS) with the purpose of improving the health of Long Island Sound. The LISS is a partnership that consists of federal and state agencies, user groups, concerned organizations, and individuals dedicated to restoring and protecting the Sound. These groups identified six problem areas to be addressed by the Comprehensive Conservation and Management Plan: (1) low dissolved oxygen (hypoxia), (2) toxic contamination, (3) pathogen contamination, (4) floatable debris, (5) living resources and habitat management, and (6) land use and development. Since the Comprehensive Conservation and Management Plan was approved by the EPA, New York and Connecticut in 1994, the LISS partners have implemented a variety of measures to restore and protect the Sound, giving priority to hypoxia, habitat restoration, public involvement and education, and water quality monitoring (EPA 2005a). While there have been improvements, there continue to be areas of contaminated sediment and problems with nitrogen loading and hypoxic conditions. Hypoxia is considered to be the most serious water quality issue in Long Island Sound (LISS 1997).

Since at least the early 19th century, mixed use of the Sound has occurred at levels that are visually discernible, both in terms of the actual activities and their effects on the environment. Over the past few decades, the shoreline has increasingly been dominated by residences, recreational and open space, and tourism-related uses (Zappieri 2006). The Sound and the surrounding area continue to experience a wide variety of human uses. Today, more than 8 million people live along the estuary boundaries. Water-borne uses include 1.5 million fishing trips and hundreds of thousands of recreational boaters annually as well as hundreds of commercial fishermen (575 commercial licenses), almost 100,000 annual commercial shipping transits, and 2 petrochemical platforms (Coast Guard 2005a, Long Island Sound LNG Task Force 2006). Along the shorelines of the Sound, there are 9 deepwater ports; more than 100 municipal treatment facilities; at least 32 power plants (gas-fired, coal-fired, and nuclear); dozens of towns and cities; and open spaces such as agricultural lands, parks, woodlands, and large estates (Coast Guard 2005a, Zappieri 2006, CTDEP 2006a).

Additional information on the environmental setting of Long Island Sound as it relates to potential impacts of the proposed Project is provided in the following resource-specific sections.

3.1 GEOLOGY AND SOILS

3.1.1 Geology

3.1.1.1 Geologic Setting

Glaciation was a key erosion factor that led to the formation of Long Island Sound. The combined erosive effects of the ice advances included re-exposing, wearing down, and smoothing the crystalline Appalachian rocks that now form the Connecticut coast; cutting back and sculpting the remaining coastal plain wedge that now forms the foundation of Long Island; and redistributing eroded material in the form of glacial deposits (Lewis 1995).

The Wisconsinan glacial stage and the Holocene interglacial stage that followed were primarily responsible for the deposition of surficial sediments (Lewis and Stone 1991, as cited in Twitchell et al. 1998). The Wisconsinan glacial stage promoted the Laurentide ice sheet advancement across Long Island Sound, which formed the Ronkonkoma and Harbor Hill-Roanoke Point-Charlestown end moraines on Long Island (Schafer and Hartshorn 1965 and Sirkin 1982, as cited in Twitchell et al. 1998). The Glacial Lake Connecticut formed behind the moraines after the ice sheet retreated. The moraine, which formed a dam for the Glacial Lake Connecticut, eventually failed at the Race, which currently separates Fishers Island from the North Fork. Glacial Lake Connecticut emptied into Block Island Sound and then to the south across the continental shelf (Lewis and Stone 1991 as cited in Twitchell et al. 1998). Long Island Sound was flooded as the sea level rose (Twitchell et al. 1998).

Long Island Sound is within the Atlantic Coastal Plain Physiographic Province, a subdivision of the Coastal Plain. The Atlantic Coastal Plain measures over 3,200 miles in length, extending from Cape Cod to Florida, and continuing along the Gulf of Mexico across the Mexican border to the Yucatan Peninsula. Long Island Sound occupies a lowland that initially was carved into the Coastal Plain by rivers and subsequently was glacially modified (Lewis 1995).

Long Island Sound is one of the largest estuaries along the Atlantic Coast of the United States. The Sound is a semi-enclosed basin that is positioned on a northeast-to-southwest angle. It is approximately 113 miles long and 21 miles across at its widest point, with a mean water depth of approximately 80 feet. The eastern end of the Sound opens to the Atlantic Ocean through several large passages between islands, whereas the western end is connected to New York Harbor through a narrow tidal strait called the East River.

Long Island Sound consists of three regions or basins that are separated by shoals: the eastern basin, central basin, and western basin. The eastern basin extends from the eastern extent of Long Island Sound to the Norwalk Shoal Complex. The eastern basin is the deepest basin within the Sound, with reported depths greater than 300 feet. The central basin is the largest and extends from the Norwalk Shoal Complex in the east to the Stratford Shoal Complex in the west. These shoal complexes consist of irregular assemblages of topographic highs and lows that are oriented north-south across the Sound and have a maximum relief of 130 feet (Knebel et al. 1999). The western basin extends from the Stratford Shoal Complex west to the East River.

The proposed FSRU would be located in the central basin. The proposed pipeline would originate in the central basin, extend approximately 21.7 miles from the FSRU across the Stratford Shoal, and tie into the IGTS Pipeline in the western basin. Broadwater conducted field surveys along the proposed pipeline route and FSRU location. These surveys indicated that water depths along the proposed pipeline route range from approximately 63 to 158 feet. At the proposed FSRU site, the mean water depth is 95.5 feet. The mean water depth is 69 feet where the pipeline route would cross Stratford Shoal. Water depths along the proposed pipeline route gradually increase to the west and east of the Stratford Shoal, averaging 121.1 feet and 103.5 feet, respectively. At the point where the proposed pipeline would interconnect with the IGTS Pipeline, the water depth is approximately 120 feet.

In January 2006, Broadwater proposed using existing onshore facilities for construction and maintenance operations for the proposed Project. Because any new construction would be limited to a guardhouse and a fence, no geologic resources would be affected. The following discussion therefore focuses on the proposed offshore portion of the Project, including potential impacts associated with mineral resources, geologic hazards, and paleontological resources.

3.1.1.2 Mineral Resources

There are no known current or future mineral leases or mining activities in Long Island Sound (CTDEP 2006a). According to the U.S. Geological Survey (USGS) Mineral Resource Data System (USGS 2006a), two mines previously operated in the offshore portion of the central basin (Taprock Quarry and Dolomitic Marble Quarry No.1). Both mining operations were located offshore of Fairfield, Connecticut, and at least 5 miles from the proposed Project. Therefore, no impacts to mineral resources are expected.

3.1.1.3 Geologic Hazards

A geologic hazard stems from the occurrence of a significant geologic event, such as an earthquake. Major geologic hazards in Long Island Sound theoretically could include:

- •• Seismicity and faulting;
- •• Soil liquefaction;
- •• Seafloor landslides; and
- •• Subsidence.

Seismicity and Faulting

Low to moderate levels of earthquake activity are quite common in many areas of the eastern United States, including New England. The historical record of earthquakes in the northeastern United States goes back to the 1500s, and a number of seismographs were operating in this region beginning in the early 1900s. Routine reporting of earthquakes in this region began in the late 1930s. According to Stover and Coffman (1993), seismic activity has been reported in the region over the past 400 hundred years. However, historic records indicate that no associated earthquakes have exceeded a magnitude of 6.0 and none has been associated with surficial fault movements.

According to the USGS "Quaternary Fault and Fold Database for the United States" (USGS 2006b) the only area in the northeastern United States known to have experienced significant shaking, and soil liquefaction is the region just north of Boston, Massachusetts associated with the Cape Ann earthquake of 1727. According to the USGS "Quaternary Fault and Fold Database for the United States," there are no active faults that run through Long Island Sound (USGS 2006).

The USGS has developed a series of maps for the entire United States that quantify seismic hazards in any given region and describe the likelihood of shaking, of varying degrees, to occur (USGS 2002). Under the National Seismic Hazard Mapping Project (NSHM), seismic hazard maps were updated in 2003. These maps are used to assess the likelihood of future seismic activity specifically, the likelihood of strong ground shaking that could damage engineered structures. The NSHM data indicate only a 2-percent probability that earthquake-induced ground shaking will exceed a peak ground acceleration of 10- to 12-percent "g" over a 50-year period for central Long Island Sound. The term "g" is a common value of acceleration equal to 32.2 ft/sec^2 (the acceleration due to gravity at the surface of the earth) and is an indication of the severity of ground shaking. While such levels of shaking can cause damage to structures not specifically designed for earthquake resistance, modern welded steel pipelines (as proposed for the Project) are inherently resistant to ground shaking and are only at risk in the event of major ground displacements.

Soil Liquefaction

Secondary seismic effects triggered by strong ground shaking are often more serious than the shaking itself. The most damaging secondary seismic effect is often soil liquefaction, a physical process in which saturated, non-cohesive soils temporarily lose their bearing strength when subjected to strong and prolonged shaking. Soils most prone to liquefaction have a uniform grain size. Soil liquefaction also can lead to other ground failures, including settlement and lateral spreading.

Soil liquefaction is a phenomenon typically associated with strong earthquakes. The only portion of the FSRU system potentially subject to earthquake ground shaking would be the YMS. The surface substrate is composed of soft sediment (clays and sands) that are prone to soil liquefaction. Broadwater proposes to conduct exploratory borings in 2008 to assess deeper substrate conditions and determine the depth of pile-driving. Broadwater anticipates that piles would be driven to a depth of at least 165 feet, terminating in glacial deposits. Bedrock is expected to be located at a substrate depth of approximately 400 feet. There is a remote potential that a major earthquake might occur in the area, causing liquefaction in the supporting strata beneath the YMS and potential movement or damage to the structure if it is not founded on bedrock or other non-liquefiable deposits.

Since Broadwater has not yet done the geotechnical surveys necessary to determine the specific liquefaction potential of the site, **we recommend that:**

- **Prior to construction, Broadwater undertake appropriate geotechnical investigations and analyses to determine the potential for seismic soil liquefaction beneath the YMS. Broadwater file with the Secretary, for review and written approval by the Director of OEP, the survey results quantifying the potential for liquefaction, including any mitigation measures/design features necessary to minimize or preclude the potential for damage to the YMS.**

Seafloor Landslides

The term "landslide" includes a wide range of slope failures or ground movement, such as deep failure of slopes, shallow debris flows, and rock failures. In general, the risk of slope failures increases as the degree of slope increases and soil particle size decreases. In addition, earthquakes can create stresses that make weak slopes fail. There is little slope along the pipeline route, with the greatest slope occurring along Stratford Shoal. The peak of the shoal along the proposed pipeline route raises to approximately 55 feet below the water surface, producing a slope of approximately 3.8 percent (gentle slope) on the west side of the shoal and 1.5 percent (nearly level) on the east side. The remainder of the seafloor along the pipeline route is virtually level (no slope). Therefore, the probability of a seafloor landslide in the proposed Project area is minimal.

Subsidence

Distinctive surficial and subsurface features developed by the dissolving of carbonate and other rocks and characterized by closed depressions, sinking streams, and cavern openings are commonly referred to as "karst" (Davies 1984). Subsidence as a result of karst terrain or underground mining is not expected to occur along the pipeline route. Underground mining is not known to occur within the proposed Project area, and the geologic conditions necessary for karst development do not exist in Long Island Sound. Davies (1984) indicates that there is no karst terrain within Long Island Sound. Therefore, subsidence would be highly unlikely along the Project route.

Blasting

The potential for geologic hazards could be influenced by the use of blasting methods. However, Broadwater's site-specific surveys along the pipeline route have not documented the presence of any bedrock within areas proposed for trenching for pipeline installation, and Broadwater has not proposed the use of blasting during construction or operation of the proposed Project.

3.1.1.4 Paleontological Resources

Paleontological resources are the fossilized remains of prehistoric plants and animals, as well as the impressions left in rock or other materials as indirect evidence of the forms and activities of such organisms. As described in Section 3.1.2.1, the substrate along most of the pipeline route is composed of depositional sands, silts, and clay. Therefore, little substrate that occurs along the pipeline route has been intact since prehistoric times. Paleontological resources have been discovered along the margins of Long Island Sound; however, none have been reported offshore in Long Island Sound (Briggs 2006). Consequently, no impacts to these resources would be expected.

3.1.2 Sediments

3.1.2.1 Existing Environment

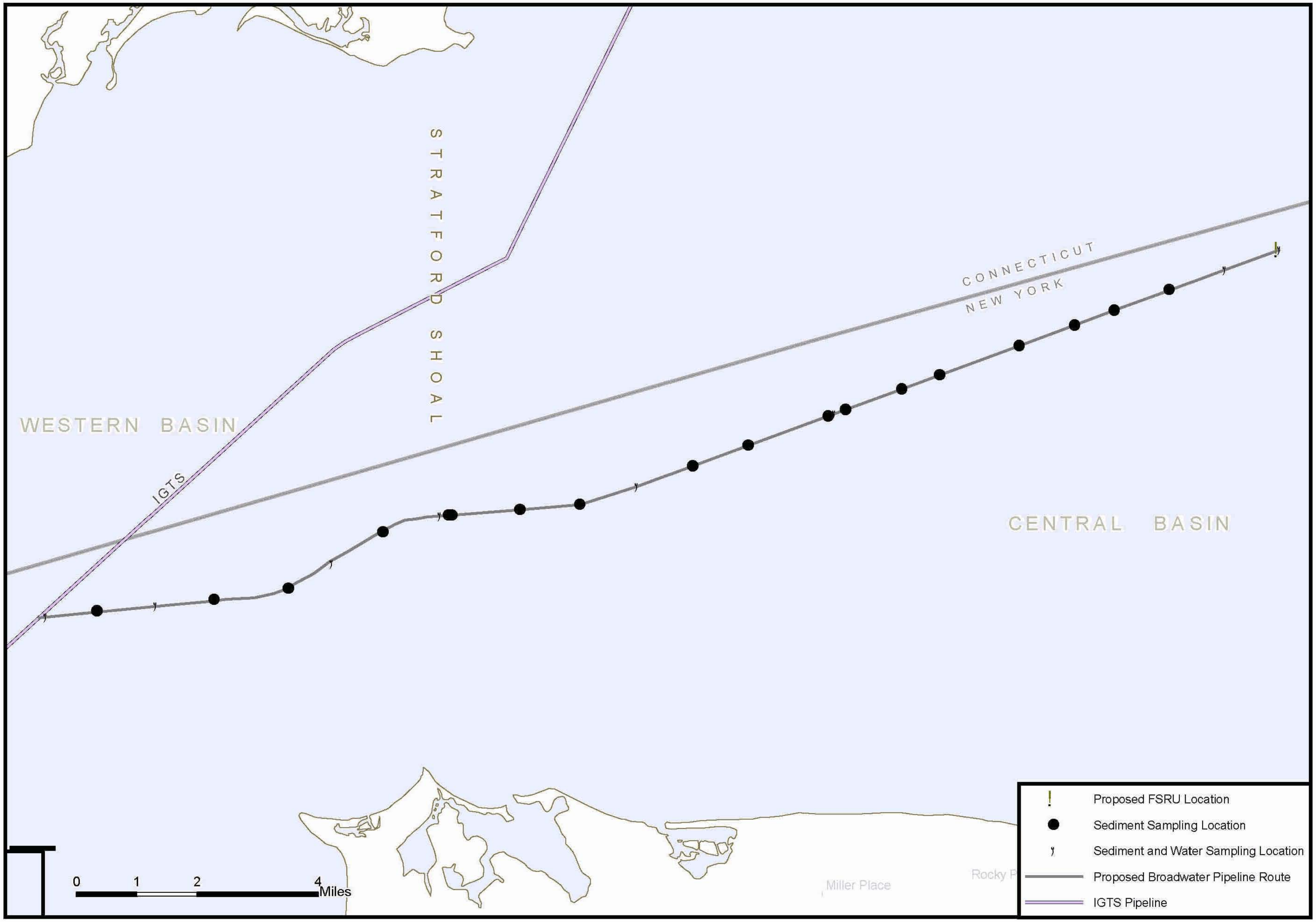
In nearshore areas, sands eroded from glacial bluffs comprise the prevailing sediments on Long Island's northern shore. Fine-grained organic silts and clays in association with tidal marsh peat deposits are common from sea level to mean high water along both the Long Island and especially the Connecticut shores, and thick accumulations of soft muds are present in the deeper parts of the Sound (Williams 1981). Sand and gravelly sand are most commonly found toward the Connecticut shore, along the northern shoreline of Long Island Sound, and bordering shallow or exposed land in the central Sound area. Silt, clay, and organic matter are also present on the Connecticut shoreline and in the center of the Sound. Lacustrine glacial deposits have been reported in the western and eastern regions of the Sound.

Four general types of bottom sedimentary environments have been identified in Long Island Sound. These environments reflect the major processes occurring in the area – specifically erosion, bedload transport of coarse-grained material, sorting and reworking of sediments, and deposition of fine-grained material (Knebel et al. 1999). Fine-grained material covers about 50 percent of the Sound, primarily large portions of the central and western Sound. Areas of sediment sorting cover approximately 22 percent of the area, and coarse-grained materials approximately 16 percent. Coarse-grained material is present mainly in the east-central portion of the Sound. Erosional depositional areas cover approximately 10 percent of the area, at the eastern entrance to the Sound, and associated with the Stratford and Norwalk Shoal Complexes.

In addition to differences in sediment associated with proximity to shore, the flow regime of Long Island Sound influences sediment composition. This flow regime has created a westward succession of environments, beginning with erosion or nondepositional substrates at the narrow eastern entrance to the Sound that changes to an extensive area of coarse-grained bedload transport in the east-central Sound. This area is adjacent to a contiguous band of sediment sorted with broad areas of fine-grained deposition on the flat basin floor in the central and western Sound (Knebel and Poppe 2000).

According to Poppe et al. (2001), the primary sediment environment at the proposed FSRU location and along the proposed pipeline is fine-grained depositional. The secondary environment is sediment sorting and reworking. There is also a slight presence of erosion or nondepositional sediment. From east to west, the proposed FSRU would be sited in sediments composed of various proportions of sand, silt, and clay. The proposed pipeline also would originate and extend west in these sediment types until it reached the Stratford Shoal. The Stratford Shoal is a combination of silty sand, sand, gravelly sand, and gravel or bedrock. Extending west from Stratford Shoal to the IGTS tie-in, the sediment type is a combination of sand, silt, and clay.

Broadwater performed field surveys to assess the current seafloor and subsea conditions in the proposed Project area. Figure 3.1-1 depicts sampling locations in the proposed FSRU location and along the proposed pipeline route. Grain-size analysis conducted on these samples agreed with the general sediment information for this portion of Long Island Sound. The large majority of the substrate is fine-grain sediment; approximately 98 percent clay, silt, or sand. The remaining 2 percent of the substrate is gravel.



Broadwater surveys conducted in April and May 2005.

Figure 3.1-1
Broadwater LNG Project
Broadwater Sediment and Water Sampling Locations along the Proposed Pipeline Route

The sediment quality and water quality of many coastal areas are affected by proximity to urban centers and by industrial and agricultural activities. Pollutants enter in the form of sewage effluent, industrial discharge, dredge spoils, urban runoff, riverine discharge, and atmospheric deposition. Semi-enclosed marine areas, such as Long Island Sound, are particularly sensitive to anthropogenic inputs because their sediments and water may be less efficiently removed, dispersed, and diluted (Buchholtz ten Brink and Mecray 1998). The sediments in Long Island Sound historically have been affected by industrial contaminants (such as lead, mercury, and chromium) and human effluence.

Both organic contaminants (such as pesticides, polycyclic aromatic hydrocarbons [PAHs], and polychlorinated biphenyls [PCBs]) and inorganic contaminants (such as metals) enter an estuarine environment from sewage outfalls, the atmosphere, and non-point sources. Contaminants are closely associated with fine-grained, organic-rich sediment particles.

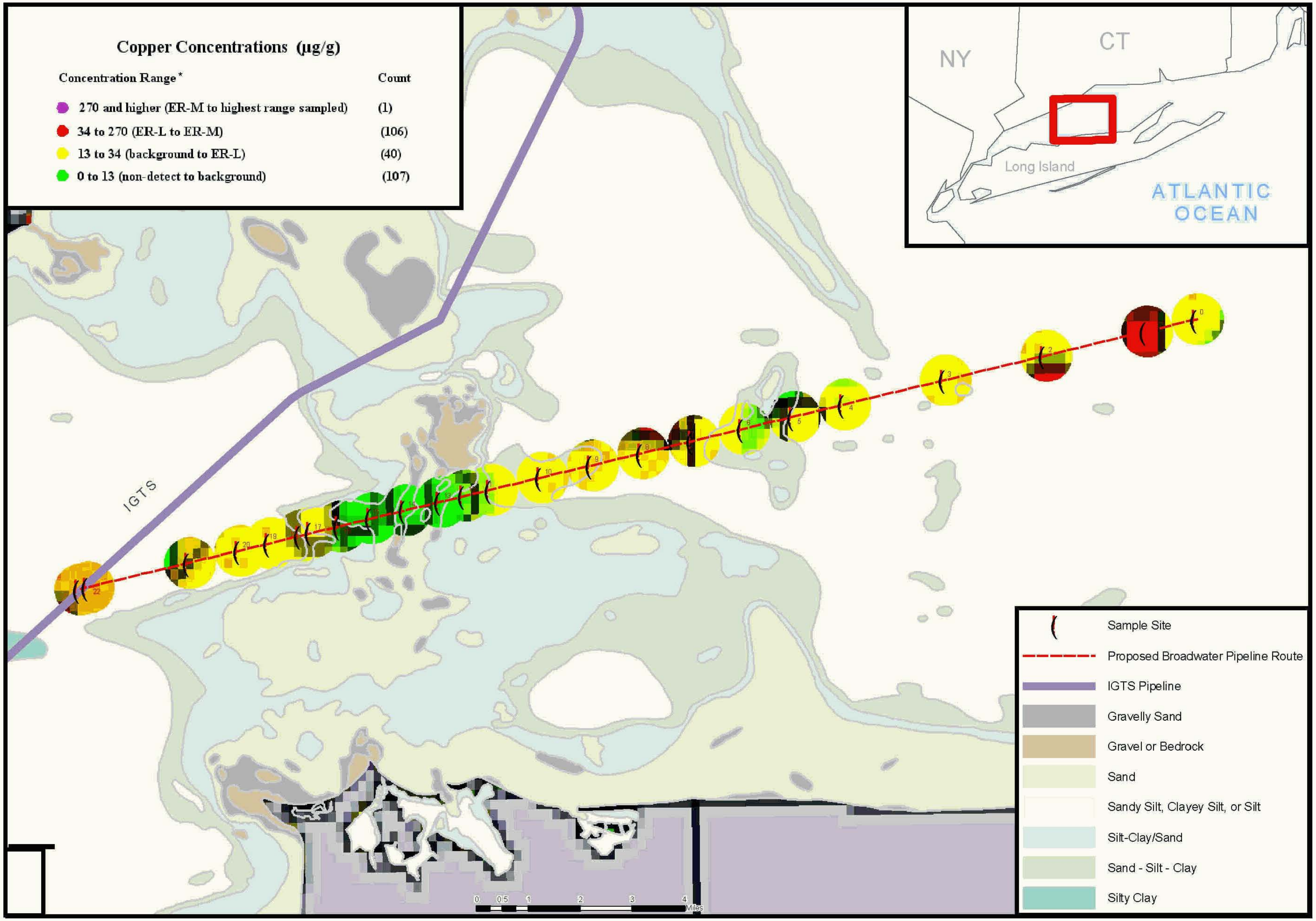
The distribution of metal contaminants in surface sediments has been measured and mapped as part of a USGS study of the sediment quality of Long Island Sound (Mecray et al. 2000). Sediment samples were collected from 219 stations in the Sound and chemically analyzed. Metal concentrations were relatively high in the western Sound, and low concentrations were measured in the eastern Sound and on the shoal complexes that divide the basins in the Sound (Mecray et al. 2000). This is consistent with historically higher urbanization/development in the western portions of the Sound compared to the eastern portion. According to Mecray et al. (2000), contaminants in the general vicinity of the pipeline route were generally within the background ranges and below federal benchmarks (effects range-low, or ER-L) for most contaminants. According to Mecray et al. (2000), copper, mercury, and lead were reported at concentrations between their ER-L and the effects range-medium (ER-M) benchmarks in the vicinity of the Project area (Figure 3.1-2 through Figure 3.1-4). According to NYSDEC's Technical and Operational Guidance Series 5.1.9 (TOGS) sediment criteria, the copper and lead concentrations are categorized under Class B, which is considered moderate contamination (chronic toxicity to aquatic life); while mercury concentrations fell into Class C, high contamination (acute toxicity to aquatic life) (NYSDEC 2004).

To further assess potential contaminant concentrations specifically along the proposed pipeline route, Broadwater collected sediment samples in April and May 2005 along the proposed route. The samples were chemically analyzed to determine the concentrations of various metals, PAHs, volatile organic compounds (VOCs), dioxins, and PCBs. The analytical results for all 28 samples collected along the proposed route were below applicable ER-L benchmarks and TOGS sediment criteria for these compounds.

3.1.2.2 Potential Impacts and Mitigation

Impacts to sediments on the seafloor could potentially occur during various construction activities, including YMS placement, general pipeline installation, specialized installation (IGTS tie-in and cable crossings), and anchor placement and associated cable sweep. In addition, sediments could be affected during periodic maintenance of the pipeline during operation of the proposed Project. These activities could result in direct physical disturbance of the seafloor, sedimentation, sediment conversion, and disturbance of contaminated sediments; these potential effects are discussed below.

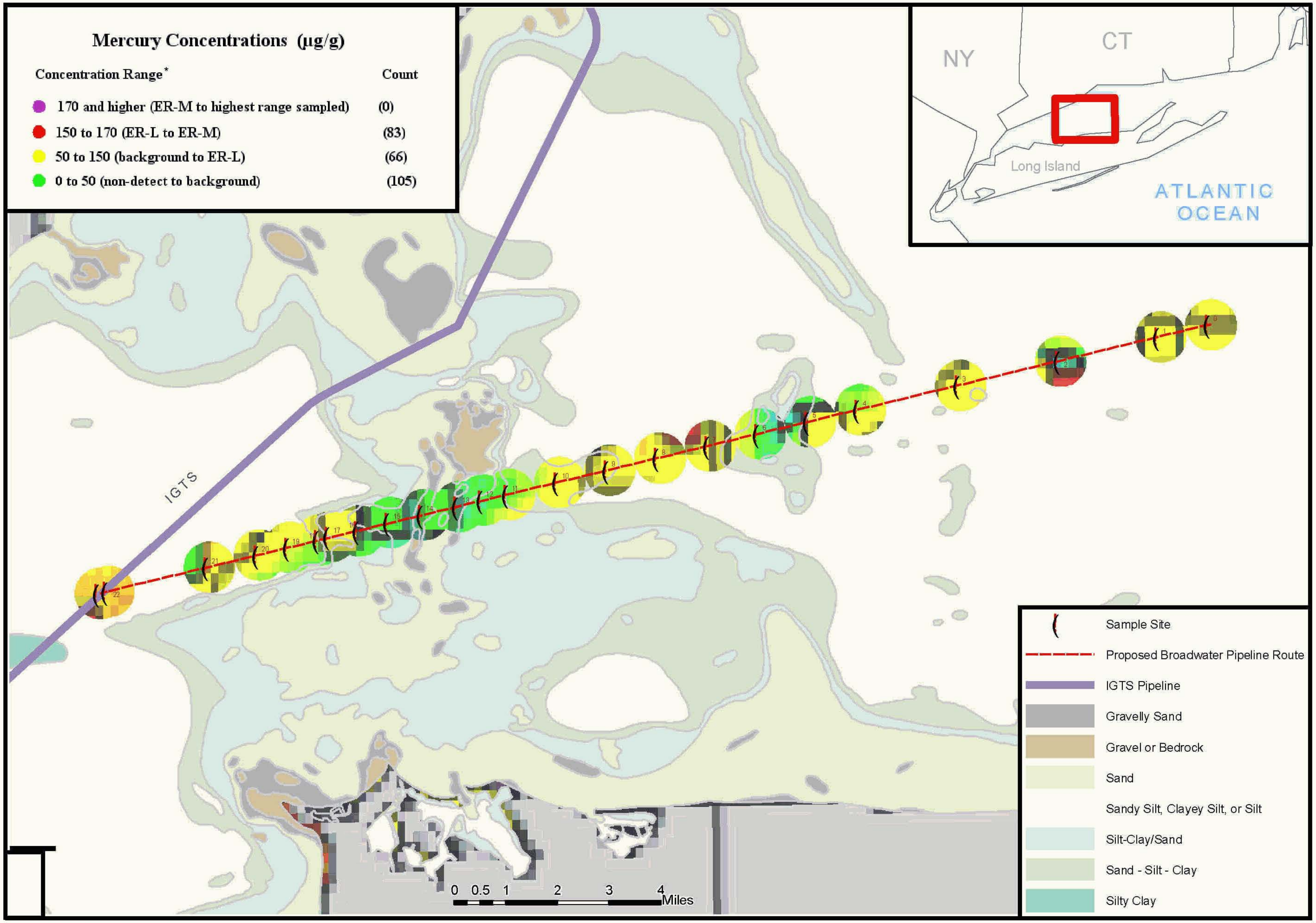
Broadwater proposed utilizing existing onshore facilities to support construction and operation of the proposed Project. Temporary onshore facilities would be used for pipe storage, contractor headquarters, and a docking area. Proposed facilities potentially would be located in the Port of New York/New Jersey and Long Island waterfront. Permanent onshore facilities would include a Broadwater-operated support office, warehouse, and industrial dock. These facilities would be located on an existing



Source: Paskevich and Poppe 2000

*ER-L: Effect Range - Low ER-M: Effect Range - Medium

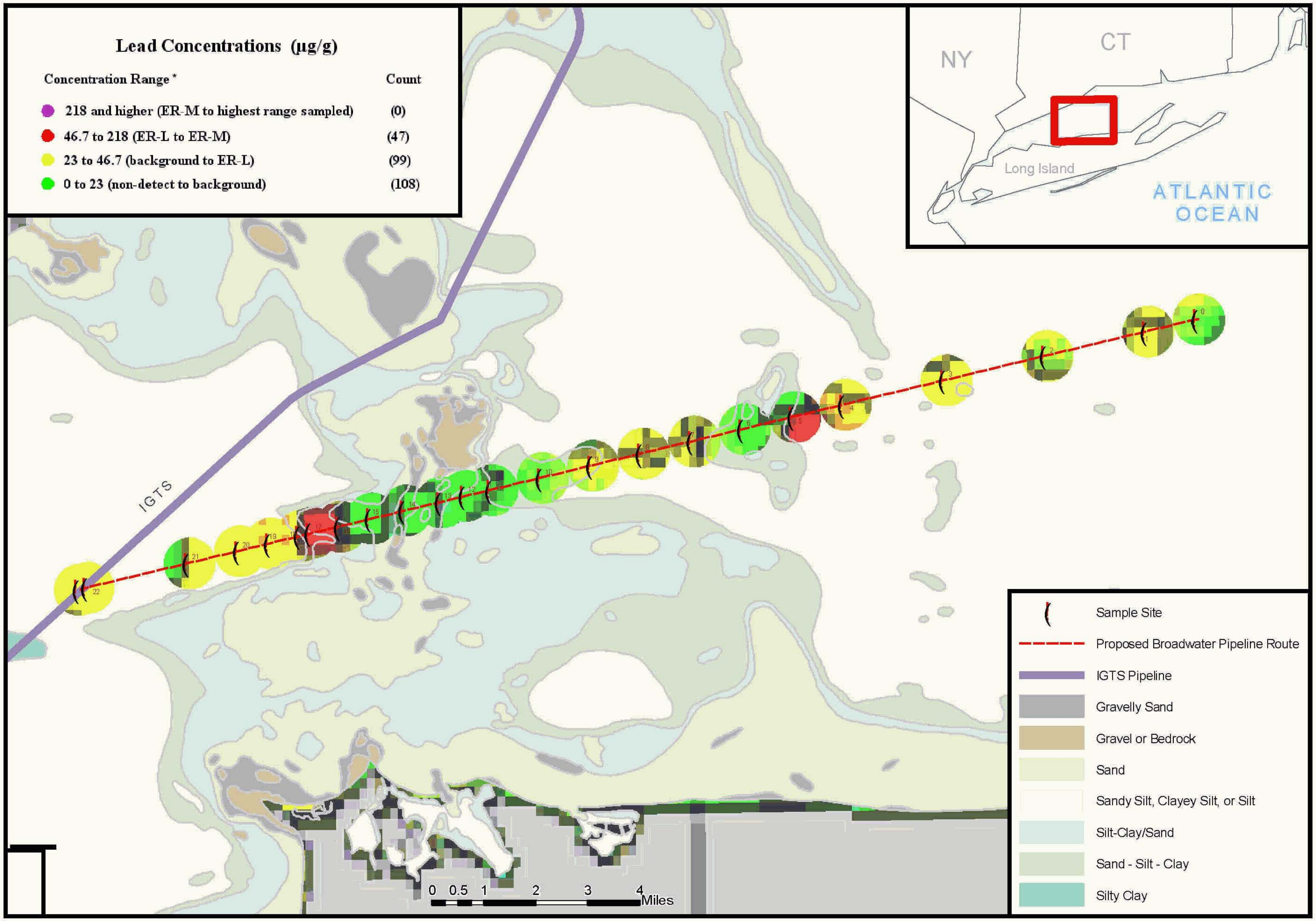
Figure 3.1-2
Broadwater LNG Project
Copper Concentrations and Sediment Types along the Proposed Pipeline Route



Source: Paskevich and Poppe 2000

*ER-L: Effect Range - Low ER-M: Effect Range - Medium

Figure 3.1-3
Broadwater LNG Project
Mercury Concentrations and Sediment Types along the Proposed Pipeline Route



Source: Paskevich and Poppe 2000

*ER-L: Effect Range - Low ER-M: Effect Range - Medium

Figure 3.1-4
Broadwater LNG Project
Lead Concentrations and Sediment Types along the Proposed Pipeline Route

industrial site on Long Island, but the specific location has not been determined. The sites under consideration would either require no new construction or construction only of a guard house and security fence. Any onshore modifications would be conducted in accordance with FERC's Procedures and FERC's Erosion and Sedimentation Control Plan (Plan) (with minor variances described in Section 3.2). Therefore, impacts to onshore soils or sediment would be avoided or negligible. In addition, there would be no impacts expected to soils ore sediments due to LNG carrier transits.

Physical Disturbance

The large majority of the sediment physically disturbed by the proposed Project would be associated with pipeline installation. As proposed by Broadwater, the direct impacts to sediment during pipeline installation would affect a total of 2,235.5 acres of the seafloor or 351,816 cubic yards of sediment (Table 3.1.2-1). Over 90 percent of this acreage would be affected by anchor cable sweep from construction and support vessels. Broadwater has proposed that some anchor lines use mid-line buoys to reduce the potential impacts due to anchor cable sweep (specifically on four of the eight anchors on the lay barge). Broadwater indicated that the additional time necessary to set, move, and re-set the additional anchors with mid-line buoys would lengthen the lay barge operations by about 8 percent (from 102 days to 111 days) while providing a nominal reduction in seabed impact. However, proper use and maintenance of mid-line buoys have been successfully used on other marine construction projects to avoid impacts of anchor cable sweep, and have been proposed as an avoidance measure for other marine pipeline construction projects (URS 1998, FERC 2004a). **Therefore, we recommend that:**

- •• **Prior to construction, Broadwater file with the Secretary for review and written approval by the Director of OEP, revised offshore construction plans and impact estimates that include the use of properly configured and maintained mid-line buoys on the anchor cables of all construction vessels that would use anchors. The plans include either the use of mid-line buoys on all anchor cables, including the lay barge or use of a dynamically positioned lay barge.**

Implementation of this recommendation should nearly eliminate any potential impacts to sediment associated with anchor cable sweep, thus reducing the extent of seafloor impacts by approximately 90 percent, such that the total seafloor area impacted would be reduced to 215.5 acres. While FERC has certificated pipeline projects where applicants have agreed to use dynamically positioned lay barges (and use of mid-line buoys on all anchor cables), Broadwater has indicated that the use of a dynamically positioned lay barge may not be feasible or cost effective. While we do not believe that the use of a dynamically positioned lay barge would be required for the proposed Project, a dynamically positioned lay barge would eliminate all anchoring impacts associated with the lay barge, including anchor cable sweep and the footprints of the anchors themselves. Since dynamically positioned lay barges use thrusters instead of anchors to maintain position, it would be acceptable for Broadwater to use a dynamically positioned lay barge if it determines that it is not feasible to use mid-line buoys on all anchor cables of the lay barge in a manner that would nearly eliminate impacts to the seafloor due to anchor cable sweep. The potential use of a dynamically positioned lay barge is evaluated as an alternative construction method in Section 4.6.1.

Broadwater proposes the use of subsea plowing as the primary method for pipe laying and installation. Once the pipe is placed on the seafloor, the subsea plow would traverse the pipeline route and excavate underlying sediments. As the plow moves and a trench is formed, displaced sediments would be cast to either side of the trench. This process would generally result in 25-foot-wide berms on both sides of a 25-foot-wide trench. Two passes could be required to achieve the minimum depth of 7 to 9 feet required for the length of the pipeline.

TABLE 3.1.2-1 Broadwater's Summary of Sediment-related Impacts			
Impact Type	**Sediment Volume (cu yards)**	**Impact (acres)**	**Comment**
Pipeline lowering via plow; 19.7 miles with 3 feet of cover (MP 2.0 – MP 21.7)	304,500	179.1	Impacts include both the trench and associated spoil mounds.
Pipeline lowering via plow; 2 miles with 5 feet of cover (MP 0.0 – MP 2.0)	39,500	18.2	In proximity to the FSRU, the pipeline would be lowered to a greater depth to accommodate design considerations.
AT&T cable crossing (MP 6.4)	1,778	0.4	Impacts include excavations for crossing bridge and pipeline trench transition.
Cross Sound cable crossing (MP 3.0)	1,778	0.4	Impacts include excavations for crossing bridge and pipeline trench transition.
FSRU tie-in (MP 0.0)	1,650	0.2	Includes expansion loop.
Check and isolation valve spool (MP 0.4)	270	<0.1	Located approximately 2,000 feet from the FSRU.
IGTS tie-in (MP 21.7)	2,340	0.3	Includes expansion offset.
YMS anchor footprint	N/A	<0.5	Area of anchor footprint during YMS installation.
YMS structure footprint	N/A	0.3	Area underneath the open YMS structure, including scour protection
Pipeline anchor footprint	N/A	16	8-point mooring, 3 anchor sets per mile, and 3 passes (one lay and two plow).
Anchor cable sweep	N/A	2,020	8-point mooring, 3 anchor sets per mile, and 3 passes (one lay and two plow); includes use of mid-line buoys on the quarter anchors.
Total	**351,816**	**2,235.5**	

MP = Milepost

A scaled-down subsea plowing was proposed by Broadwater to address trenching through the coarser substrate along Stratford Shoal. In the event that the scaled-down plow approach is unsuccessful, Broadwater proposes a dredging alternative for Stratford Shoal. This alternative would require a dredged trench of 26 to 54 feet wide by 4,000 feet long to extend across the shoal. A second alternative proposed by Broadwater would involve placing the pipeline on the seafloor across Stratford Shoal and covering it with concrete mats. In the event that the subsea plow is not effective and alternative installation methods may be appropriate, **we recommend that:**

- **Prior to implementation of an alternative installation method across Stratford Shoal, Broadwater provide a contingency plan to the Secretary, for review and written approval by the Director of OEP, that outlines the specific alternative method, potential**

impacts, and mitigation measures that would be implemented to avoid and minimize potential impacts associated with pipeline installation across Stratford Shoal, should the subsea plow be unable to excavate the trench.

As proposed by Broadwater, the large majority of the excavated trench (about 20 miles) would be allowed to backfill naturally. Preliminary modeling by Broadwater indicates that most of the trench would be backfilled naturally within a year and virtually all of the trench would be filled naturally within 3 years, since most of the area where the pipeline is to be installed is considered depositional. However, the modeling estimate is based on certain assumptions that may not prevail during the post-construction period. Further, the results from other linear projects in the area indicate that the modeled results may not be accurate. The most recent pipeline project in Long Island Sound that used subsea plow methods is the Eastchester Expansion Pipeline Project Initial post-construction monitoring along the pipeline corridor indicated that the methods used to mechanically backfill the trench largely were not successful at filling the trench, and subsequent monitoring offered little evidence that most of the trench had substantially backfilled naturally a year later. Construction of the HubLine Pipeline Project in Massachusetts also used subsea plow and mechanical backfilling methods. Post-construction monitoring on HubLine indicated that the trench was mostly backfilled, although it was necessary to use rock to backfill some specific portions along the pipeline route (Martin 2006).

We believe that active and successful restoration of the seafloor grade would minimize potential impacts to the seafloor. Therefore, **we recommend that:**

- **Prior to construction, Broadwater file plans with the Secretary, for review and written approval by the Director of OEP, describing methods to mechanically backfill the trench with the excavated spoil material in a manner that successfully results in the excavated material being returned to the trench immediately following installation. The plan incorporate interagency coordination to identify the conditions under which backfilling would be required, the appropriate methods for backfilling, and detailed post-construction monitoring criteria to assess success.**

For the rest of the trench length (approximately 2 miles), Broadwater proposes to actively backfill the trench with imported clean rock material, including the first 2 miles of pipeline extending from the YMS and the tie-in to the IGTS line. The FSRU and IGTS tie-ins, cable crossings, legs of the YMS, and any other areas requiring hand or submersible pump excavation would also be backfilled with sandbags, concrete mats, and/or prefabricated protective structures, in addition to clean rock material. Any imported rock material would be obtained from EPA- or state-approved sources in accordance with COE requirements.

During construction, anchors would result in direct impact to approximately 16.5 acres of the seafloor, including 16.0 acres associated with pipeline installation and less than 0.5 acre associated with YMS installation. If Broadwater elected to use a dynamically positioned lay barge, the 16 acres of impact associated with pipeline installation would not occur. Following construction, the impacted area would be allowed to naturally recover.

We received comments about the possibility that operation of the Project could result in repeated disturbance of the seafloor associated with expansion of the subsea pipeline due to the heated gas. Broadwater anticipates that there would be minimal movement of the pipeline during startup of operation. As the warmed LNG flows through the pipeline, there would be some bending caused by thermally-induced increases of the "expansion loop" linking the FSRU and the pipeline. High-density concrete weight and 5 feet of backfill would add greater overburden for this portion of the pipeline to restrict movement. In addition, potential for pipeline movement would be likely to occur only during the startup of operations because LNG is expected to flow through the pipes continuously at a fairly constant temperature, which would minimize thermal expansion over time. No movement would be noticeable at the seafloor surface.

With implementation of these recommendations, the potential impacts to sediment associated with direct physical disturbance would be temporary and minor, except as identified below.

Sedimentation

Construction of the Project could indirectly affect sediments due to turbidity and sedimentation. Sediment transport is influenced by sediment size and type as well as site-specific hydrodynamics. To assess the potential impact of sedimentation during pipeline installation, Broadwater implemented the MIKE3 model. The MIKE3 modeling method is used to predict the transportation and eventual fate of sediments due to disturbance. As discussed in Section 3.2.3.1, Broadwater modeled the extent, magnitude, and duration of turbidity and subsequent sedimentation associated with construction of the proposed Project, using standard turbidity modeling methods. The modeling results indicate that minor, temporary impacts caused by sedimentation would occur in the Project area, with minimal sedimentation (less than 0.2 inch thick) beyond the 75-foot Project corridor associated with the two spoil piles (each 25 feet wide) on either side of the pipeline trench, which would be 25 feet wide. Deposition of suspended sediments would be no greater than 0.04 inch at distances between 300 to 660 feet from the pipeline route. Coarser sand and gravel would be pushed into spoil piles adjacent to the pipeline trench. Potential impacts associated with turbidity are discussed in Sections 3.2 and 3.3. Based on the limited extent and magnitude of this impact as well as the expanse of softbottom sediments in the Project area, any impacts to the seafloor associated with sedimentation would be minor.

Sediment Conversion

Sediment conversion involves displacement of original or native surficial substrate and subsequent substitution of non-native substrate. During construction, a total of approximately 7.5 acres of seafloor would be converted from softbottom sediment to hard substrate. Most of this conversion would consist of approximately 2 miles of the pipeline trench that would be backfilled with imported rock (totaling approximately 6.1 acres). Backfilling the pipeline trench with native softbottom materials would not constitute a sediment conversion, and backfilling or armoring with imported rock and gravel would provide a semi-natural surface for bottom-dwellers to colonize. The source, size, and type of the imported backfill for the 2 miles of subsea pipeline would be selected in coordination with COE. Other sites where sediment conversion would occur include the use of concrete mats at the utility crossing (0.8 acre), tie-ins to the IGTS pipeline and the YMS riser (0.5 acre), and the physical structure of the YMS legs and associated scour protection (0.1acre). This conversion would constitute a permanent impact to substantially less than 0.1 percent of the native softbottom sediment of Long Island Sound (potential impacts to the associated benthic biological community are discussed in Section 3.3.1.2). While some of the areas of sediment conversion could naturally become covered with native substrate over time, we considered impacts from sediment conversion to be minor but permanent.

Scouring

Other linear projects in Long Island Sound have been reported to result in scouring along the utility corridors. The potential for scouring is primarily related to hydrodynamics (current speed, storm activity) and substrate type. The location of the Broadwater Project would reduce the potential for scouring along most of the route due to the relatively deeper waters, where potential impacts of typical and storm currents would be minimized. Current speeds along most of the pipeline route would be expected to average less than 1 foot per second based on field monitoring conducted along the proposed route. The highest currents along the proposed route would be expected across Stratford Shoal due to its relatively shallow depth (approximately 55 feet). Field measurements indicated that average current speeds across Stratford Shoal were about 1.3 feet per second.

To further minimize potential impacts associated with scouring, we have included a recommendation in Section 3.1.2.2 that Broadwater backfill the pipeline trench with native sediment immediately following pipeline installation and develop a post-construction monitoring plan to evaluate success. This would include backfilling the trench across Stratford Shoal with the gravel or cobble that was excavated from the trench, and these materials are commonly used to armor sediments to resist scouring. In addition, Broadwater would further evaluate the potential for scour during final design phases of the proposed Project; additional measures could include increasing the burial depth of the pipeline, or providing additional rock armor along portions of the trench or around the YMS initially or during the life of the Project. For example, Broadwater proposes to use concrete mats and sand bags to minimize scouring around each leg of the YMS, along cable crossing areas, and at the FSRU and IGTS tie-ins. With these measures, any impacts associated with scouring would be expected to be minor.

Contaminated Sediments

As discussed in Section 3.1.2.1, site-specific sediment analyses have found that contaminant concentrations in sediment along the pipeline route are below ER-Ls and TOGS standards. Therefore, any impact associated with contaminated sediments, if such sediments are present, would be insignificant and temporary.

3.2 WATER RESOURCES

In general, water resources may include groundwater; surface runoff; freshwater wetlands, ponds, lakes, streams, and rivers; and estuaries and open water marine habitats. For the proposed Project, virtually the entire Project and its related impacts would be associated with the offshore marine waters of Long Island Sound. A minor onshore facility is proposed as part of the Broadwater Project, but this facility would be located at an existing industrial dock and warehouse, and the only new construction possibly would be a guardhouse and a fence. No freshwater waterbodies would be associated with the potential onshore facility, and impacts to groundwater or surface runoff associated with construction of the guardhouse and fence are not expected. Operation of the onshore facility is not expected to affect onshore water resources. Any sewage generated at the onshore facility would be removed via the existing sewage system. Use of the docking facility by Project-related vessels would be consistent with existing use and standard practices, and any impact to nearshore water resources associated with Project-related vessels would be negligible.

Therefore, the focus of this section is the description of the existing environment and evaluation of potential impacts of the proposed Project to the offshore waters of Long Island Sound. In addition, potential impacts to water resources along the transit routes within U.S. territorial waters are discussed.

3.2.1 Existing Environment

3.2.1.1 Oceanography

Long Island Sound is the body of water that lies between Long Island, New York and the coastline of Connecticut. From an oceanographic perspective, Long Island Sound is divided into three basins: the eastern, central, and western basins (Lee and Lwiza 2005). The eastern basin of Long Island Sound is generally the deepest and narrowest, with depths occasionally exceeding 300 feet in some areas. The eastern end of Long Island Sound connects with Block Island Sound through the Race. The Race occupies the area between Fishers Island and Gull Island, including Valiant Rock, near the easternmost end of Long Island Sound. The eastern basin is separated from the central basin by the relatively shallow Norwalk Shoal Complex. The central basin, the widest basin, has depths up to 126 feet near the proposed Project. Stratford Shoal is a relatively shallow feature that bisects Long Island Sound and defines the border between the central and western basins. Stratford Shoal physically limits water circulation between the two basins. Most of the proposed Project, including the proposed FSRU, would be located in the central basin. The remaining one-third of the proposed pipeline, including the tie-in to the IGTS pipeline, would be located in the western basin (Figure 2.1-1). Once entering Long Island Sound through the Race, LNG carriers would transit through the western basin to the FSRU and then depart Long Island Sound along the same general route.

Semi-diurnal tides in Long Island Sound range from about 2.6 feet at the eastern end to about 7.2 feet at the western end (EPA 2004a). Tidal surface currents are variable and may sometimes exceed 3.5 mph at the Race. Currents on the seafloor typically range between 0.7 and 1.0 foot per second in the central basin of Long Island Sound (EPA 2004a). Field measurements indicated that average current speeds were slightly higher across Stratford Shoal, at about 1.3 feet per second. In central Long Island Sound, these tidal currents generally travel northeast to southwest or vice versa.

3.2.1.2 Weather

Long Island Sound typically has hot summers and relatively cold, stormy winters (EPA 2004a). The average precipitation is about 40 inches per year. Average monthly wind speeds are typically between about 8 and 16 mph, peaking in late fall and winter and with minimum wind speeds occurring in June or July (UC 2004–2005). Throughout most of the year, winds are typically from the west and southwest, based on wind data from a central buoy in Long Island Sound (UC 2003–2005). Winds are typically from the east in spring, from the southwest during summer, and from the northwest in fall and winter (UC 2003–2005).

Long Island Sound occasionally experiences strong winds associated with storms and, on rare occasions, hurricanes. Direction and duration of winds from these storms can result in relatively large waves. During the past 2 years of monitoring, the central Long Island Sound buoy recorded a maximum wave height of 6.5 feet (UC 2004–2005). According to historical data, a 100-year storm event would be expected to produce wave heights of 14.2 feet, and a 1,000-year storm event would be expected to produce wave heights of 18.8 feet (Cox and Swail 1999, Swail and Cox 2000, Swail et al. 2001, Cardone et al. 2000). The terms "100-year storms" and "1,000-year storms" refer to major rainfall and subsequent flooding events with a 1 percent and 0.1 percent chance of occurring, respectively, in any given year.

Hurricanes are categorized according to the strength of their winds, using the Saffir-Simpson Hurricane Scale (NOAA 2006a). Category 1 hurricanes have sustaining winds between 74 and 95 mph; Category 5 hurricanes have winds exceeding 156 mph. In about the last century and a half (1851 to 2005), seven hurricanes have passed through Long Island Sound (NOAA 2006b). The strongest hurricane to cross over Long Island Sound on record was a Category 3 hurricane in 1938, with recorded winds at 125 mph and tidal surges of 12 to 16 feet. As described in Section 3.10.5, the Project has been designed to withstand sustained winds of a Category 5 hurricane.

Fog affects Long Island Sound approximately 20 percent of the year, with visibilities of less than 0.5 mile (Coast Guard 2005b). Foggy conditions are predominately found in May and June and affect harbors, the east end of the Sound, and the north shore. Fog is generally found in eastern Long Island Sound in spring and early summer (NOAA 2006c) and tends to burn off by approximately noon (Coast Guard 2005b).

Floating and pack ice occur during ordinary winters in central and eastern Long Island Sound; this is not usually a navigation impediment to commercial vessels that operate within the shipping lanes (see the Coast Guard's WSR in Appendix D). During severe winters, however, ice may cause unnavigable areas (NOAA 2006c). Drift ice that forms along the north shore may drift across the Sound to the south shore. Southerly winds tend to push the ice back to the north shore. In ordinary winters, ice generally forms in the western end of the Sound; in exceptionally severe winters, ice may extend to Falkner Island and farther eastward (NOAA 2006c). The tides have little effect on movement of ice (NOAA 2006c).

3.2.1.3 Water Quality

The EPA National Coastal Assessment Index (EPA 2006a) for Long Island Sound is based on five water quality parameters (dissolved oxygen [DO], chlorophyll *a*, water clarity, nitrogen, and phosphorous). NCAI monitoring data from 2000 and 2001 collected from stations surrounding the proposed Project area in Long Island Sound are described in the following subsections. As part of its effort to restore and protect the Sound, LISS (2006a) evaluated water quality parameters for each basin (western, central, and eastern) from 1994 to 2004. In general, water quality improves from west to east. The western basin is the most stressed due to the physical conditions within the basin (such as topography, currents, and flushing), and the dense population and associated impacts in the surrounding communities.

Long Island Sound is categorized as a Class SA water type that, according to NYSDEC, represents waters best used to provide shellfishing for market purposes, primary and secondary contact recreation, and fishing. In addition, the waters should be able to support fish propagation and survival. Water quality standards for Class SA waters are provided in Table 3.2.1-1.

TABLE 3.2.1-1
New York State Department of Environmental Conservation
Water Quality Standards for SA Waters[a]

Parameter	Standard
pH	The normal range shall not be extended by more than one-tenth (0.1) of a pH unit
Dissolved oxygen	Shall not be less than 5.0 mg/L at any time
Suspended, colloidal, and settleable solids	None from sewage, industrial wastes, or other wastes that will cause deposition or impair the waters for their best usages
Turbidity	No increase that will cause a substantial visible contrast to natural conditions

[a] Source: New York State Department of Environmental Conservation regulations Part 703, amended 1999.

NYSDEC created separate standards to address criteria for thermal discharges to surface waters, regardless of specific class. Water quality standards indicate that all thermal discharges to the waters of the State shall ensure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the body of water (NYSDEC 1999). The NYSDEC water quality standards for thermal discharges into estuaries (NYSDEC 1991) indicate that water discharged must not raise or lower ambient temperatures by more than 1.5•F if the surface temperature is greater than 83•F between July and September, The temperature of at least 50 percent of the cross sectional area or volume of the flow of the estuary must not be lowered or raised more than 4•F over the ambient temperature or to a maximum of 83•F whichever is less. At no time should the surface water temperatures of an estuary artificially be raised to greater than 90•F.

Long Island Sound water quality is affected by many point and non-point sources. Point sources include effluent from sewage treatment plants, industrial discharges, and discharges from port and marina operations. Non-point sources include stormwater runoff, agricultural runoff, and atmospheric deposition. The ambient water quality parameters that theoretically could be affected by the proposed Project include water temperature, salinity, DO, and turbidity.

Broadwater collected water quality samples along the proposed pipeline route in April and May 2005 to characterize the ambient physical and chemical water quality. Sampling locations are illustrated in Figure 3.1-1. Water quality samples were collected from three discrete depths: just below the water surface (less than 5 feet), at the midpoint of the water column, and near the bottom of the water column (5 feet from the bottom). Water quality parameters included nitrogen and total suspended solids (TSS), among others. A Seabird-CTD water quality meter was used to collect water quality readings for DO, salinity, temperature, and pH. Meter readings were obtained at 5-foot vertical intervals, initiating at 5 feet below the water surface and extending through the water column to the seafloor (up to 130 feet deep). The sampling plan was provided to federal and state regulatory agencies, and was approved by NYSDEC prior to sampling. Additional water quality data were collected from within 1 square nautical mile surrounding the proposed FSRU during ichthyoplankton surveys conducted in August and October 2005; also in February, March, April, and May 2006; and during the lobster larvae survey conducted in July 2006. Temperature, salinity, and DO readings were recorded during the day and night, from multiple depths that ranged from 20 to 90 feet below the surface. The ambient water quality conditions in Long Island Sound, including the results of Broadwater's surveys, are summarized in the following subsections.

Water Temperature

There is substantial variability in the annual temperature range in the waters of Long Island Sound NCAI data from locations surrounding the proposed Project area indicate that average temperatures in summer (July through September 2000 and 2001) in surface water is 71.4°F and in deeper waters (defined in this study as greater than 64 feet) is 68.5°F. Surface water temperature is also available from the central Long Island Sound Buoy operated by the University of Connecticut for most months between July 2004 and December 2005 (Table 3.2.1-2). Average monthly temperatures ranged from 34.7°F in February 2005 to 75.4°F in August 2005. The maximum surface water temperature recorded by the central Long Island Sound Buoy during this period was 90°F in August 2005.

During the April and May 2005 data collection effort, Broadwater reported that water temperature readings ranged from 39.5 to 51.9°F, with an average of 44.6°F, throughout the water column along the proposed pipeline route. Data collected during the six ichthyoplankton surveys and one lobster larvae survey in the area surrounding the proposed FSRU indicate that water column temperatures ranged from 69.8 to 75.2°F in August, 69.8 to 73.4°F in October, 39.6 to 41.5°F in February, 38.7 to 41.7°F in March, 42.6 to 50°F in April, 55.9 to 56.1°F in May, and 62.8 to 77°F in July.

TABLE 3.2.1-2 Surface Water Temperatures (•F) from Central Long Island Sound Buoy[a]												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2004 Average	41.7	--	--	--	--	--	71.8	72.7	72.0	67.6	--	43.9
Maximum	42.1	--	--	--	--	--	75.2	77.9	77.9	70.5	--	47.8
2005 Average	39.0	34.7	36.5	43.7	51.4	66.0	72.5	75.4	--	61.7	56.8	46.0
Maximum	42.1	37.4	40.1	50.2	58.5	72.7	80.1	90.0	--	65.7	59.5	51.6

-- = Not available.

[a] Source: UC 2004–2005.

Salinity

Long Island Sound receives freshwater input from streams and rivers within its 16,820-square-mile watershed. Saltwater flushes in from and out to the Atlantic Ocean. Ninety percent of all freshwater input into Long Island Sound comes from the Thames, Housatonic, and Connecticut Rivers in Connecticut (LISS 2006b). Due to the tidal influx and outflow of saltwater and these various freshwater inputs, the salinity of the water column within Long Island Sound varies from west to east. Salinity measurements typically range from 23 parts per thousand (ppt) in the western end of Long Island Sound, where the tidal influx of saltwater is restricted through the Narrows, to about 35 ppt (seawater) in the eastern end (LISS 2006b).

According to NCAI data collected from July through September (2000 and 2001) from stations closest to the proposed Project, salinity in surface water averaged 27 ppt and ranged between 26.2 and 28.2 ppt; and salinity in bottom water (greater than 64 feet deep) averaged slightly higher, at 28 ppt with a range between 27.2 and 28.7.

During the April and May 2005 data collection effort, Broadwater reported salinity measurements that averaged 25.7 ppt and ranged from 24.7 to 26.6 ppt. Data collected during the six ichthyoplankton surveys and one lobster larvae survey in the area surrounding the proposed FSRU indicate that salinity measurements throughout the water column are fairly consistent throughout the year. Results ranged from 24.4 to 25.8 ppt in August, 27.5 to 28 ppt in October, 23.5 to 24.2 ppt in February, 25.5 to 26.8 ppt in March, 23.4 to 25.4 ppt in April, 22.7 to 25.5 ppt in May, and 23.5 to 25.3 ppt in July.

Dissolved Oxygen

Due to wave action and proximity to the atmosphere, the uppermost surface water of any waterbody typically contains higher levels of DO than deeper water. The temperature decreases rapidly within a thermocline, which is a transitional layer between the warmer, mixed upper layer and the colder, deep water layer. In winter, when there is less difference between water and air temperature, the thermocline disappears and there is relatively uniform mixing throughout the water column, from surface to bottom. This allows DO concentrations to be fairly uniform in winter, whereas in summer DO concentrations are usually distinct in the upper and lower portions of the water column.

Parker and Reilly (1991) report that the DO values within Long Island Sound vary spatially and seasonally. Generally, average DO readings within Long Island Sound range from 7 to 12 milligrams per liter (mg/L, or parts per million). Monitoring data from the summers of 2000 and 2001 indicate that DO levels averaged 7 mg/L in surface water column measurements and 5 mg/L in bottom water column measurements (EPA 2006a). Winter levels tend to consistently remain between 11 and 13 mg/L, when the water column is well mixed.

Nutrients, especially nitrogen, increase the growth of phytoplankton (microscopic algae) in Long Island Sound. The phytoplankton then die, settle to the bottom, and begin to decay. Bacteria break down the organic material in the phytoplankton for food and use oxygen in the process. Therefore, nutrient enrichment can lead to algal blooms and subsequent oxygen depletion (CTDEP 2005b).

When the dissolved oxygen falls below about 3 mg/L, this condition is considered "hypoxic." Under this condition, fish, benthic animals, and other organisms that require oxygen to respire become increasingly stressed. Overall, hypoxic events can cause large reductions in the abundance, diversity, and harvest of fish in affected waters – and can contribute to an overall loss of biodiversity. Hypoxia is considered to be the most serious water quality issue in Long Island Sound (LISS 1997). In western Long Island Sound, hypoxic conditions typically exist in bottom waters from mid-July through September, when water temperatures peak (LISS 1997). The extent of hypoxia is mainly confined to the Narrows and the western basin of Long Island Sound, or to those areas of Long Island Sound west of a line from Stratford, Connecticut to Port Jefferson, New York (CTDEP 2004).

When hypoxic conditions develop in summer, DO levels can drop below 1.0 mg/L, a level at which fish will leave the area or suffer mortality (EPA 2005a). Long Island Sound exhibits an east-west gradient of decreasing bottom DO readings, especially in summer. DO levels in the central portion of Long Island Sound range from approximately 3 mg/L in summer to approximately 11 mg/L in winter (Parker and O'Reilly 1991). Hypoxic conditions in Long Island Sound typically are most pronounced in August. The largest extent of hypoxia (indicated by low DO concentrations) measured in Long Island Sound in the past decade totaled 345 square miles in 2003. In average years, such as 2004, the maximum area of hypoxic conditions is about 250 square miles (CTDEP 2005a).

An excessive loading of nutrients (eutrophication) is a long-term occurrence within Long Island Sound. Organic carbon and biogenic silica found in sediment cores from western and central Long Island Sound indicate that strong eutrophication began around the year 1850, which coincided with substantial commercial development and population growth in the Long Island Sound watershed (Varekamp et al. 2004). Nitrogen enters Long Island Sound from several sources, including human sewage, agricultural runoff, and atmospheric deposition. Of these, human sewage input is by far the greatest contributor. It is estimated that about 70 percent of the nitrogen input to Long Island Sound comes from sewage (Whitall et al. 2004). Approximately 105 sewage treatment plants in Connecticut and New York discharge into the Sound or its tributaries. New York City alone owns and operates 14 water pollution control plants. Together, they treat more than 1 billion gallons per day of raw wastewater that is discharged into the surrounding waters, including Long Island Sound and Jamaica Bay.

To address the declining water quality of the Sound, the LISS in 1998 adopted a 58.5-percent reduction target for nitrogen loads from human sources to the Sound by 2014, with interim 5- and 10-year targets to assure steady progress. To help meet the goal of reducing nitrogen pollution by 58.5 percent, Connecticut and New York have developed plans to gradually phase in sewage treatment plant upgrades.

During the April and May 2005 sampling effort conducted by Broadwater, one sample location out of 595 ambient water quality readings for DO did not meet the NYSDEC DO standard of 5.0 mg/L for SA waters. In general, lower DO concentrations were observed near the water surface, with an average value of 7.9 mg/L. At sample depths between 10 and 130 feet, there was little variation in DO levels; they ranged from 8.9 to 11.3 mg/L. Data collected during the six ichthyoplankton surveys and one lobster larvae survey by Broadwater in the area surrounding the proposed FSRU indicate that DO measurements ranged from 4.5 to 7.3 mg/L in August, 4.9 to 7.5 mg/L in October, 10.8 to 13.5 mg/L in February, 10.3 to 11.2 mg/L in March, 8.9 to 10.6 mg/L in April, 8.9 to 11.1 mg/L in May, and 4.8 to 8.8 mg/L in July.

Turbidity

Turbidity and TSS levels both indicate water clarity or amount of particulates suspended in the water column. TSS is a measure of the actual weight of material per volume of water, while turbidity is a measure of the amount of light that is scattered and absorbed by particles in the sample (more suspended particles results in more scattering). Water clarity can vary based on season, depth, weather, and human activity, and may limit the amount of sunlight reaching underwater plant life. Particulates suspended in water absorb heat from sunlight, thereby increasing the water temperature, which results in reduced capacity of the water to retain DO. Monitoring TSS data (EPA 2006a) collected in late summer 2000 and 2001 from stations throughout Long Island Sound surrounding the proposed Project area indicate that TSS levels in surface water ranged from 3 to 6 mg/L, with an average concentration of 3.8 mg/L. TSS measurements taken at the bottom ranged somewhat higher, from 3 to 11 mg/L, and averaged 6.7 mg/L. The Water Quality Monitoring Program of the CTDEP has collected TSS measurements in Long Island Sound nearly every month from January 1991 to December 2005 (CTDEP 2005a). TSS measurements collected from the surface and the bottom range from 0.5 to 74.9 mg/L over this period. These data revealed that monthly average TSS in surface water were always less than the corresponding monthly average TSS for bottom water. Average TSS levels collected by CTDEP were lowest in April (5.5 mg/L for bottom measurements, 4.2 mg/L for surface measurements) and highest in July (10.0 mg/L for bottom measurements, 7.6 mg/L for surface measurements). During storm events, it is expected that concentrations may increase over an order of magnitude, with increases most pronounced proximal to the seafloor.

During the April and May 2005 sampling effort conducted by Broadwater, TSS concentrations ranged from 0.8 to 2.1 mg/L, with an average value of 1.9 mg/L. The lowest TSS values primarily were observed in the surface interval.

The New York turbidity standard for SA waters allows no increase that would cause a substantial visible contrast to natural conditions. Review of pertinent scientific literature indicates that the duration of exposure to elevated TSS levels is an important component in the development of behavioral, sublethal, and lethal response in fish. Wilber and Clarke (2001) reviewed multiple studies documenting the biological effects of exposure to suspended sediments in estuarine fish. This review indicated that the lowest observed concentration-duration combination at which sublethal effects due to reduced respiratory function occurred in estuarine fish was 650 mg/L for 5 days. However, several species of estuarine fish, such as mummichug and striped killifish, are considerably more tolerant to elevated TSS levels; the lethal concentration for 10 percent of the populations tested was exposure to greater than 10,000 mg/L for 24 hours.

3.2.2 Variances to FERC Procedures

In response to past concerns raised by federal, state, and local agencies regarding the potential impact of construction of pipeline projects in general, we developed our Procedures to provide a baseline level of protection for waterbodies and wetlands affected by natural gas projects (FERC 2003). Our Procedures include specific requirements for pre-construction planning, environmental inspection, construction methods, sediment and erosion control, restoration, and post-construction maintenance.

Our Procedures were primarily developed for freshwater habitat. However, Broadwater has agreed to incorporate the requirements of our Procedures to minimize construction-related impacts to Long Island Sound as part of its Wetland and Water Body Construction and Mitigation Procedures Plan. Broadwater has requested five variances to our Procedures due to the open water nature of this proposed Project; these are discussed below.

3.2.2.1 Equipment Fueling

Our Procedures require that equipment refueling be conducted at least 100 feet from a waterbody (Section IV.A.d). Because this Project would be constructed using marine vessels, it is not feasible to refuel equipment onshore. In addition, the proposed Project site is approximately 9 miles or more from the nearest shore-based refueling site. Therefore, it is recognized that construction equipment would require refueling on-water. Broadwater would use standard refueling practices for marine vessels, in addition to implementing its SPCC Plan to minimize the likelihood of potential spills and to contain a spill if it were to occur. Broadwater would clean up any spill in the event that a spill occurred. **We recommend that:**

- **Prior to construction, Broadwater file with the Secretary, for review and written approval by the Director of OEP, an offshore-specific SPCC Plan; the estimated volumes associated with a worst-case spill scenario; an appropriate evaluation of the associated potential impacts to water resources and marine life; and appropriate mitigation measures to minimize the likelihood of a spill, as well as measures to contain and clean up a spill if it were to occur during construction or operation.**

Based on the logistics of this Project and implementation of an approved offshore SPCC Plan, we accept this requested variance.

3.2.2.2 Storage of Hazardous Materials

Similarly, our Procedures require hazardous materials to be stored at least 100 feet from waterbodies (Section IV.A.e). This measure is not practical for the proposed Project in regard to storage of fuels, chemicals, and lubricating oils that would be required to operate the construction equipment. Based on the logistics of this Project and implementation of an approved offshore SPCC Plan, we accept this requested variance.

3.2.2.3 Construction Period

Our Procedures contain seasonal construction windows that are designed to protect freshwater fish, especially coldwater fish that spawn in fall and winter (Section V.B.1.a). Because the proposed Project would be located in the middle of Long Island Sound, where fish spawning peaks in spring and summer, we accept Broadwater's requested variance to avoid the peak spawning season by allowing construction primarily during fall, winter, and early spring.

3.2.2.4 Spoil Placement

Since our Procedures are primarily focused on construction in relatively small waterbodies, they require that excavated spoils be placed at least 10 feet from the water's edge (Section V.B.4.a) and that sediment barriers be used to prevent the flow of the spoils into any waterbody (Section V.B.4.b). Broadwater has requested a variance to allow spoil placement next to the excavated trench (without a barrier) since removal to upland areas would likely cause more impacts than placing them next to the trench during subsea plowing. We agree that placement immediately next to the trench would reduce potential turbidity relative to techniques that would excavate the sediments at depths as great as 120 feet, place them in a barge, and haul them to land. Therefore, we accept Broadwater's requests to allow spoil placement next to the trench without the need for sediment barriers.

3.2.3 Potential Impacts and Mitigation

Although potential impacts to water resources could occur during construction and operation of the FSRU, YMS, pipeline, and LNG carriers, the greatest impacts likely would occur during pipeline construction and FSRU operation.

3.2.3.1 Construction

FSRU

Potential impacts to water resources from construction of the proposed FSRU would be limited because the proposed FSRU would be constructed at a qualified shipyard outside the United States and then towed to Long Island Sound. However, potential impacts related to placement of the proposed FSRU in Long Island Sound could be associated with the initial ballast water exchange for the FSRU and the use of anti-fouling paint.

Ballast Water

In the process of being initially towed to the Project site, the FSRU would contain ballast water obtained proximal to the construction facility. Prior to entering Long Island Sound, the FSRU would exchange this ballast water offshore and replace it with relatively clean offshore water in accordance with standard Coast Guard requirements. Therefore, the initial ballast water exchange near Long Island Sound is not expected to adversely affect water resources. The ballast exchange would take place at least 200 nautical miles from the nearest land, in waters with a depth of at least 660 feet, and would require the exchange of 95 percent of the ballast water.

Anti-Fouling Paint

As is typical for protecting the hull of recreational and commercial marine vessels, Broadwater proposes to use a copper-based anti-fouling paint on the proposed FSRU and YMS. Anti-fouling paints retard biological growth by leaching copper, which prohibits attachment of organisms. Broadwater has not specified which types of copper-based anti-fouling paints they would use: leaching paints or copolymer paints, also known as ablative paints. The following description of leaching paints and copolymer paints is based on information from BoatUS (2005). Leaching paints contain about twice as much copper as copolymers; they leach high levels of copper initially and gradually taper off. Copper is evenly distributed throughout the hardened paint film. Copper particles closest to the surface dissolve into water, leaving tiny holes in the remaining paint. This further allows water access to penetrate deeper into the paint film and dissolve more copper. Copolymer paints work differently, tending to release copper at a constant rate over time rather than in a tapering pattern. The paint itself slowly erodes away as the copper dissolves, which continually exposes new copper. The rate of leaching is determined by the chemical composition of the paint, turbulence, and current speed passing the hull.

Anti-fouling paint would be applied to the proposed FSRU hull at the shipyard outside the United States. According to Broadwater, approximately 27.8 pounds per day of copper would be leached into the Sound (International Paint 1998). Broadwater estimated the concentration of copper that would leach into the water column, assuming a consistent leaching rate that the Sound was a static system (with no tides or currents) and using the volume of water equal to a cylinder (calculated from the radius in which the FSRU would weathervane around the YMS, to a depth of 100 feet). Broadwater reported that the resulting copper concentration (1.0 microgram per liter [μg/L]) would be below EPA's ambient water quality criteria for acute and chronic exposures (3.1 and 1.9 μg/L, respectively) (EPA 2003a). Therefore, the estimated copper concentrations from anti-fouling paint would not significantly affect water quality or aquatic organisms, especially considering the hydrodynamic nature of Long Island Sound. These low concentrations of dissolved copper in the water column are not expected to significantly add to the existing copper concentrations in the sediments in the middle of Long Island Sound (see Section 3.1.2.1). Any impacts to water resources from the use of anti-fouling paint during construction would be minimal, localized, and consistent with standard marine practices. Broadwater has stated that anti-fouling paint would not be reapplied to the FSRU throughout the life of the proposed Project.

YMS

Potential impacts associated with YMS construction could be associated with the use of anti-fouling paint and disturbance of the seafloor during YMS installation. As described in the section above, the cumulative leaching of copper from the anti-fouling paint on the YMS and the FSRU into the water column would be below EPA's ambient water quality criteria and would therefore not significantly alter the water quality or harm aquatic organisms in the Project area. Similarly, Broadwater would not reapply anti-fouling paint to the YMS throughout the life of the Project.

Construction of the proposed YMS could affect water resources through increased turbidity from direct disturbance of the seafloor habitat. Construction of the proposed YMS primarily would occur at an existing onshore construction facility. However, installation of the proposed YMS on the seafloor would directly disturb approximately 0.8 acre of seafloor (less than 0.5 acre for the anchor footprint and 0.3 acre of impact for installation of the physical structure and scour protection of the YMS). Installation of the proposed YMS, including pile driving and attachment of the YMS to the piles installed in the seafloor, would occur over a period of approximately 8 weeks. Installation work is planned to take place from about the middle of September through the middle of November 2010. Pile-driving activities would be conducted from a support vessel and would take approximately 1 week per piling. Erection of the proposed YMS on the piles would be conducted in approximately 1 day, resulting in sediment disturbance within the footprint of the proposed YMS likely lasting for less than 1 day. Therefore, because the disturbance would be temporary, no significant impact to water resources would be associated with installation of the proposed YMS; impacts that occur would be highly localized.

Pipeline

Pipeline construction could result in increased turbidity during trenching and pipeline installation, impacts to water quality during hydrostatic testing of the pipeline, and accidental spills during construction activities as further described below.

Turbidity

Turbidity, or water column suspension of seafloor sediments, would occur when seafloor sediments were disturbed by subsea plowing, specialized pipeline installation methods, and anchoring. Broadwater has stated that no blasting would be used to install the proposed Project. The majority of the proposed pipeline would be installed via a subsea plow, which would cause most of the turbidity associated with pipeline installation. Specialized pipeline installation methods could include manual excavation by divers or use of submersible pumps at the IGTS tie-in, proposed FSRU tie-in, and the two utility crossings.

Fine-grained sediments that would be disturbed during construction would more likely be suspended in the water column farther and longer than coarser-grained sediments, which would be expected to settle out of the water column relatively quickly. This suspension of fine sediments into the water column could temporarily affect water quality by reducing light penetration.

To evaluate potential turbidity impacts, Broadwater conducted sediment transport modeling, using the MIKE3 sediment model to determine the extent and magnitude of turbidity resulting from installation of the proposed pipeline. The MIKE3 model has been regularly used on other large-scale marine or estuarine projects in the region where sediment disturbance and subsequent turbidity and sedimentation have been a concern. Broadwater provided proposed modeling protocols to appropriate federal and state regulatory agencies for review and comment. Federal and state agencies confirmed that the model was appropriate for use for the proposed Project.

The MIKE3 model incorporates Project-specific input parameters to calculate the vertical and horizontal distribution and magnitude of sediments in the water column over time. Input parameters include the volume of sediment disturbed, the percentage that would be suspended, and the composition of the sediment based on the site-specific sediment surveys. Broadwater calculated the sediment volume based on proposed trench measurements and estimated that approximately 20 percent of sediment would be suspended into the water column. According to Broadwater, past modeling practice and professional experience indicate that approximately 2 to 5 percent of sediment material is introduced into the water column. Therefore, Broadwater chose 20 percent as a conservative, upper bound limit of this input parameter.

Results of the sediment transport modeling showed that the highest TSS values would be near the bottom. TSS values in the upper and middle portions of the water column of Long Island Sound were predicted to be less than 10 mg/L and mostly less than 5 mg/L. Therefore, it is not expected that increases in turbidity in the surface layer would constitute a substantial visible contrast to natural conditions, in compliance with New York's water quality standards for SA waters. TSS levels would be greatest in the bottom strata; the modeling results provided by Broadwater indicate that the maximum TSS level would be approximately 80 mg/L for brief durations (less than 10 hours). Estimated levels of TSS indicate that concentrations of sediment suspended in the bottom strata of the water column due to plowing would be typically less than 14 mg/L, and at only a few points in time would concentrations of 20 mg/L be observed more than 1600 feet from the trench. Within 8 hours of plowing cessation, TSS levels were estimated to be less than 6 mg/L anywhere along the length of the trench. The model showed that any increases in TSS values associated with subsea plowing would be largely assimilated into Long Island Sound within 12 hours of sediment disturbance. The results of the modeling are supported by the water quality monitoring conducted by TRC during construction of the HubLine project, which indicated that elevated turbidity rarely exceeded 492 feet from the jet sled and was typically retained in the bottom third of the water column (TRC 2003). In addition, TRC (2004) concluded that plowing and backfill plowing had the least potential to contribute to turbidity based on review of the water quality monitoring results collected during the construction of HubLine. In the proposed Project, active plowing and associated subsequent turbidity would last approximately 23 days. As mentioned in Section 3.2.1.3, a review of scientific literature indicated that the lowest suspended sediment concentration and duration combination that caused sublethal effects in estuarine fish was 650 mg/L for 5 days. The maximum suspended sediment concentrations estimated by Broadwater due to plowing does not approach the range at which sublethal effects (i.e., decreased oxygen blood levels due to clogged gills) have been demonstrated to occur in estuarine fish. Therefore, based on the relatively small size and short duration of the turbidity plume, construction would not result in any significant impact to water quality, and any temporary impact would exist during and immediately following active construction.

Modeling to assess impacts from excavation activities associated with the specialized installation methods (for example, at the proposed IGTS and FSRU tie-ins) also was conducted. The model results showed no substantial increase in TSS values throughout the entire water column associated with the localized use of specialized installation methods.

The anchors for lay barges also would disturb bottom substrate. As proposed by Broadwater, the vast majority of the seafloor disturbed during construction (over 90 percent) would be caused by cable sweep, which can occur when anchor lines are not taut. As a result, we have included a recommendation in Section 3.1.2.2 that Broadwater use mid-line buoys on all of the anchor lines to elevate them above the seafloor, which would virtually eliminate any impacts to water resources due to cable sweep and turbidity. The placement of anchors during construction would result in highly localized turbidity, and it is anticipated that the extent and magnitude of turbidity due to anchoring would be minimal and temporary.

Broadwater would develop and throughout construction would conduct a monitoring program, in coordination with appropriate federal and state agencies. The monitoring would define the extent and magnitude of the suspended sediment plume, using real-time instrumentation and TSS analytical results of water samples collected during and after plowing. The monitoring plan would include turbidity profiling, using optical and acoustic backscatter scans (including an acoustic Doppler current profiler [ADCP] for continuous readings); grab samples of surface water for laboratory analysis of TSS, temperature, and salinity profiling; and documentation of geographic location of sampling and profiling, using a differential global positioning system (DGPS).

Broadwater has proposed using subsea plowing to install the pipeline across Stratford Shoal and has identified alternative installation methods, such as dredging or placement on the seafloor and covering with concrete mats, if plowing cannot be successfully conducted. In the event that subsea plowing is not feasible, we have included a recommendation in Section 3.1.2 that Broadwater submit contingency plans for any alternative installation methods to cross Stratford Shoal that specify the methods, potential impacts, and appropriate mitigation.

Theoretically, suspension of sediments could impact water quality if the sediment were contaminated or anoxic. As described in Section 3.1.2.2, it is not anticipated that disturbance of the seafloor would result in release of any significant contamination into the water column because the existing sediments along the pipeline route satisfy regulatory guidelines associated with contaminated sediments. In addition, any disturbance of anoxic sediments is not expected to significantly affect water quality due to the well-oxygenated water column that typically exists during the winter construction period. Any impacts associated with low DO levels would be highly localized and temporary in the immediate vicinity of active construction.

Hydrostatic Testing

The integrity of the pipeline would be verified during construction, using standard hydrostatic testing procedures. Hydrostatic testing would be performed following installation but prior to backfilling of the proposed pipeline and prior to completion of the tie-in with the IGTS pipeline. Hydrostatic testing of the pipeline would involve flooding the proposed pipeline with seawater that has been treated with a biocide to prevent microbial growth. The total volume of seawater required to fill the proposed 21.7-mile, 30-inch-diameter pipeline would be approximately 3.9 million gallons. The seawater would be withdrawn from Long Island Sound via a submersible pump, which would withdraw water from approximately 20 to 40 feet below the surface of the water in order to limit entrainment of organisms and debris into the proposed pipeline. This water would be filtered through a 74-micron mesh screen (mesh opening is less than 0.01 inch) to further prevent debris and organisms from entering the pipe. The proposed pipeline would be filled with seawater at a rate of approximately 4,000 gpm. The proposed pipeline would remain flooded between the hydrostatic testing in spring 2010 until final tie-in and hydrotesting of the completed pipeline near the end of 2010. Therefore, the hydrostatic testing water could remain in the proposed pipeline up to approximately 8 months. Because the pipe would need to be hydrostatically tested when laid on the seafloor and then again after installation in the trench, Broadwater would limit the amount of water needed for both of these tests by withdrawing the water once and holding it for both tests. Prior to discharge, the hydrostatic test water would be pumped to holding tanks located on support vessels. The test water would be treated onboard and neutralized with hydrogen peroxide. The test water would be held to allow adequate neutralization and then re-oxygenated with a diffuser before being discharged into Long Island Sound. Broadwater estimates that the hydrostatic test water would be discharged at a rate of approximately 2,000 gpm.

All of the water withdrawn from Long Island Sound for hydrostatic testing would be returned to Long Island Sound, and the entire hydrostatic testing process would be conducted in accordance with SPDES requirements (the SPDES application was filed with the NYSDEC on March 24, 2006). Therefore, any impacts to water resources associated with hydrostatic testing would be localized and negligible.

Accidental Releases

In general, the proposed Project would be constructed using standard construction procedures, including best management practices to avoid and minimize the potential impacts of an accidental release of fuels, lubricants, and other chemicals used during construction. Nevertheless, we have recommended that Broadwater provide an offshore-specific SPCC Plan (Section 3.2.2.1). The offshore SPCC Plan would include a worst-case spill scenario and identify potential impacts to water resources and marine life, as well as appropriate mitigation measures to minimize the likelihood of a spill and measures to contain and clean up a spill if it were to occur. Additionally, all vessels would be required to comply with the International Convention for the Prevention of Marine Pollution from Ships (MARPOL), an international convention that aims to prevent operational or accidental pollution of the marine environment by ships (IMO 1978). For these reasons, any impacts to water resources from accidental releases would be unlikely, but temporary and minor if a spill were to occur.

3.2.3.2 Operation

FSRU

Potential impacts to water resources during operation of the proposed FSRU would be associated with various water intakes and discharges. In addition, operation of the proposed FSRU could result in impacts associated with accidental releases.

FSRU Water Intakes

Several water intakes would be associated with the proposed FSRU, including two sea chest intakes and two firewater intakes. Each of these intakes (Table 3.2.3-1) and associated impacts are discussed below.

Sea Chest Intakes. The two sea chest intakes would be located port and starboard on the bottom of the proposed FSRU hull, at a water depth of approximately 40 feet. These intakes would be required for continuous operation of the proposed FSRU, and the flow of water withdrawn from the Sound would not exceed 0.5 foot per second. This water would be primarily used as ballast and secondarily for desalinization for use as potable water and the side-shell curtain during LNG transfer.

TABLE 3.2.3-1
Proposed FSRU Intakes for Standard Operations

Type of Intake	Number of Intake Points	Frequency of Intake	Volume of Intake (mgd)	Total Annual Intake Volume (million gallons)
Sea chest intakes	2 (only 1 functioning at a time)	Daily	5.5[a]	2000
Firewater intake	2	1 hour per month	0.7	8.9

gpm = gallons per minute; mgd = million gallons per day.

[a] The annual average daily intake would be 5.5 mgd based on the average annual intake; typical daily intake would be 6.6 mgd, except when loading LNG onto the FSRU when the intake would be 0.9 mgd.

The sea chest intake systems would consist of a 35-inch pipe with a coarse grate, positioned flush with the hull. The openings in the grate would measure approximately 4 inches by 2 inches to allow ready water intake but to exclude larger-sized marine life and debris from the intakes. The pipe would lead to a 0.2-inch mesh screen. Maintenance of intake screens would be performed by underwater diver-operated power brushing equipment, and no chemicals would be used. Between the coarse grate and the mesh screen, sodium hypochlorite would be continuously injected into the seawater (at a dose of 0.2 ppm), resulting in a residual sodium hypochlorite concentration in the withdrawn seawater between 0.01 and 0.05 ppm. The 35-inch pipe would extend between port and starboard so that all seawater-based operating systems on the proposed FSRU could be supported by either intake. Only one sea chest intake would operate at a given time. The FSRU annual average daily intake volume would be 5.5 mgd. This annual average is based on the intake of 0.9 mgd for use as potable water during the transfer of LNG from the carrier to the FSRU, when ballast water would be discharged (estimated at 15 hours per shipment), and the intake volume at all other times would average 6.6 mgd. This average intake volume of 6.6 mgd is based on an average gas sendout of 1.0 bcfd. It would supply water for all of the proposed FSRU operations, including approximately 5.7 million gallons for ballast water over a 24-hour period, as well as an additional 0.9 mgd contingency for all other systems that require seawater. The proposed FSRU could operate at a peak gas sendout of 1.25 bcfd for a short time, although the annual average would not exceed 1.0 bcfd. During peak gas sendout, the sea chest intakes would supply approximately 8.2 mgd for all of the proposed FSRU operations.

Firewater Intakes. The firewater intakes would be located fore and aft on the proposed FSRU. Similar to the sea chest intakes, the firewater intake structure would have a coarse grate, with openings measuring approximately 4 inches by 2 inches, positioned flush with the hull of the proposed FSRU. Unlike the sea chest intakes, the firewater intakes would not have a small mesh screen and would not be treated with sodium hypochlorite. The firewater intakes would have a maximum intake of 0.7 million gallons per hour (mgh). They would be operationally tested for 1 hour every 30 days and would withdraw the maximum intake (0.7 million gallons) per test. The firewater intakes would not be operated otherwise unless there was a fire emergency onboard the FSRU. During monthly testing, the firewater would be immediately discharged overboard to Long Island Sound; consequently, any impact to water volume or quality would be negligible.

Emergency Central Cooling Water. The emergency central cooling water system would be used in the unlikely event that standard glycol/water system operations of the proposed FSRU failed. This emergency system would be used only if necessary to provide gas to the region. The central cooling water would intake seawater through sea suction grids and a coarse sea chest filter. The intakes would be located on each side and on the bottom of the proposed FSRU. If needed, Broadwater anticipates that approximately 132,086 gallons per hour would be used for central cooling. The central cooling water system is not intended to be used during routine operations; and it is not expected that the system would be used during the life of the Project, based on the safeguards included as part of the glycol/water system. For these reasons, intakes associated with the central cooling water is not expected to significantly affect the water resources of Long Island Sound.

Cumulative Water Intakes. The annual average daily intake of the FSRU would be 5.5 mgd, which includes the 1 hour per month additional intake of 0.7 million gallons for firewater testing and the near-constant intake of 6.6 mgd at all times with the exception of when the FSRU is taking on LNG from carriers. Because ballast water would be discharged during loading of LNG from the carrier to the FSRU, the minimal intake volume of 0.9 mgd for contingency operations (non-ballast water purposes) would be in effect during this operation. All water intakes to the FSRU would be conducted in accordance with SPDES Permit requirements. For these reasons, any impacts to water quality and volume associated with water intakes are considered minor but long term because they would continue for the life of the proposed Project.

FSRU Water Discharges

Daily operations of the proposed FSRU would result in three point-source discharges into Long Island Sound (Table 3.2.3-2), including:

- Two ballast water discharge points (port and starboard), located approximately 3 feet below the water line;
- One desalinization unit overboard, located approximately 13 feet below the water line; and
- One wastewater (if it can be treated onboard to meet New York State discharge requirements) discharge point located approximately 3 feet below the water line on either the port or starboard side.

Maintenance every 5 to 7 years would result in discharge via one inert gas scrubber cooling pump overboard, located approximately 3 to 6 feet below the water line. Operation of the proposed FSRU also would result in three non-point-source discharges into Long Island Sound, including:

- A side-shell water curtain for the FSRU;
- Firewater system; and
- Uncontaminated deck runoff from storm events.

All operational discharges from the FSRU would be conducted in compliance with SPDES Permit requirements. Most of these discharges would be conducted as part of routine operations and would continue for the life of the proposed Project, although some either would occur infrequently (for periodic maintenance) or are never intended to occur unless there is a system shutdown (e.g., the central cooling water system).

TABLE 3.2.3-2 Proposed FSRU Discharges			
Type of Discharge	Number of Discharge Points	Frequency of Discharge	Annual Discharge Volume (million gallons/year)
Ballast water	Two (only one point functioning at a time)	118 days per year	2,030[a]
Desalinization unit overboard	One	Daily	219
Treated wastewater	One	Daily	1.8
Inert gas scrubber cooling pump overboard	One	Once every 5 years	2.3[b]
Side-shell water curtain	Non-point	118 days/ year	15.4 (variable)
Firewater system	Non-point	1 hour per month	8.9
Stormwater (deck runoff)	Non-point	Variable (based on storm events)	Variable

[a] This estimate is based on 17.2 mgd, the maximum discharge of ballast water.

[b] This is an annual average. Actual discharge of 11.6 million gallons would occur once every 5 years.

FSRU Ballast Water Discharge. The proposed FSRU ballast water system would discharge approximately 15 hours per day, 118 days per year (based on the estimated LNG carrier schedule). According to Broadwater, the maximum ballast water discharge volume for the proposed FSRU would be 17.2 mgd. Because the ballast water would not remain in the holding tanks for an extended period of time, the temperature and DO concentration of ballast water would be expected to be similar to ambient conditions found in the surrounding waters of Long Island Sound.

The residual chlorine concentration in the ballast water discharge from the proposed FSRU would range between 0.01 and 0.05 ppm (10 and 50 μg/L or parts per billion [ppb]). The EPA chronic benchmark for chlorine discharges is 7.5 μg/L (EPA 2006b). Broadwater would monitor sodium hypochlorite concentrations through sampling of overboard water prior to discharge into the Sound with a colorimetric assay. Depending on the monitoring results, Broadwater would adjust the production and injection rates of sodium hypochlorite in order to comply with SPDES Permit requirements. SPDES requirements could entail establishment of a mixing zone, which has been the approach for other LNG terminals recently permitted in the United States. It is expected that mixing would occur rapidly to ambient conditions due to the volume of water in and the hydrodynamics of the open waters of Long Island Sound. Therefore, the discharge of ballast water would result in a minor impact to the water resources of Long Island Sound for the life of the proposed Project.

Desalinization Unit Overboard. The desalinization unit would be used to make potable water onboard the proposed FSRU. The salinity of the discharge water from the desalinization unit overboard would be slightly higher than ambient Long Island Sound salinities. Broadwater estimates that this unit would discharge approximately 0.6 mgd, for an annual discharge volume of 219 million gallons. The source of the desalinization unit overboard discharge would be seawater originating from the sea chest. The desalinization process would increase the salinity of the desalinization discharge by less than 1 ppt. This discharge would result in little or no measurable salinity increase in the receiving water, where ambient salinity averaged around 27 ppt. Therefore, no significant impact to water quality is expected from the desalinization unit overboard.

Treated Wastewater. The proposed FSRU would be equipped with a membrane bioreactor to treat all sewage (blackwater) and graywater that would be generated. Current specifications for the membrane bioreactor indicate that all wastewater discharge could be treated to comply with NYSDEC SPDES standards. If the wastewater discharge could not be treated to meet SPDES discharge requirements, all of the wastewater would be stored onboard the proposed FSRU and shipped to shore for disposal at an appropriate facility. If the maximum rate of discharge is assumed (5,000 gallons per day), the FSRU would discharge approximately 1.8 million gallons of wastewater per year. Discharge from the membrane bioreactor would be tested weekly from the treatment system. In addition, Broadwater would prepare and implement water quality monitoring plans to ensure adherence to NYSDEC requirements as outlined in the SPDES Permit.

Inert Gas Scrubber Overboard. The inert gas scrubber would be used only when LNG storage tanks require purging in order to be cleaned or inspected, approximately once every 5 years. The tank would first be drained of cargo and the temperature would be raised to vaporize any remaining liquid, at which point inert gas would be used to purge the storage tanks of any vapor. Water from the sea chest would be used to cool the exhaust gas purged from the tank. This wash water then would be released overboard. Broadwater estimates that approximately 290,000 gallons per hour, or a total of approximately 11.6 million gallons of water, would be discharged after purging all of the tanks over a 1- to 2-day period. The temperature of the water used to purge the inert gas scrubbers is expected to be 52•F higher than ambient water, and pH is expected to be between 5.5 and 6. Broadwater has not proposed specific measures to protect water quality associated with this discharge, but any discharge from the inert gas scrubber would be conducted in compliance with SPDES requirements. A minor impact would be infrequently expected once every 5 years from the inert gas scrubber overboard, for the life of the Project.

Side-Shell Water Curtain. The side-shell curtain would be needed whenever an LNG carrier off-loads at the FSRU. A side-shell water curtain would be directed overboard between the FSRU and the LNG carrier during off-loading and would help the FSRU and the LNG carrier maintain hull integrity. The side-shell curtain would be needed while LNG carriers off-load at the FSRU. Because the source for the FSRU side-shell water would be the sea chest, the side-shell curtain discharge would have residual chlorine levels (estimated concentration of 0.01 to 0.05 ppm). The side-shell water curtain would be discharged directly into Long Island Sound at an approximate rate of 8,718 gallons per hour during LNG off-loading. The size of the LNG carrier would determine the length of time the side-shell curtain would be needed, but current steam-powered LNG carriers would require approximately 15 hours to transfer the cargo to the FSRU. A larger LNG carrier with greater LNG carrying capacity would require a longer off-loading time, and the volume of water needed for the side-shell curtain would vary accordingly. However, given the rate of discharge (8,717 gallons per hour) and 15 hours for cargo transfer, the discharge due to the side-shell curtain would total 0.13 mg per LNG shipment. Assuming 118 shipments of LNG per year, the annual discharge volume associated with the side shell curtain would be approximately 15.4 million gallons. With the exception of residual chlorine levels, the water quality of the side-shell water curtain discharge would approximate ambient water quality. As with the ballast water discharge, the residual chlorine concentration in the curtain water is not expected to significantly affect water quality.

Firewater System. Water that would be used to test the emergency firewater system would not be treated with sodium hypochlorite and would be discharged overboard immediately after the 1-hour test was complete. According to the information provided by Broadwater, the annual discharge volume from this system would be approximately 8.9 million gallons. Consequently, any impact to water volume or quality would be negligible.

Stormwater (Deck Runoff). Rain water from storms would drain off the above-water surface of the FSRU through scupper drains. The exact volume of the stormwater discharge depends on the amount of rainfall, but the runoff would be at ambient temperature when discharged to the Sound. If the surface area were contaminated with oil and grease, the rain water would be collected and stored in the bilge holding tank until it could be treated onshore. No impacts to water quality from the discharge of rainwater are expected.

Emergency Discharges. Broadwater has incorporated emergency back-up systems in the event that there is an unexpected failure in the standard processes of the Project. These include an emergency central cooling water system and an emergency bilge overboard. The emergency central cooling water system would not discharge during routine operations; and it is not expected that discharge would occur during the life of the Project, based on the safeguards included as part of the glycol/water system.

According to Broadwater, it is anticipated that the emergency bilge overload would not be used at any time for the life of the proposed Project. Therefore, impacts from the emergency bilge overload are not anticipated.

Cumulative Water Discharge. The cumulative daily water discharges for the proposed FSRU would vary based on the frequency of LNG carriers off-loading. The maximum daily discharge volume (17.2 mgd) from the FSRU would occur approximately 118 days per year and would result primarily from the discharge of ballast water while LNG is being loaded onto the FSRU. Ballast water discharge and the desalinization unit would account for approximately 98 percent of the water discharged annually from the FSRU during regular standard operations. The remainder of the regular discharge would consist of treated wastewater, which would be appropriately treated or hauled to shore. Several other discharges from the proposed FSRU would be performed on a less frequent basis. The proposed FSRU would discharge approximately 0.7 million gallons once a month for testing of the firewater bypass system. Approximately once every 5 years, about 11.6 million gallons would be discharged for the inert gas scrubber overload. Although not anticipated during the life of the Project, discharges could be associated with the emergency central cooling water system and emergency bilge overboard. All of these processes, if they did occur, would discharge directly into Long Island Sound.

Routine discharge waters from the proposed FSRU would approximate ambient temperature, and most would be treated with sodium hypochlorite biocides. The residual chlorine concentration is not expected to affect water quality because of the relatively low concentration of the sodium hypochlorite in the discharge water (minimum effective concentration between approximately 0.01 and 0.05 mg/L), and mixing upon discharge would occur rapidly due to the volume of water in Long Island Sound and mixing by the tides and currents. The associated discharges either would be required to satisfy New York's water quality standards for SA waters or would require special SPDES Permit requirements to reduce potential impacts to water resources. For these reasons, any impacts associated with water discharges during operations are considered minor but long term because they would continue for the life of the proposed Project.

YMS

The only potential impact to water quality during YMS operation would be the accidental release of ballast water from the YMS. Ballast water in the YMS would be comprised of a mixture of freshwater and glycol to inhibit corrosion and freezing; this ballast water would be expected to remain within the YMS during the life of the Project. Concentrations of glycol in ballast water would be dilute; if accidentally released, they would quickly breakdown in seawater. Therefore, impacts to water resources from operation of the proposed YMS are not anticipated during standard operations or in the event of an accidental release of ballast water.

Pipeline

As proposed by Broadwater, potential impacts to water resources during operation of the pipeline could include thermal impacts along the pipeline route prior to backfilling and turbidity during periodic maintenance activities.

Thermal Impacts

Broadwater proposes to install the 21.7-mile pipeline in an open trench and then allow most of the pipeline to be buried gradually by natural backfilling of the trench (about 20 miles). The type and methods of backfilling are discussed in Sections 2.3.2.1 and 3.1.2.2. The remaining 2 miles would be actively backfilled, primarily in association with the tie-ins and valves. Prior to natural backfilling, the elevated temperature of gas in the pipe along most of the pipeline route would warm the water around the exposed pipe. The thermal impacts associated with the pipeline that would lie in a trench on the seafloor were modeled by Broadwater. For the exposed pipeline in an open trench, the water temperature immediately adjacent to the pipe would increase by as much as 20•F above ambient temperatures. The average temperature increase approximately 6 feet from the exposed pipe would be slightly less than 1.5•F. As proposed by Broadwater, the extent and magnitude of the thermal impacts to the water from the exposed pipeline would decrease as the pipe was gradually covered when the trench was naturally backfilled with sediment. The modeling results for the pipeline covered with 3 feet of sediment indicate that thermal impacts to water surrounding the pipeline were negligible. Although Broadwater modeled the natural backfill process and generated an estimate of approximately 1 to 3 years for restoration of the grade, we believe that active backfilling of the trench would minimize potential impacts to marine resources. Therefore, we have included a recommendation in Section 3.1.2.2 that Broadwater mechanically backfill the subsea pipeline immediately following pipeline installation. Active backfilling would eliminate any potential thermal impacts to water resources associated with an open trench and exposed pipeline.

In addition to the subsea portion of the pipeline, the 140-foot section of the proposed riser extending from the FSRU to the seafloor would directly contact the seawater of Long Island Sound. There would be thermal exchange between the heated gas in the riser and the seawater of Long Island Sound. During periods of low gas flow, the temperature of the natural gas within the riser would decrease from 130°F as it exits the FSRU to approximately 120°F at the foot of the riser on the seafloor. At higher gas flows, the temperature of the natural gas would be approximately 100°F through the riser. According to the modeling conducted for Broadwater, the water temperature approximately 3 feet downcurrent of the exposed pipeline would be elevated to a maximum of 3•F above ambient temperatures, regardless of season. There would be no predicted increase in water temperature approximately 4 feet from the riser due to mixing to ambient temperatures. As a result of the short length of this exposed pipe and the hydrodynamics of Long Island Sound, no significant impact to ambient water temperatures in Long Island Sound is expected to be associated with this thermal exchange.

Periodic Maintenance

General pipeline maintenance activities could require limited excavation of the buried pipeline or tie-ins. Maintenance would include regularly scheduled pigging operations at the IGTS tie-in approximately once every 5 to 7 years. Pigging operations would require limited excavation near the IGTS tie-in to access the pig launcher. In addition, daylighting other portions of the pipeline could be necessary if pigging operations indicated a need to inspect or repair the subsea pipeline. This excavation would be conducted using a submersible pump or by divers using hand-jetting or air-lifting equipment. At the conclusion of any required testing, the exposed pipeline would be backfilled. These activities would result in highly localized turbidity due to disturbance and suspension of seafloor sediments. As with the use of these specialized excavation methods during initial pipeline construction, these activities would not significantly affect water quality, and any impacts to water resources would likely be of short duration and extent. Therefore, potential impacts to water resources during periodic maintenance activities would be localized, minor, and temporary. Although infrequent, these maintenance activities could occur periodically throughout the life of the Project.

LNG Carrier

LNG carriers that would deliver LNG to the proposed FSRU would transit offshore waters before entering Long Island Sound to off-load cargo at the FSRU. Thus, LNG carrier activity could theoretically affect the water resources in the Atlantic Ocean, Rhode Island Sound, Block Island Sound, and Long Island Sound. The primary effect on water resources by LNG carriers would be the intake and discharge of cooling water. The cooling water requirements, however, are similar to those of all diesel- and steam-powered commercial vessels currently using the Sound (Blume 2006). While in transit offshore in the Atlantic Ocean, and within Rhode Island Sound, Block Island Sound, and Long Island Sound, LNG carrier operations and any resulting impacts to water resources would be comparable to typical shipping traffic, and would need to comply with international and U.S. shipping regulations. The primary carrier-related impacts to water resources would be associated with operational intakes and discharges while berthed at the FSRU. Each of these intakes and discharges are quantified in Table 3.2.3-3.

TABLE 3.2.3-3
LNG Carrier Intakes and Discharges While Berthed at the FSRU

Type of Intake	Volume of Intake (million gallons)	Volume of Discharge (million gallons)
Ballast Water		
145,000 m^3 LNG carrier (Steam-powered)	13.2	Not expected
250,000 m^3 LNG carrier (Diesel-powered)	25.6	Not expected
Cooling Water		
145,000 m^3 (Steam-powered)	57.2[a]	57.2[a]
250,000 m^3 (Diesel-powered)	18.6[b]	18.6[b]

[a] Broadwater provided this volume based on the approximate amount of time the steam-powered LNG carriers would be berthed to the FSRU.

[b] Broadwater provided this volume based on the approximate amount of time the diesel-powered LNG carriers would be berthed to the FSRU.

Ballast Water Intake

As with other large cargo ships, LNG carriers would take on ballast water to maintain stability and trim as they off-load their cargo, but they would not be fully loaded with ballast when departing Long Island Sound. The amount of ballast water required by each LNG carrier would vary according to its size and the weather conditions. A typical 145,000-m^3 LNG carrier would require approximately 13.2 millions gallons of ballast water, which also would support routine operational needs such as generation of freshwater and side-shell curtain. Ballast water would be obtained in Long Island Sound while off-loading LNG and then transported out of Long Island Sound. This would constitute a minor but recurring impact to the water resources of Long Island Sound.

Although LNG carriers loaded with LNG would not be expected to carry substantial ballast water when entering U.S. territorial waters or Long Island Sound, current regulations require that ballast water be exchanged at least 200 nautical miles offshore where the water depth is at least 660 feet (200 meters) prior to entering U.S. ports. In addition, ships must have onboard and adhere to a Ballast Water Management Plan and must maintain a Ballast Water Record Book to record the intake and discharge of ballast water (IMO 2004). As part of the International Convention for the Control and Management of Ships' Ballast Water and Sediments, the International Maritime Organization may institute more stringent requirements for the control of invasive organisms in ballast water, if the convention is ratified by at least 30 member states (only 8 have currently ratified it). Under the 2004 convention, all ships with ballast water capacity more than 5,000 m^3 (which would include all LNG carriers) would be required to follow Ballast Water Exchange and/or Performance Standards, which include testing to demonstrate that potentially harmful organisms either are not present or are present in very small quantities.

Although ballast water intake by the LNG carrier would occur during off-loading of the LNG, it is unlikely that any ballast water would be discharged into Long Island Sound. Any limited discharge of ballast water, if it were to occur, would be conducted in accordance with the Coast Guard's mandatory ballast water management program (33 CFR 151; Coast Guard 2006c).

Cooling Water Intake

In addition to ballast water, LNG carriers (as with other large ships) would intake and discharge some water during operations in Long Island Sound. Broadwater anticipates that the majority of LNG carriers off-loading at the proposed FSRU would be steam-powered vessels. Steam-powered vessels require more cooling water than comparably sized diesel-powered vessels. Broadwater estimates that a steam-powered LNG carrier moored at the proposed FSRU would intake and discharge approximately 2.6 mgh of seawater, or a total of 57.2 million gallons over the period during which the carrier would be berthed at the FSRU. The next generation of LNG carriers (larger and diesel powered) are estimated to require approximately 18.6 million gallons of cooling water while berthed at the FSRU.

Water Discharges

LNG carriers would discharge water associated with operation of the vessel (cooling water, freshwater generation, and reliquefaction for future diesel-powered LNG carriers) and water specifically associated with off-loading operations (side-shell curtain). Although various types of LNG carriers could off-load at the proposed FSRU, the greatest cooling water discharge would be associated with steam-powered carriers. Broadwater estimates that the discharged cooling water from the steam-powered LNG carrier would be 3.6°F higher than ambient water temperatures. Because the cooling water intake would be at ambient temperature, which is seasonally dependent, the increase in water temperature of the discharge would be expected to remain relatively constant (3.6°F) throughout the year. This estimate is similar to the elevated temperature in discharges from the carriers proposed in the Northeast Gateway

Project (4.7°F and 9.9°F greater than ambient); water temperatures were estimated to return to ambient levels within a mixing zone of 64 cubic yards, increasing surface water temperatures by less than 1°F (TetraTech 2005).

As discussed in Section 3.2.1.3, surface water discharges are not permitted if they would raise or lower ambient temperatures by more than 1.5•F if surface temperature is greater than 83•F between July and September, and the temperature of at least 50 percent of the cross sectional area or volume of the flow of the estuary must not be lowered or raised more than 4•F over the ambient temperature or to a maximum of 83•F whichever is less. At no time should the water temperature of the estuary exceed 90•F. Based on the current available information for average monthly temperatures, the discharge of cooling water from LNG carriers is not expected to exceed New York's water quality criteria for thermal discharges into estuaries (Table 3.2.1-2). By comparison, the thermal discharges from power plants in the area are significantly greater than those for the LNG carriers in volume and thermal discharge. Maximum discharge volumes from the Northport facility (Suffolk County, New York) and the Ravenswood Generating Station (Queens County, New York) are approximately two orders of magnitude greater than those for LNG carriers. More importantly, the permitted discharge temperature for these power plants is 92•F (Northport) to over 104•F (Ravenswood) according to EPA (EPA 2006c). The CTDEP tentatively intends to renew the Millstone NPDES permit, which would allow a maximum water temperature of 105•F in the discharge to Long Island Sound (CTDEP 2006b).

As is standard in the shipping industry, the cooling water for the LNG carriers would be injected with a low dose of biocide (expected to be sodium hypochlorite for LNG carriers) to prevent the growth of marine organisms. As with FSRU discharges, this residual chlorine concentration is not expected to significantly affect water quality. In addition, LNG carriers would not discharge onboard wastewater during off-loading operations at the FSRU, regardless of the LNG carrier type.

As stated previously, the next generation of LNG carriers is anticipated to be much larger (up to 250,000 m^3) and diesel powered, and would require less cooling water than steam-powered LNG carriers. Because none of these carriers have been constructed, all information regarding water use is an approximation. As with steam-powered LNG carriers, water used for cooling, reliquefaction, side-shell curtain, and freshwater generation would be discharged into Long Island Sound; and any impacts would be expected to be comparable or less than those described above for steam-driven LNG carriers.

The annual average daily volume of water that current steam-powered LNG carriers would intake would be 22.7 mgd while berthed at the FSRU, calculated as 13.2 mg of ballast water plus 57.2 mg of cooling water needed per carrier visit, multiplied by 118 carriers per year over 365 days. The annual average daily discharge of LNG carriers would be 18.5 million gallons, similarly calculated as 57.2 mg cooling water per carrier, multiplied by 118 carriers per year over 365 days. Impacts to water quality from current and future LNG carriers are expected to be minor. While the other water uses for the proposed Project would not reduce the volume of water in Long Island Sound, the LNG carriers would physically remove water from Long Island Sound and carry the water to sea as ballast water, which would constitute a minor but long-term impact.

Accidental Releases

Spills, leaks, or accidental releases of fuels, lubricants, or other hazardous substances during operation of the proposed Project could adversely affect water resources. In Section 3.2.2.1, we recommend that Broadwater provide an offshore-specific SPCC Plan. The offshore SPCC Plan would include a worst-case spill scenario, identify potential impacts, and specify measures to avoid and minimize impacts to water resources and marine life. Broadwater would implement its offshore SPCC Plan to minimize the likelihood of any release and to maximize the containment and cleanup of any accidental spills of fuels, lubricants, or solvents in an appropriate manner. For these reasons, any impacts to water resources from accidental releases would not be expected and, should they occur, would be minor and temporary. Information regarding potential impacts to water resources and other resources associated with an accidental release of LNG is provided in Section 3.10.

3.3 BIOLOGICAL RESOURCES

Most of the proposed Project facilities would be located in the middle of Long Island Sound. The FSRU would be located in the central basin, and the pipeline would extend from the central basin across Stratford Shoal to the tie-in with the IGTS pipeline in the western basin.

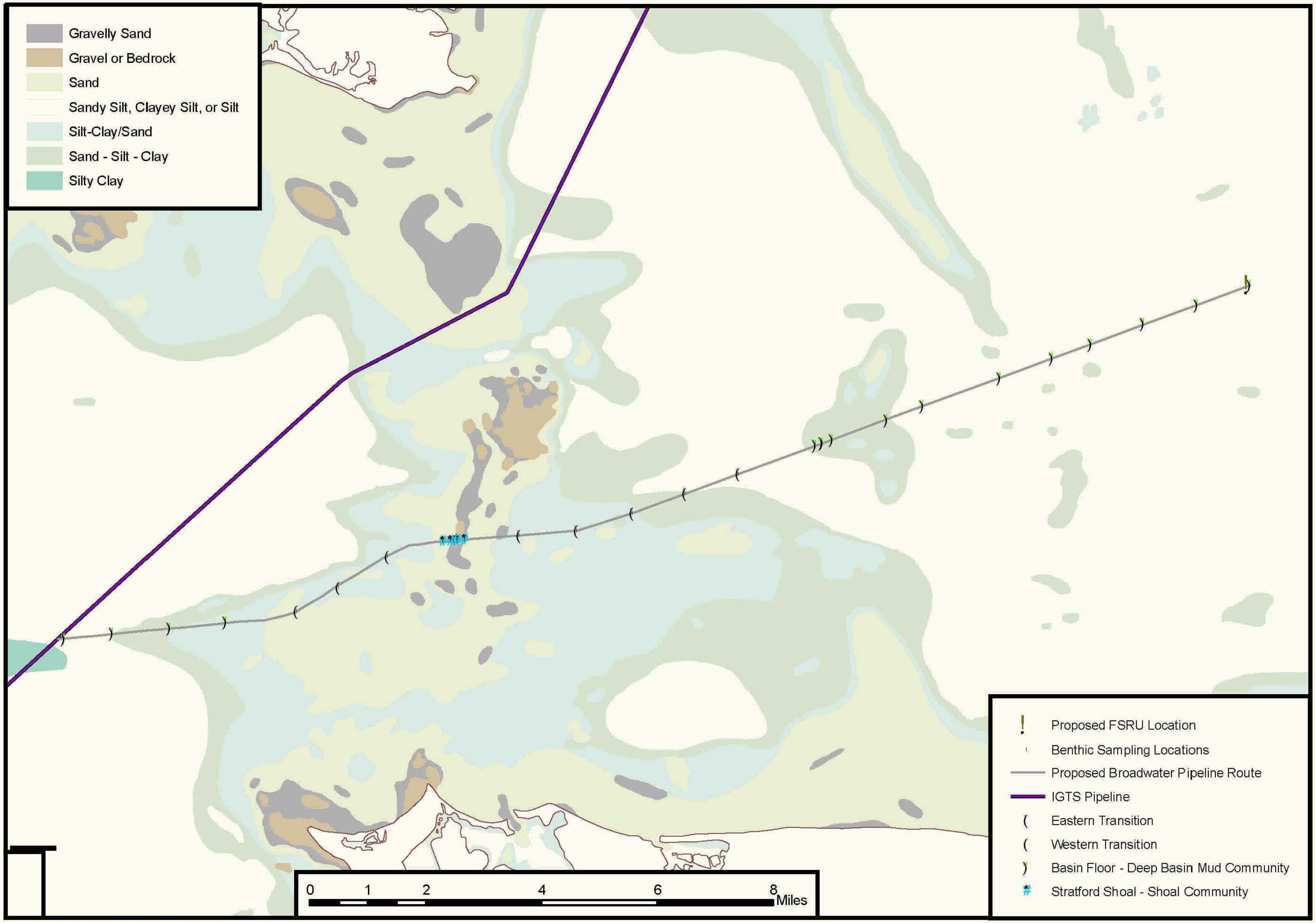
A minor onshore component of the Project would consist of an existing industrial dock and warehouse/office facility along the northern shoreline of Long Island. No new construction would be required for the onshore facility, with the possible exception of a guardhouse and chain-link fence constructed in existing developed areas. Potential biological impacts also could be associated with Project-related vessel traffic, including construction vessels, LNG carriers, and support vessels. These vessels primarily would operate in the offshore waters of Long Island Sound and the open seas, although some of the support vessels (tugs) would use the docking facilities at the onshore facility during construction and operation.

There would be no potential biological impacts to sensitive freshwater or estuarine wetlands, nearshore habitats (eelgrass or shellfish beds), freshwater streams or lakes, or terrestrial wildlife that is not already accustomed to an industrial setting. Therefore, the discussion of the existing biological setting and potential impacts to biological resources focuses on the benthic communities, finfish, marine mammals, and avian resources that could be affected by construction and operation of the proposed Project primarily in the offshore habitats of Long Island Sound.

3.3.1 Benthic Communities

3.3.1.1 Existing Environment

"Marine benthic communities" refers to the biological organisms that live in the sediment (infaunal community) or on the substrate (epibenthic species such as shellfish) in marine environments. Broadwater conducted quantitative benthic surveys in April and May 2005 to characterize the biological resources that utilize the seafloor along the proposed pipeline route. This survey also included videotaping the seafloor along the pipeline route and recording any organisms observed. The benthic communities that would be crossed by the proposed pipeline were divided into four general categories: a Deep Basin Mud Community, a Western Transition Community, a Shoal Community, and an Eastern Transition Community (Figure 3.3-1). The Deep Basin Mud Community occurs at the eastern and western ends of the proposed Project area. The Deep Basin Mud Community is characterized by substrates of fine silt and sand with patches of clay. Polychaetes, amphipods, and juvenile bivalves were the dominant organisms collected at these stations. The Western Transition Community is located in the western portion of the proposed Project area, between the western basin and Stratford Shoal. The substrate of the Western Transition Community is characterized by fine-grained silt. Pea crabs, tunicates, and polychaete worms were the dominant species found in this habitat. The Shoal Community is located at Stratford Shoal, and the substrate consists primarily of gravelly sand and bedrock substrates. Organisms that were reported along the proposed pipeline route in this area included a variety of bivalve, hydroid, amphipod, spider crab, whelk, shrimp, and polychaete species. The substrate in the Eastern Transition Community is made up of silt and sand. Benthic organisms found in this community consisted of polychaetes, burrowing anemones, tunicates, hydroids, amphipods, and bivalves.



Sources: USGS 2001, Broadwater surveys conducted in April and May 2005

Figure 3.3-1
Broadwater LNG Project
Benthic Communities along the Proposed Pipeline Route

Soft-sediment communities at all stations primarily consisted of burrowing and tube-dwelling polychaetes, amphipods, tunicates, and anemones. Several stations had evidence of burrows that may be used by lobsters, fish, and other invertebrates.

In addition to the infaunal communities, Long Island Sound is home to several species of shellfish. Many mollusk species typically are associated with nearshore habitats and would not be expected to be prevalent in the middle of Long Island Sound; no live individuals of hard clams, surf clams, or oysters were observed within the proposed Project area during the benthic video surveillance (HDR/LMS 2005). However, some species of mollusk, such as hard clams, have planktonic larval stages (or veligers). Hard clam veligers are planktonic and drift with the tides and currents. Veligers are abundant in the zooplankton in estuaries during summer (Stone et al. 1994). The veliger stage typically lasts about 7 to 30 days and ends with settlement (Stanley 1985).

Crustaceans that commonly inhabit the waters of Long Island Sound are the blue crab, lady crab, spider crab, rock crab, red crab, green crab, horseshoe crab, and American lobster. The crab species inhabit sand, rock, or mud. The benthic video survey documented shrimp, amphipods, polychaetes, tunicates, anemones, horseshoe crabs, a spider crab, a whelk, and two species of fish (one in the family Gadidae and a juvenile flatfish).

Of these epibenthic species, the one generally considered of most interest in the deeper waters of Long Island Sound is the American lobster due, in part, to its importance to the local commercial fishery. Eggs, juveniles, and adult American lobster can be highly abundant in Long Island Sound throughout the year. Larvae are abundant or highly abundant between May and August (Stone et al. 1994). Initially, young American lobster float or are free-swimming larvae prior to settling to the seafloor as juveniles (MacKenzie and Moring 1985). The early benthic phase (EBP) lifestage is a series of juvenile lobster stages that spans several years. Juvenile lobsters in the shelter-restricted stage remain in their shelters 100 percent of the time, feeding on plankton and other benthic organisms found in or at the mouth of their shelters. The large majority of EBP lobsters are located in burrows of inshore waters less than about 33 feet (10 meters) deep, although some could be located at the greater depths found within the Project area (Lawton and Lavalli 1995, Palma et al. 1998). As they mature, lobsters begin to forage outside of their shelter for limited amounts of time (Lawton and Lavalli 1995). Juvenile lobsters become adults when they are physiologically and sexually mature. Adults are commonly found in waters between about 33 and 1,050 feet deep, and prefer sand habitat with rock or cobble as cover (McRae 1960). Adult lobsters are found in the deeper waters of Long Island Sound throughout the year, although some may migrate to offshore waters in winter (Stone et al. 1994, Lawton and Lavalli 1995). In fall 1999, a massive die-off of lobsters in Long Island Sound has been attributed to above-average water temperatures and low DO levels near the seafloor, storm events, parasites, and possibly chemicals sprayed to control mosquitoes. In recent years, there are indications that the stock is recovering; but abundance is reported to be about 70 percent below the long-term average (Gottschall et. al 2006). .

3.3.1.2 Potential Impacts to Benthic Communities and Mitigation

Construction

FSRU

The proposed FSRU would be fabricated at an existing industrial facility overseas and towed to Long Island Sound. Therefore, the only potential impacts of proposed FSRU construction to the aquatic resources of Long Island Sound would be the potential for introduction of exotic species in the ballast water and impacts from the use of anti-fouling paint. As discussed in Section 3.2.3.1, Broadwater would exchange ballast water in the proposed FSRU in the open ocean before entering Long Island Sound to avoid potential impacts associated with ballast water.

As is common for marine vessels and structures, Broadwater proposes to initially use anti-fouling paint on the FSRU hull to retard biological growth on the surface of the FSRU prior to towing to Long Island Sound. Anti-fouling paints are toxic to marine life and can be absorbed by marine fish and shellfish. Anti-fouling paints retard biological growth by leaching copper, which prohibits attachment of organisms. Anti-fouling paint would be applied to the proposed FSRU hull at the shipyard outside the United States and would not be reapplied to the FSRU during the life of the Project. As described in Section 3.2.3.1, Broadwater reported that the concentration of copper in the water column would be less than the EPA chronic and acute standard (EPA 2003a). Due to the hydrodynamic nature of Long Island Sound and the standard use of anti-fouling paint in the industry, it is anticipated that the copper concentrations from anti-fouling paint would not result in a measurable impact to the water quality or aquatic organisms of Long Island Sound.

YMS

Potential impacts to the benthic community from proposed YMS installation could include direct disturbance of benthic habitat and impacts from the use of anti-fouling paint.

Construction of the proposed YMS initially would result in disturbance of approximately 0.8 acre of benthic habitat due to the footprint of the YMS itself (0.3 acre) and anchoring during installation (<0.5 acre). This would include installation of pilings to secure the structure to the seafloor and the physical structure of the proposed YMS itself, including the YMS legs and a mud mat. Although the footprint of the tower is 0.3 acre, the actual contact with the bottom by the pilings and jackets would likely result in the long-term conversion of less than 0.3 acre of softbottom habitat to hard structure. A mud mat consisting of a latticework of untreated lumber would be required to keep the proposed YMS intact and stable during installation on the seafloor. During installation, the mud mat would be pressed into the seafloor within the footprint of the proposed YMS. This would initially result in injury and mortality of some benthic organisms occupying the YMS and anchor footprints. Impacts to benthic habitat associated with installation of the YMS would be insignificant because of the relatively small area affected and the relatively rapid recovery of the softbottom community following installation within most of the YMS footprint. Impacts to the benthic community from installation of the pilings and YMS legs would be minor, but it is estimated that approximately 0.1 acre of softbottom habitat would be converted to hard substrate for at least the life of the Project. This conversion would result in a minor adverse impact on the softbottom community and could benefit epibenthic species that prefer the habitat provided by hard substrate.

Broadwater proposes to apply anti-fouling paint to the YMS prior to installation in Long Island Sound. Similarly, Broadwater would not reapply anti-fouling paint to the YMS throughout the life of the Project, and no measurable impact to aquatic organisms would be expected with the use of anti-fouling paint on the YMS. As described in Section 3.2.3.1, the cumulative leaching of copper from the anti-fouling paint on the FSRU and YMS into the water column would be less than the EPA water quality criteria and would therefore not significantly alter the water quality or harm aquatic organisms in the Project area.

Pipeline

Potential impacts to the benthic and epibenthic community from the proposed pipeline installation could include direct disturbance of the seafloor habitat and increased turbidity and sedimentation.

Direct Disturbance of Benthic Habitat. Installation of the pipeline, as proposed by Broadwater, would directly disturb a total of 2,235.5 acres of seafloor from the use of anchors (cable sweep and anchor footprints) and trenching along the seafloor. Approximately 90 percent of this acreage would be affected by cable sweep (2,020 acres), and we have included a recommendation in Section 3.1.2.2 for Broadwater to use mid-line buoys or a dynamically positioned lay barge to virtually eliminate this impact. Anchors and trenching would directly affect the seafloor, and most sessile invertebrates and some mobile invertebrates could suffer mortality within the approximately 215.5 acres that would be directly affected. Of this total, plowing and specialized trenching methods would directly affect approximately 197.3 acres of the seafloor, with the large majority affected by plowing (179.1 acres). This impact generally would include the 25-foot-wide trench and a 25-foot-wide spoil pile on either side of the trench. Broadwater proposes to utilize the subsea plow as the primary means to install the proposed pipeline. This technology is recommended by NOAA for reducing damage to the seafloor and greatly reducing recovery time (NOAA 2005a). The anchor footprint during pipeline installation would total approximately 16 acres of seafloor impact. Based on the weight of the anchors and the predominantly soft substrate, it is anticipated that anchoring would result in loss of the benthic community within the anchoring footprint during construction.

Recovery of the benthic communities disturbed by trenching and anchoring would occur at varying rates following construction, dependent on a variety of environmental parameters and the severity of the impact. Larger mobile species and lifestages that move away during active construction likely would return to the area when construction was completed. Epifaunal sessile components and infaunal communities would take longer to recover. Newell et al. (1998) reviewed dredging impacts to benthic communities and indicated that, although a variety of environmental parameters affect benthic recovery rates, some general recovery time frames are associated with habitat type. Disturbed muds, like those along most of the proposed pipeline route, typically recover within 1 year whereas sands and gravels can take from 2 to 3 years to recover – and even longer where rare slow-growing components are present. Post-construction monitoring for the Cross Sound Cable across Long Island Sound conducted within 6 months after construction found that the benthic habitat in the offshore waters along the cable route was not discernibly different from benthic habitats outside of the cable route (OSI 2003). Although the cable installation was conducted using different methods than proposed for the Broadwater Project, the cable generally was installed to a depth of 6 feet.

The IGTS pipeline is another linear project installed across Long Island Sound. The pipeline was installed in 1991, and the IGTS pipeline route was surveyed in 1993 and 1999 to assess benthic recovery (TFOLIS 2003). Although there have been reports of long-term impacts to the seafloor in nearshore shellfish beds along the portion of the IGTS pipeline route that was dredged, the results of these offshore surveys showed that natural sediment transport and infilling covered the offshore pipeline within 1 or 2 years of installation in those areas where the pipeline was installed by plowing through clay sediments.

Installation of the Eastchester Expansion Pipeline Project in Long Island Sound used a subsea plow as is proposed by Broadwater. Although benthic recovery was not monitored following construction of the Eastchester Expansion Pipeline Project, the results of post-construction monitoring are worth noting because the Eastchester Expansion Project included mechanical backfilling methods. Post-construction monitoring of the bathymetry along the Eastchester Expansion route has shown that attempts at mechanically backfilling the trench were not successful and that natural backfilling of the trench had not substantially occurred along most of the pipeline route approximately 18 months after installation. No information is available related to the success of recolonization of the benthic community along the Eastchester route.

Broadwater proposes to allow most of the trench (19 miles) to naturally backfill and has reported that natural backfilling would fill most of the trench within 1 year and virtually the entire trench within

3 years. Due to the differences among post-construction monitoring reports and concern about potential impacts of an open trench and exposed pipeline during natural backfilling, we have recommended that Broadwater develop plans to successfully backfill the trench with excavated spoil material immediately following pipeline installation and to conduct post-construction monitoring in coordination with appropriate federal and state resource agencies (Section 3.1.2.2). With implementation of this recommendation, it is expected that impacts to disturbed benthic communities along the proposed pipeline route would be short term; recovery would be expected to begin immediately following construction, and recolonization of various benthic communities is expected to require from a few months to up to 1 to 2 years.

Similarly, active backfilling of the trench would be expected to accelerate recovery of the benthic habitat affected by spoil placement along the trench. Impacts and recovery within dredge spoil areas from Long Island Sound to Maine have been documented by the COE's Disposal Area Monitoring System program. Several monitoring reports have documented rapid recolonization of the dredge disposal mounds with infaunal assemblages (SAIC 2001a, 2001b, 2001c). Initial mound recolonization typically occurs within a few months and is completed within a few years. Thus, recovery of the spoil area for the Broadwater pipeline corridor would be expected to initiate shortly after active construction and be complete from within a few months to up to 1 to 2 years.

Broadwater has proposed to actively backfill a little more than 2 miles of the trench with imported rock material, specifically including the IGTS tie-in, valves, and the 2 miles of pipeline closest to the FSRU. Broadwater proposes to use concrete armoring at the proposed utility crossings and potentially at Stratford Shoal (as an alternative crossing method). Backfilling portions of the trench with rock would convert the surface substrate for approximately 6.6 acres of benthic habitat, including 2 miles of the pipeline trench nearest the FSRU (6.1 acres) and the IGTS and FSRU tie-ins (0.5 acre). This does not include the alternative use of rock to backfill the trench across Stratford Shoal in the event that plowing is not feasible (which would convert up to about 5 acres of benthic habitat). It should be noted that the potential conversion of seafloor substrate at Stratford Shoal would consist of converting the existing substrate, primarily rock and gravel, to imported rock and/or gravel. We have included a recommendation in Section 3.1.2.2 for Broadwater to develop contingency plans for the use of any alternative methods for crossing Stratford Shoal to avoid and minimize potential impacts. Concrete armoring at the proposed utility crossings could affect approximately 0.8 acre. Areas that could be backfilled with clean rock or covered with concrete mats would permanently convert the seafloor from softbottom to rock substrate or concrete. While the conversion to hard substrate would adversely impact the softbottom benthic community, the introduction of rock substrate or concrete mats would improve habitat diversity and could increase habitat for some epibenthic species. It is expected that the hard substrate provided by the concrete armoring would provide additional habitat for species such as oysters, barnacles, and mussels. In addition, the concrete armoring could provide cover for lobsters and species such as tautog.

Turbidity and Sedimentation. Installation of the proposed pipeline also could indirectly impact benthic communities due to increased turbidity and sedimentation during and immediately following construction. The majority of the proposed pipeline would be installed with a subsea plow. A specialized method of manual excavation by divers or submersible pumps would be used at the IGTS tie-in, proposed FSRU tie-in, and two utility crossings. Fine-grained sediments would be more likely to be suspended into the water column when disturbed than coarser-grained sediments. As described in Section 3.2.3.1, sediment transport modeling was conducted to determine the extent of turbidity and sedimentation as a result of installation of the proposed pipeline. Results of the sediment transport modeling showed that the turbidity (measured as total suspended solids or TSS) would occur in the lower portion of the water column during active plowing and would be assimilated into Long Island Sound within about 12 hours of sediment disturbance. Impacts from excavation activities associated with the specialized manual excavation methods also were modeled by Broadwater. The model results showed no discernible increase above ambient conditions throughout the entire water column. As discussed in Section 3.2.3.1, Broadwater has proposed to monitor turbidity during construction using optical backscatter techniques, ADCP profiling, and collection of turbidity grab samples. The exact locations, frequency, and potential turbidity concentrations of concern would be determined in coordination with NYSDEC as part of the SPDES permitting process.

Broadwater also has conducted modeling to determine the amount of sediment deposition along the proposed pipeline route. Modeling results showed that sediment deposition outside of the 75-foot-wide corridor consisting of the trench and adjacent spoil areas would be less than 0.2 inch, and that deposition would be no greater than 0.1 inch more than 300 feet from the proposed pipeline route. According to Nichols et al. (1978), infaunal organisms in softbottom sediments can survive burial up to a depth of about 4 inches. Therefore, impacts to benthic organisms from sedimentation would be minor.

Based on the construction methods, monitoring procedures, and implementation of our recommendations, any Project-related increases in turbidity would be minor, and any increased concentrations above naturally occurring conditions would be readily assimilated into Long Island Sound.

Effects on Epibenthic Resources. In addition to the benthic community, pipeline installation could affect epibenthic resources such as shellfish. Due to the softbottom habitat, the dominant shellfish species along the majority of the pipeline route is the American lobster. Construction of the proposed Broadwater Project could affect various lifestages of lobsters. The potential impacts to lobsters would depend on the lifestages present in the construction area during the time of construction.

Because pipeline installation would occur during fall to early spring, no larval lobster would be present in Long Island Sound during construction. Juvenile or EBP lobsters primarily are located in shallow waters less than about 30 feet deep. Adult lobsters and any EBP lobsters present along the pipeline route during construction could be injured or suffer mortality during trenching and anchoring activities if the lobsters did not avoid construction activity. The plow would slowly push sediment from the trench onto the seafloor adjacent to the trench. The subsea plow would advance at approximately 1 to 3 miles per day. The slow rate of advancement and the sidecasting of the spoil may allow mobile organisms, such as adult lobsters, to escape impact. Installing the pipeline during winter would avoid impacts to a portion of the adult lobster population because they would have migrated offshore. However, the adult lobsters that overwinter in Long Island Sound may tend to be largely inactive due to colder water temperatures, which could inhibit their ability to avoid the construction activity. While densities would be expected to be low in the deeper waters of Long Island Sound, EBP lobsters within the construction corridor likely would be lost because EBP lobsters tend to reside in burrows and would not likely escape construction activities. Proposed trenching would directly affect substantially less than 0.1 percent of the seafloor of Long Island Sound.

Excavated materials have been documented to attract lobsters (Morton et al. 1985). Therefore, it is possible that lobsters could occupy the spoil mounds created by the plowing and then be affected when the spoil is pushed back into the trench to bury the proposed pipeline. Broadwater has proposed to backfill the trench in the vicinity of the FSRU and the tie-in to the IGTS pipeline, and we have included a recommendation in Section 3.1.2 that Broadwater actively backfill the remaining length of the pipeline instead of allowing it to naturally backfill. Broadwater indicates that its proposed backfilling would be completed within 25 days of trenching. It is unlikely that a significant number of lobsters would occupy the spoil mounds in this short time frame, especially because construction would occur during winter when many lobsters have left Long Island Sound, and the lobsters that remain would tend to be inactive. However, those lobsters that did occupy the mounds could suffer injury or mortality activities if they did not evacuate the area during backfilling operations. Although we have included a recommendation to reduce seafloor impacts by at least 90 percent using mid-line buoys, any lobsters in the direct area of anchor placement likely would also suffer mortality.

Overall, injury or mortality to adult lobsters could result from proposed pipeline construction, which could result in a short-term local reduction in lobsters in the immediate vicinity of the pipeline route. However, no significant impact to the lobster population is anticipated due to the timing of the proposed construction (fall to early spring) and the relatively small size of the construction footprint (substantially less than 0.1 percent of the available habitat in Long Island Sound).

In addition to using the softbottom habitat along the majority of the pipeline, lobsters and other epibenthic organisms inhabit the gravel-cobble habitat of Stratford Shoal. This type of complex substrate is preferred by EBP lobsters. Broadwater has stated that dredging may be necessary to cross Stratford Shoal, if initial plowing attempts are unsuccessful. We have included a recommendation in Section 3.1.2.2 that Broadwater develop contingency plans that specify methods, potential impacts, and appropriate mitigation to avoid and minimize impacts in the event that plowing is not feasible across Stratford Shoal. If dredging was conducted, Broadwater estimates that an approximately 4,000-foot-long trench would be excavated across Stratford Shoal, using either a long-arm excavator or a clamshell dredge. The excavated trench would measure approximately 54 feet wide at the top. The trench material would be removed to a hopper barge and disposed of at an approved dredge disposal area. After pipeline installation, the trench would be backfilled with clean rock or gravel. As with the standard trenching methods, any lobsters in the construction corridor at Stratford Shoal could be injured or killed. Due to the construction timing and the small area of the Stratford Shoal that would be crossed by the proposed Project (5 acres or less), any impacts to the lobster population would be localized and negligible.

Operation

FSRU

FSRU operations would be expected to have little to no impact on benthic resources. Minimal impacts could be associated with the physical presence of the proposed Project and associated safety and security zone, and potential impingement/entrainment of larval lifestages of benthic species. The presence of the FSRU and YMS would result in a minor but permanent conversion of the mud and silt seafloor to an area of hard substrate, and would introduce vertical structure and shade into the open waters of Long Island Sound. These introduced features would result in establishment of a small-scale artificial reef habitat. It is possible that the exclusion of fishing vessels and lobster pots within the 1.5-square-mile safety and security zone surrounding the YMS and FSRU would allow lobster populations in this general area to increase, but the area would be small compared to the area of the Sound, and there would be no tangible underwater boundaries to impede the movement of these organisms. While the existence of the safety and security zone theoretically could result in a highly localized increase in abundance, it is not anticipated that it would result in a measurable increase in biological populations in Long Island Sound. Potential impacts on commercial and recreational fishing are discussed in Section 3.5.5.2.

Since larval stages of mollusks (veligers) are planktonic, they could be affected by impingement/ entrainment during standard FSRU operations. However, potential impacts to larval mollusk are expected to be minimal because they are planktonic for only approximately 7 to 30 days during the summer months (May to September) (Stanley 1985, Stone et al. 1994). More importantly, the annual water intake for the proposed Project would total less than 0.1 percent of the water volume in the central basin. Thus, the intake of planktonic organisms would be expected to be approximately 0.1 percent of the standing stock in the basin, assuming that densities were equal throughout the water column and the basin. In reality, some plankton species would be expected to be at homogeneous densities throughout the water column, but many other plankton species and lifestages would be expected to be at relatively low densities in the middle of the water column where the water intakes would be located. Therefore, no significant changes to plankton populations or lifestages are expected to occur in the area of the FSRU. Potential impacts to ichthyoplankton and lobster larvae are discussed in Section 3.3.2.

YMS

Broadwater has not stated whether or not the YMS would be abandoned in place or removed from Long Island Sound during decommissioning of the proposed Project. If the YMS was abandoned in place, there would be a permanent loss of approximately 0.1 acre of softbottom habitat.

The exposed riser extending from approximately the top of the YMS to the buried pipeline at the base of the YMS would allow thermal exchange between the vaporized natural gas contained within the riser and seawater passing the exposed pipe. Modeling conducted by Broadwater indicates that the temperature of the seawater would be as much as 3•F greater than ambient temperatures within 35 inches of the riser, and would decline to less than 0.5•F above ambient water temperatures within 40 inches of the riser. This marginal temperature increase in a discrete area would not significantly alter the habitat conditions of Long Island Sound, especially related to the benthic community.

Pipeline

Potential impacts to the benthic community from proposed pipeline operations could include resuspension of sediments during maintenance activities and thermal impacts along the pipeline.

Proposed general pipeline maintenance would require limited daylighting of the buried facilities in the vicinity of the IGTS tie-in, using a submersible pump or hand-jetting or air-lifting equipment. It is expected that general maintenance of the pipeline would occur once every 5 to 7 years. Depending on the results of the periodic inspections, there could be infrequent daylighting at other specific locations along the pipeline for maintenance purposes. These activities would result in localized disturbance of the benthic habitat and redistribution of sediments. Any turbidity impacts would be infrequent and temporary if they did occur. Direct impacts to the benthic habitat would be very localized, but recovery could take from a few months to up to 1 to 2 years.

Theoretically, heat dissipation from the subsea pipeline could result in impacts to surrounding benthic communities during the period of natural backfilling as proposed by Broadwater. According to Broadwater, the temperature of the gas traveling through the concrete-coated pipeline could range from 130°F near the FSRU to around 50°F at the IGTS pipeline. Dissipation of heat to sediments or water surrounding the proposed pipeline could alter the benthic community. Broadwater estimated that, with a covered trench, the temperature of the seafloor in contact with seawater would not be measurably different than undisturbed sediments. Although temperatures within the top 6 inches of sediment could be a few degrees warmer, this slight increase in temperature would not be expected to have any measurable impact on the benthic community. To avoid potential impacts of an open trench and exposed pipeline to marine resources, we have included a recommendation in Section 3.1.2.2 that Broadwater mechanically backfill the pipeline trench and conduct post-construction monitoring. Therefore, no potential impacts to the benthic community would be expected during pipeline operations, except for those associated with infrequent maintenance.

3.3.2 General Fisheries Resources

3.3.2.1 Existing Environment

Three general fisheries resources are within the proposed Project area: finfish communities, ichthyoplankton communities, and plankton communities.

Finfish

Long Island Sound is home to numerous finfish species of significant ecological, commercial, and recreational value. Although at least 96 finfish species are known to occupy Long Island Sound, only a few species (for example, tautog) are considered year-round residents (Gottschall et al. 2000, 2005). Most finfish species, such as striped bass, bluefish, and scup, migrate through the region in response to seasonal fluctuations in water temperature, salinity, and access to spawning and nursery grounds in Long Island Sound (Gottschall et al. 2000). Table 3.3.2-1 lists the finfish species that have been collected in Long Island Sound during the Long Island Sound Trawl Surveys (LISTS) between 1984 and 2004.

TABLE 3.3.2-1
Finfish Species Collected during Long Island Sound Trawl Surveys (LISTS) from 1984 to 2004[a]

Common Name	Scientific Name
Anchovy, bay	*Anchoa mitchilli*
Anchovy, striped	*Anchoa hepsetus*
Banded rudderfish	*Seriola zonata*
Bass, striped	*Morone saxatilis*
Bigeye	*Priacanthus arenatus*
Bigeye, short	*Pristigenys alta*
Black sea bass	*Centropristes striata*
Bluefish	*Pomatomus saltatrix*
Bonito, Atlantic	*Sarda sarda*
Butterfish	*Peprilus triacanthus*
Cod, Atlantic	*Gadus morhua*
Cornetfish, red	*Fistularia petimba*
Croaker, Atlantic	*Mircopogonias undulatus*
Cunner	*Tautogolabrus adspersus*
Cusk-eel, fawn	*Lepophidium profundorum*
Cusk-eel, striped	*Ophidion marginatum*
Dogfish, smooth	*Mustelus canis*

TABLE 3.3.2-1 (continued)
Finfish Species Collected during Long Island Sound Trawl Surveys (LISTS) from 1984 to 2004[a]

Common Name	Scientific Name
Dogfish, spiny	*Squalus acanthius*
Eel, American	*Anguilla rostrata*
Eel, conger	*Conger oceanicus*
Filefish, orange	*Aluterus schoepfi*
Filefish, planehead	*Monacanthus hispidus*
Flounder, American plaice[b]	*Hippoglossoides platessoides*
Flounder, fourspot	*Paralichthys oblongus*
Flounder, smallmouth	*Etropus microstomus*
Flounder, summer	*Paralichthys dentatus*
Flounder, windowpane	*Scophthalmus aquosus*
Flounder, winter	*Pseudopleuronectes americanus*
Flounder, yellowtail	*Pleuronectes ferrugineus*
Glasseye, snapper	*Priacanthus cruentatus*
Goatfish, dwarf	*Upeneus parvus*
Goatfish, red	*Mullus auratus*
Goby, naked	*Gobiosoma bosci*
Goosefish	*Lophius americanus*
Grubby	*Myoxocephalus aeneus*
Gunnel, rock	*Pholis gunnellus*
Haddock	*Melanogrammus aeglefinus*
Hake, red	*Urophycis chuss*
Hake, silver	*Merluccius bilinearis*
Hake, spotted	*Urophycis regia*
Herring, alewife	*Alosa pseudoharengus*
Herring, Atlantic	*Clupea harengus*
Herring, blueback	*Alosa aestivalis*
Herring, round	*Etrumeus teres*
Hogchoker	*Trinectes maculatus*
Jack, crevalle	*Caranx hippos*
Jack, yellow	*Caranx bartholomaei*
Kingfish, northern	*Menticirrhus saxatilis*
Lamprey, sea	*Petromyzon marinus*
Lizardfish, inshore	*Synodus foetens*
Lookdown	*Selene vomer*

TABLE 3.3.2-1 (continued)
Finfish Species Collected during Long Island Sound Trawl Surveys (LISTS) from 1984 to 2004[a]

Common Name	Scientific Name
Lumpfish	*Cyclopterus lumpus*
Mackerel, Atlantic	*Scomber scombrus*
Mackerel, Spanish	*Scomberomorus maculatus*
Menhaden, Atlantic	*Brevoortia tyrannus*
Moonfish	*Selene setapinnis*
Ocean pout	*Macrozoarces americanus*
Oyster toadfish	*Opsanus tau*
Perch, white	*Morone americana*
Pipefish, northern	*Syngnathus fuscus*
Pollock	*Pollachius virens*
Pompano, African	*Alectis ciliaris*
Puffer, northern	*Sphoeroides maculatus*
Rockling, fourbeard	*Enchelyopus cimbrius*
Salmon, Atlantic	*Salmo salar*
Sand lance, American	*Ammodytes americanus*
Sandbar (brown) shark	*Carcharhinus plumbeus*
Scad, bigeye	*Selar crumenophthalmus*
Scad, mackerel	*Decapterus macarellus*
Scad, rough	*Trachurus lathami*
Scad, round	*Decapterus punctatus*
Sculpin, longhorn	*Myoxocephalus octodecemspinosus*
Scup	*Stenotomus chrysops*
Sea raven	*Hemitripterus americanus*
Seahorse	*Hippocampus* sp.
Sea robin, northern	*Prionotus carolinus*
Sea robin, striped	*Prionotus evolans*
Sea snail	*Liparis atlanticus*
Sennet, northern	*Sphyraena borealis*
Shad, gizzard	*Dorosoma cepedianum*
Shad, hickory	*Alosa mediocris*
Sharksucker	*Echeneis naucrates*
Silverside, Atlantic	*Menidia menidia*
Skate, barndoor	*Dipturus laevis*
Skate, clearnose	*Raja eglanteria*

TABLE 3.3.2-1 (continued) Finfish Species Collected during Long Island Sound Trawl Surveys (LISTS) from 1984 to 2004[a]	
Common Name	**Scientific Name**
Skate, little	*Leucoraja erinacea*
Skate, winter	*Leucoraja ocellata*
Smelt, rainbow	*Osmerus mordax*
Spot	*Leioxtomus xanthurus*
Stingray, roughtail	*Dasyatis centroura*
Sturgeon, Atlantic	*Acipenser oxyrhynchus*
Tautog	*Tautoga onitis*
Tomcod, Atlantic	*Microgadus tomcod*
Triggerfish, gray	*Balistes capriscus*
Weakfish	*Cynoscion regalis*

[a] Source: Gottschall et al. 2005.

[b] American plaice was recorded for the first time during the 2004 LISTS.

The abundance of adult and juvenile finfish in Long Island Sound increases from April to October, with two notable peaks in May and October (Gottschall et al. 2000). Finfish abundance is consistently higher in the western and central basin of the Sound compared to the eastern basin. In addition, seasonal trends in abundance and distribution patterns vary for demersal (bottom-dwelling) and pelagic (water column-dwelling) finfish. Demersal finfish abundance peaks in May and then declines through summer as water temperatures warm in the Sound. In contrast, pelagic finfish abundance is relatively low during spring, increasing throughout the summer as water temperature rises, and peaking in October. Therefore, the general finfish assemblage in Long Island Sound varies between a cold water demersal assemblage and warm water pelagic migrants.

Ichthyoplankton

The vast habitat diversity in Long Island Sound supports a thriving ichthyoplankton community. The term "ichthyoplankton" generally refers to the egg and larval lifestages of finfish. Ichthyoplankton data specific to the deeper waters of Long Island Sound are limited. The most appropriate existing data are from the New York Power Authority's 2002 Poletti Ichthyoplankton Program and Broadwater's site-specific ichthyoplankton surveys conducted in 2005 and 2006. The Poletti Ichthyoplankton Program collected data on the distribution of fish eggs and larvae in Long Island Sound between March and August 2002 (PBS & J/LMS 2003). The study area for the Poletti Ichthyoplankton Program was divided into 10 regions. Data from Regions 7 through 9 specifically represent central Long Island Sound and were used to assess the general ichthyoplankton community in the vicinity of the proposed Project. Each of the regions was divided into three strata (shallow, intermediate, and deep), depending on the depth of the water column from the water surface to the seafloor. Specifically, the shallow stratum consisted of areas in Long Island Sound where the water column depth was up to 20 feet (surface to seafloor). The intermediate stratum included areas where the seafloor depth was 20 to 98 feet below the water surface, and the deep stratum included all areas where the distance between the water surface and the seafloor was over 98 feet. Sampling within each stratum was collected at three depths (near surface, mid-depth, and near bottom). However, because the samples from the three depths and from the various sampling locations within a region were composited into one sample prior to laboratory identification, the results cannot be used to assess species density or diversity at a specific depth in the water column or a specific location within the region. Sampling for the Poletti Ichthyoplankton Program was conducted during daylight hours on a biweekly basis.

The seafloor at the proposed FSRU location (about 95 feet) is approximately the depth that delineated the intermediate stratum and the deep stratum in the Poletti study (98 feet). While we reviewed the results for both the intermediate stratum and the deep stratum, we believe the deep stratum is the most technically valid one for assessment related to the proposed Project because the pelagic and demersal fisheries community at the proposed FSRU would be expected to be better categorized as an open, deep water community rather than a combination of both relatively shallow and deep water communities that would be included in the intermediate stratum (20 to 98 foot depth to seafloor) of the Poletti study. Therefore, the following discussion focuses on the results for the deep stratum except as noted.

In general, the survey found that the fish eggs were most abundant in spring (April to early June) and decreased through the last survey of the sampling program in early August. Mean larval density was lowest during the first survey in early to mid-March, peaked in mid- to late-June, and then decreased through the end of the sampling program.

Mean egg and larval densities from deep stratum sampling sites peaked at approximately 5,000/1,000 m^3 and 11,000/1,000 m^3, respectively. Although eggs for at least 23 species were collected during the study (all strata) in the central basin, six species comprised over 90 percent of the eggs (weakfish/scup, fourbeard rockling, tautog, sea robin, Atlantic menhaden, and windowpane flounder). Larvae were collected representing at least 45 species, but approximately two-thirds of the larvae collected were Atlantic menhaden (42.2 percent), scup (12.2 percent), and tautog (12.1 percent).

While the results of the Poletti study are useful for identifying the general seasonal occurrence and relative abundance for the central basin of Long Island Sound, they may not be as useful for estimating the potential ichthyoplankton impacts of the proposed water intakes at the proposed Project location for a variety of reasons. The Poletti study composited collections from various depths, which could overestimate the proportion of the ichthyoplankton that could be affected by mid-depth water intakes because mid-depth densities tend to be less than those near the surface or possibly the bottom. Similarly, there was no sampling between early August and March, when densities and diversity of ichthyoplankton typically are lower than in late spring and summer. In addition, sampling was conducted only during daylight, and depth distribution and relative abundance may vary at night. Lastly, some sampling locations included in the Poletti study were relatively distant from the proposed Project.

As a result, Broadwater conducted six ichthyoplankton surveys between August 2005 and May 2006. The surveys included collecting site-specific samples at discrete depth intervals as well as sampling during both day and night, to better address some of the shortcomings of the Poletti survey as they relate to potential impacts of the proposed Project. The sampling area consisted of a square-nautical-mile block centered on the location of the proposed FSRU. Three random stations were selected, and three depth strata were sampled: near surface (0 to 30 feet), mid-depth (35 to 65 feet), and near bottom (70 to 95 feet). One ichthyoplankton tow was collected during the daytime and one at nighttime for each depth strata and at each station. This resulted in a combined total of 18 samples for each quarterly survey.

The results of the Broadwater survey showed that species diversity and abundance dropped markedly between summer and fall, with almost no ichthyoplankton present in winter at any of the three depth intervals. Diversity and abundance had increased significantly by mid-spring. In August, 14 species were collected. The catch was dominated by bay anchovy, which accounted for approximately

80 percent of all eggs and larvae collected. Bay anchovy abundance was approximately an order of magnitude higher in the night-time surveys compared to those during the day. Over 95 percent of the catch was composed of anchovy, smallmouth flounder, butterfish, and sea robin. The mid-depth sampling interval would be most representative of the ichthyoplankton that would be affected by the proposed Project, and day and night densities in this sampling interval averaged about 750 eggs per 1,000 m^3. Larval densities averaged about 6,240 per 1,000 m^3.

By October, ichthyoplankton abundance had decreased by about an order of magnitude compared to late August. Only three species were collected (Atlantic menhaden, bay anchovy, and feather blenny). Average mid-depth densities were 117 eggs per 1,000 m^3 and about 493 larvae per 1,000 m^3. In February, only two fourbeard rockling eggs were collected (1 per 1,000 m^3). Larvae of six species were collected, with 98 percent of the catch composed of sand lance (86.6 percent) and rock gunnel (11.7 percent). Larval density was less than 2 percent of the densities recorded in August (February averaged 94.5 larvae per 1,000 m^3).

In February and March, relatively few species were collected compared to the August and October surveys. In February, only 2 eggs in total were collected, both of which were fourbeard rockling eggs, and 99 percent of the larvae were American sand lance and rock gunnel. Average mid-depth diversity of fish larvae was about 9 larvae per 100 m^3. In March, 99 percent of the eggs collected were fourbeard rockling, and 99 percent of the larvae were American sandlance and winter flounder (two-thirds of which was American sandlance). Average mid-depth densities were 153 fish eggs per 1,000 m^3 and 13 larvae per 1,000 m^3. Egg densities were fairly homogenous throughout the water column, and there was no significant difference between the fish egg densities collected during the night or day.

Species diversity was still low in April 2006; over 99 percent of eggs collected were fourbeard rockling. By the end of May, seven taxa of fish eggs and six taxa of fish larvae were collected, and egg density was fairly uniform throughout the water column. While there was no significant difference in egg or larval densities during day- or night-time sampling in April, egg density was significantly higher in the surface strata than the bottom or mid-depth strata. There was no significant difference in overall larval density between day and night sampling, or between the three depth strata from the ichthyoplankton survey in May 2006. One individual species, winter flounder larvae, was present at a statistically greater density at mid-depth at night.

Between August 2005 and May 2006, the Broadwater ichthyoplankton surveys captured snapshots of the seasonal trends in community composition. In August, species abundance and diversity was highest, with declines in these measures through October to a minimum in February. The March and April surveys included a transition to springtime ichthyoplankton communities, and by May, the species abundance and diversity had increased considerably. The results from the Poletti and Broadwater ichthyoplankton sampling programs are typical of estuarine systems in the Mid-Atlantic Bight. Ichthyoplankton abundance is highest in spring and summer when most fish species spawn, and then abundance decreases substantially in fall (Able and Fahay 1998). By winter, there is no spawning by most species (Able and Fahay 1998).

Plankton

Long Island Sound is home to a diverse plankton community. Plankton are small, free-floating or weakly swimming organisms that drift through the water column. Despite their size and short life span, plankton play an essential role in the distribution, transfer, and cycling of nutrients and minerals in marine environments. Plankton consists of two major groups: phytoplankton and zooplankton. The phytoplankton community, comprised of unicellular plants, is a major contributor to primary production in the ocean whereas the zooplankton community consists of microscopic animals such as small crustaceans. In Long Island Sound, seasonal stratification of the water column is a major environmental factor that affects the distribution of phytoplankton and zooplankton communities. From fall through late spring, the water column is well mixed; but increased freshwater runoff and increasing water temperatures cause buoyant, warmer water to layer over more dense, colder water during summer and early fall. Therefore, phytoplankton and zooplankton communities generally are confined to the top (0 to 16 feet) of the water column in Long Island Sound during summer and late fall (Peterson 1983).

3.3.2.2 Potential Impacts to Fisheries Resources and Mitigation

Construction

FSRU

As discussed previously, the proposed FSRU would be constructed overseas and then towed to the Project area. Potential impacts to fisheries communities in the proposed Project area during the FSRU installation phase would be limited to the potential introduction of foreign species through initial ballast water exchange in the proposed FSRU. If ballast water taken into the ballast tanks prior to sailing to Long Island Sound then were discharged into Long Island Sound, invasive species could be introduced – potentially affecting finfish, ichthyoplankton, and plankton communities. To avoid potential impacts associated with foreign ballast water and invasive species, Broadwater would exchange FSRU ballast water prior to entering Long Island Sound in accordance with Coast Guard requirements and standard marine shipping practices. Therefore, the potential for introducing invasive species to Long Island Sound from the proposed FSRU's ballast water is minimal.

As discussed in Section 3.3.1.2 for benthic resources, the use of anti-fouling paint would result in minimal concentrations of copper in the water column. These concentrations would be less than EPA's ambient water quality criteria that are intended to be protective of aquatic life. Broadwater has stated that it does not propose to reapply anti-fouling paint to the FSRU during the life of the Project. Thus, no adverse impacts to fisheries resources are expected in association with the use of anti-fouling paint.

YMS

The primary construction impact to fisheries resources during YMS installation would be noise from pile-driving activities. Finfish species and ichthyoplankton could be affected by acoustical disturbances associated with pile-driving used during installation of the proposed YMS. Underwater sound level is highly variable, depending on vessel traffic and weather conditions. Ambient underwater noise in calm seas may be as low as 90 decibels (dB; at standard reference sound pressure of 1 microPascal) and may be as high as 110 dB, depending on sea conditions (Woodside 2002). Existing underwater noise levels in Long Island Sound would be expected to be higher than ambient natural conditions due to vessel traffic. Although ambient levels of noise in the ocean are attributable to both natural (wind, rain) and anthropogenic (vessel traffic) sources, intense bursts of sound energy have the potential to disturb fish and mammals alike. According to Broadwater, a conventional pile-driver (either vibratory or impact hammer) would be used to install the four legs of the YMS into the seafloor. The legs would be installed one by one, and installation would require approximately 1 week (12 hours per day not to occur at night) for each leg. Broadwater has stated that specific pile-driving methods would be determined in coordination with NMFS after geotechnical surveys are complete.

While the effects of pile-driving on fisheries resources are not fully understood, intense sound pressure waves are known to alter fish behavior or injure/kill fish by rupturing swim bladders or causing internal hemorrhaging (NOAA 2003). Fish tolerance to sound waves depends on peak sound pressure and frequency. Underwater sound levels often are expressed in decibels, which represent the intensity of sound. The decibel scale is not linear, but logarithmic, such that a sound level of 70 dB is twice as loud to the listener as a sound of 60 dB (WADOT 2006a).

According to Hastings (2002), underwater sound pressure levels below 190 dB (at 1 microPascal) will not harm fish. NMFS has established a threshold of 180 dB for physical harm to fish for other projects (NOAA 2004a, 2004b). Broadwater's preliminary noise estimates indicate that impulse noise levels during pile-driving may be as high as 190 dB up to 0.2 mile and 180 dB up to 0.6 mile from the activities. Potential mitigation strategies for reducing underwater sound pressures by 3 dB to as much as 20 dB include air bubble curtains or sleeves surrounding the pile (Wursig 2000, WDOT 2006b). Therefore, **we recommend that:**

- **Prior to construction, Broadwater coordinate with NMFS to identify construction and operational noise thresholds that are protective of marine resources, including marine mammals and federally-listed threatened and endangered species, and file with the Secretary, for review and written approval by the Director of OEP, a written description of the agency-approved noise thresholds, including any appropriate mitigation to avoid and minimize potential impacts during construction and operation.**

Secondary impacts to the biological community could be associated with anti-fouling paint and seafloor disturbance. However, as discussed above, use of anti-fouling paint on the YMS would be expected to have a negligible impact on fisheries resources, and anti-fouling paint would not be reapplied on the YMS during the life of the Project.

Juvenile and adult finfish are highly mobile and would be expected to avoid the proposed YMS construction area. As discussed above for benthic communities, YMS installation would impact approximately 0.8 acre, of which approximately 0.3 acre would be within the YMS footprint and 0.5 acre would be associated with anchoring. It is anticipated that impacts to finfish communities during YMS installation would consist of displacement of mobile organisms, with potential loss of less mobile lifestages (eggs and larvae) due to pile-driving activities and YMS installation. YMS installation, including pile-driving, would occur in fall, when egg and larval densities would be relatively low. With implementation of our recommendation, any impacts to fisheries resources from noise during construction of the YMS would be minor and temporary.

Pipeline

Potential impacts to finfish communities during pipeline installation could include direct disturbance of bottom habitats, physical injury or mortality to individual fish and/or prey species, and impacts to water quality from sedimentation and turbidity. In addition to these impacts, potential impacts to ichthyoplankton and plankton communities during pipeline installation could include impingement and/or entrainment during hydrostatic testing and specialized trenching methods.

Physical Disturbance. Most impacts to finfish associated with installation of the proposed pipeline are expected to be temporary. With incorporation of our recommendation to use mid-line buoys (or possibly a dynamically positioned lay barge) as described in Section 3.1.2.2, the direct impact to the seafloor during construction would be reduced by approximately 90 percent. In addition, our recommendation to actively backfill the trench immediately after construction (and conduct post-construction monitoring) would avoid the potential impacts to biological resources associated with an exposed pipeline and an open trench during natural backfilling.

There still would be physical disturbance to approximately 215.5 acres of seafloor habitats during construction. Pelagic and demersal finfish species in the construction path of the proposed pipeline could experience physical injury or mortality if they did not leave the active construction area. Because most juvenile and adult pelagic and demersal finfish are highly mobile, they would be expected to avoid contact with pipeline installation equipment and spoil sidecasting activities. Therefore, impacts to adult and juvenile finfish associated with installation of the proposed pipeline are expected to be primarily limited to their temporary displacement from the immediate vicinity of active construction, although a small number of less mobile fish species or lifestages could be killed or injured during pipeline installation.

Benthic invertebrates within the proposed pipeline route could provide a food source for finfish during part or all of their lifecycle. Direct alteration of the benthic substrate could cause physical injury and/or mortality to benthic prey species and could hinder settlement and recolonization of the benthic habitat. Therefore, direct impacts to benthic habitat could adversely affect food sources of demersal finfish. It is expected that demersal finfish would avoid active construction areas and would forage elsewhere during recolonization. While short-term impacts may result to the benthic invertebrate community during recolonization of the disturbed seabed, any impacts to finfish as a result of alteration of the benthic habitat are expected to be temporary and insignificant due to the small footprint of the pipeline corridor in Long Island Sound.

Turbidity and Sedimentation. Installation of the proposed pipeline would increase turbidity and sedimentation along and immediately adjacent to the proposed pipeline route during construction. Increased turbidity and sedimentation potentially could affect finfish behaviorally or physiologically. Possible behavioral effects from increased turbidity include interference with feeding for sight-foraging finfish and habitat avoidance. Potential physiological effects include mechanical abrasion of surface membranes, delayed larval and embryonic development, and interference with respiratory functions. As discussed in Section 3.2.3.1, Broadwater would monitor turbidity concentrations in the water column during seafloor disturbance activities in accordance with plans developed in coordination with the appropriate resource agencies and SPDES requirements. Plowing and related turbidity would last for approximately 3 weeks, depending on the exact rate of advancement. Turbidity caused by pipeline installation activities would be expected to settle out of the water column or be largely assimilated into the waters of Long Island Sound within 12 hours of sediment disturbance. Little sedimentation would occur outside the 75-foot-wide construction corridor (less than 0.2 inch would accumulate), which would include the trench and the spoil areas on either side of the trench. Therefore, no significant physiological or behavioral effects on finfish species are anticipated in association with turbidity or sedimentation. Additionally, pipeline installation with the subsea plow is proposed to occur during late fall and winter, when Long Island Sound finfish abundance is lowest, thereby avoiding the majority of spring and summer spawning adults and early lifestages of most finfish species. Therefore, any impacts of turbidity to fisheries resources would be temporary and minor. Impacts of sedimentation would be very minor but are considered short term because they may persist for a few weeks or months following active construction.

Impingement/Entrainment. Ichthyoplankton and lobster larvae in the proposed pipeline installation area could suffer physical injury or mortality during construction due to impingement/ entrainment during specialized trenching methods or hydrostatic testing. Broadwater has proposed use of submersible pumps or hand-jets as specialized excavation methods for utility crossings and tie-ins. These methods use surrounding seawater to excavate benthic substrate, and they have the potential to entrain small organisms inhabiting the water column and/or the adjacent benthic environment. Impingement/entrainment using these specialized excavation methods could adversely affect finfish, especially if any early lifestages were locally present during the construction period (fall to early spring). Any impacts to ichthyoplankton populations resulting from entrainment or impingement from specialized trenching methods would be highly localized and temporary.

To ensure the integrity of the proposed pipeline, hydrostatic testing would occur following installation and prior to initial operation. According to Broadwater, this testing would be performed in spring 2010. Testing involves filling the pipeline with seawater using a suction head or submersible pump. The total volume of seawater required to fill the proposed 21.7-mile-long, 30-inch-diameter pipeline is approximately 3.9 million gallons. The proposed pipeline would be filled at a rate of approximately 4,000 gpm. Broadwater proposes to withdraw water from 20 to 40 feet below the surface of the water and use a 74-micron mesh screen (mesh opening <0.01 inch), thus reducing the potential for entrainment of ichthyoplankton and plankton. Although there likely would be 100 percent mortality of any ichthyoplankton or plankton entrained or impinged, filling the pipeline with seawater would be a one-time event that would not significantly affect the ichthyoplankton/plankton population of Long Island Sound.

Hydrostatic Discharge. In addition to impingement/entrainment, ichthyoplankton and other finfish could suffer physical injury or mortality from hydrostatic testing of the proposed pipeline due to elevated chemical concentrations in the water column.

Broadwater is proposing the use of biocides in the test water to protect the interior of the proposed pipeline from excessive corrosion during hydrostatic testing. Biocide would be added to the water during filling of the pipeline for hydrostatic testing. After approximately 6 months, the hydrostatic test water with biocide would be pumped to holding tanks on a support vessel for treatment prior to its discharge into Long Island Sound. The biocide in the hydrostatic test water would be neutralized and chemically tested in accordance with SPDES requirements prior to returning the water to Long Island Sound. Therefore, no impacts to fisheries resources would be expected, and if they did occur, they would be highly localized and temporary.

Onshore Facilities

No impacts to finfish, ichthyoplankton, or plankton communities are expected due to construction of onshore facilities because construction activities would be limited to the possible construction of a guardhouse and fence at an existing industrial facility.

Operation

FSRU

As discussed for benthic resources in Section 3.3.1.2, the physical presence of the FSRU and YMS may provide a limited amount of artificial habitat conditions for the finfish community in the middle of Long Island Sound that otherwise is limited or non-existent in the area. These artificial habitat conditions include shade from the FSRU and YMS, and vertical hard substrate due to the YMS. In addition, the proposed Project would include establishment of a safety and security zone where commercial and recreational fishing would be restricted, which would eliminate fishing pressure in this 1.5-square-mile safety and security zone. The potential impacts of this restriction on commercial and recreational fishing are discussed in Section 3.5.5.2. It is anticipated that these artificial habitat conditions may be beneficial to fish for the life of the Project, but any benefit would be highly localized and would result in a negligible influence on the biological communities of Long Island Sound.

Other potential impacts to the finfish, ichthyoplankton, and plankton communities from operation of the proposed FSRU could include physical injury or mortality caused by impingement/ entrainment, impacts to water quality from discharges, and impacts associated with LNG spills and other hazardous materials.

Impingement/Entrainment. Ichthyoplankton communities could be affected by impingement/ entrainment during standard FSRU operations. Measures to minimize impacts of water intakes on ichthyoplankton have been identified by federal and state regulatory agencies for other LNG projects, including the physical location of the water intakes at a water depth with relatively low densities (approximately mid-depth of the water column), limiting the water intake velocity (0.5 foot per second or less), and using a small mesh screen on the intakes (less than 0.2-inch mesh screen).

According to Broadwater, the proposed Project would require an annual average daily intake of approximately 28.2 mgd of seawater for the proposed FSRU and LNG carrier operations. Estimates of ichthyoplankton and lobster larvae impinged/ entrained were calculated based on the Poletti ichthyoplankton data and site-specific sampling conducted by Broadwater, as described in Section 3.3.2.1.

Ichthyoplankton densities were used to estimate impingement/ entrainment rates by multiplying the densities for each species during each sampling interval by the annual average daily intake water volume for both the FSRU and the LNG carriers. Due to the differences in the seasons of each survey, impingement/ entrainment for ichthyoplankton estimates were calculated using the Poletti results between March and early August, and the Broadwater results between late August and March. Estimates were calculated based on different sampling strata (Poletti), day/night results (Broadwater), and attempting to adjust the daytime densities from the Poletti results for night-time densities documented during the Broadwater surveys. Using these various approaches, annual impingement/ entrainment for eggs ranged from 49.8 to 101.9 million eggs, with the most valid estimate of 53.1 million eggs based on the location of the proposed Project and adjusting for day/night differences in abundance. The annual impingement/ entrainment estimate for larvae ranged from 67.4 to 173.1 million, with the most valid estimate being 78.4 million.

Lobster larvae generally are present in the water column in early to mid-summer, once water temperatures are warm enough. The first three larval instars (Stages I, II, and III) occur throughout the water column, and data from Poletti (PBS & J/LMS 2003) for the deep strata (water depth greater than 98 feet) were used to estimate annual entrainment by the FSRU and LNG carrier intakes. The Broadwater study (Normandeau 2006) sampled the surface layer (0 to 1.6 feet), and based entrainment estimates for Stage IV individuals on these data. Annual entrainment estimates of individuals at Stages I through III would be 44,000; for Stage IV lobsters, an estimated 163 individuals would be entrained. Because Stage IV lobsters primarily reside in the surface water, rather than at the depth of the FSRU intake (about 40 feet below the surface), this entrainment estimate is likely conservative.

The daily water intake for the FSRU and the LNG carriers would total approximately 0.0003 percent of the volume of the water in the central basin of Long Island Sound (Poletti Regions 7 through 9). The annual total water intake would be approximately 0.1 percent of this volume. Therefore, the annual entrainment of eggs and larvae without further mitigation measures also would be generally estimated to be approximately 0.1 percent of the standing crop for Poletti Regions 7, 8, and 9.

As mentioned previously, the majority of this ichthyoplankton would be present during the late spring and summer, and the abundance estimates during this period primarily were based on the results of the Poletti ichthyoplankton survey, which provided only mean densities over the entire water column. Actual densities in the mid-depth interval that would be exposed to the water intakes generally would be expected to be lower, and the number of species that would be affected also would be expected to be fewer because the eggs and larvae of most fish species tend to be found near the water surface or near the bottom of the water column. In addition, these estimates do not incorporate Broadwater's additional operational measures designed to reduce potential impingement/entrainment, including relatively low intake velocities and fine mesh screen on the intakes, as described above. Therefore, these estimates are likely conservative estimates (substantial overestimates) of actual entrainment or impingement.

Because the estimated values represent such a small percentage of the standing crop of central Long Island Sound, these losses are not expected to affect the overall finfish or lobster population within Long Island Sound. However, entrainment and impingement associated with water intakes of the proposed Project would continue throughout the life of the Project

Water Quality. Finfish, ichthyoplankton, and plankton communities could suffer injury or mortality attributed to water quality impacts from proposed FSRU discharges. To prevent biofouling, Broadwater proposes to constantly inject sodium hypochlorite at a minimum effective concentration into the FSRU water intake systems. Therefore, the sodium hypochlorite concentrations in the discharges would be between 0.01 and 0.05 ppm. Water discharges would be monitored to measure the actual concentrations of chlorine. In addition to chlorine discharges, Broadwater proposes to discharge between 2,000 and 5,000 gallons of wastewater per day from an onboard wastewater treatment facility. All FSRU discharges would be conducted in accordance with SPDES requirements throughout the life of the Project. Therefore, no significant impact to marine resources would be associated with standard water discharges.

Lighting. Lighting on the external areas of the FSRU would be necessary to ensure safe operation at all times. These light sources could attract species to the area. Broadwater would use the minimal number of lights and wattage necessary, and would shield the light to focus the beams on the work at hand. Light shining into the water would be focused in the area around the vessels, except for navigational purposes. Lighting could result in a highly localized effect on prey and predator abundance in the immediate vicinity of the light. Because the light would not be visible beyond approximately 0.6 mile, however, lighting would not significantly alter the migratory, spawning, or feeding behaviors of the aquatic species in the vicinity.

LNG and Chemical Spills. General fisheries communities could be affected in the event of a spill of LNG or other hazardous material. A discussion regarding environmental impacts from LNG spills can be found in Section 3.10. Although no spills are anticipated, the likelihood of a chemical spill and the extent of the impacts of a spill if one were to occur would be minimized by implementation of an SPCC Plan, emergency response plan, and additional emergency plans and procedures designed to reduce the risk of adverse environmental impact to the local marine (and human) environment. In the event that a spill did occur, impacts to biological resources would be localized and temporary, and would be limited to the water surface and/or the upper water column. In addition, we have included a recommendation in Section 3.2.2.1 that Broadwater provide an offshore-specific SPCC Plan to further minimize the likelihood of a spill as well as the magnitude of the impacts if a spill were to occur. For these reasons, any impacts to marine resources from accidental releases would be temporary and insignificant.

Pipeline

Potential impacts to the finfish, ichthyoplankton, and plankton communities from pipeline operations could include resuspension of sediments during maintenance activities and thermal impacts. General pipeline maintenance would require minimal daylighting of buried pipeline facilities, with excavation by a submersible pump, or hand-jetting or air-lifting equipment. Maintenance operations would not significantly affect finfish, plankton, or ichthyoplankton communities due to the highly localized and infrequent maintenance activities (approximately once every 5 to 7 years) and the temporary nature of impacts when they would occur.

As proposed by Broadwater, heat dissipation from the subsea pipeline theoretically could result in highly localized impacts to water temperatures and benthic prey species along the pipeline route during the time it takes the trench to naturally backfill. In Section 3.1.2.2, we have recommended that Broadwater mechanically backfill the pipeline immediately following installation to minimize potential impacts to the benthic habitat associated with an exposed pipeline and the presence of a trench. With implementation of our recommendations no impacts to finfish or benthic prey species would be associated with an exposed subsea pipeline during operations.

Onshore Facilities

Operation of the onshore facilities would result in minimal or no impact to finfish, ichthyoplankton, or plankton resources. The onshore facilities would consist of existing offices, warehouse, and dock, which would not include any water intakes or point discharges into Long Island Sound. The docking facilities currently are used for industrial marine vessels. Any vessel operations would be conducted in accordance with standard maritime regulations and would constitute a minor increase in marine traffic in the area (see Section 3.7 for additional discussion of marine transportation).

LNG Carriers

Potential impacts to general fisheries communities from LNG carrier traffic could include impingement/ entrainment of ichthyoplankton, introduction of potentially invasive species to Long Island Sound through ballast water exchange, physical impacts from vessel movements, and lighting impacts. Details regarding potential impingement/ entrainment impacts to ichthyoplankton from water intakes, including the water intake volumes for LNG carriers, are included in the above discussion regarding impingement/ entrainment associated with the FSRU.

LNG carriers would withdraw water from Long Island Sound primarily for ballasting and cooling. The intake water systems on LNG carriers differ from vessel to vessel. In addition, the exact depth of the intake would depend on off-loading operations. In general, intakes on many LNG carriers are located approximately 15 to 25 feet below the water line when fully loaded. Some LNG carriers have high and low sea chest intakes, which are located approximately 25 to 35 feet below the water line for a low intake and approximately 15 to 25 feet below the water line for a high intake.

LNG carriers would arrive in U.S. waters fully loaded with cargo and would take in ballast water while off-loading. Therefore, there would be little or no reason to discharge ballast water in U.S. waters. Current regulations require that ballast water be exchanged 200 nautical miles offshore where water depth is at least 660 feet prior to entering U.S. ports. In addition, ships must have onboard and adhere to a Ballast Water Management Plan, and maintain a Ballast Water Record Book to record the intake and discharge of ballast water (IMO 2004). Therefore, this mandatory ballast management program would avoid or minimize impacts associated with foreign ballast water and invasive species. Any minimal impact that would occur would be comparable to impacts associated with other offshore shipping traffic.

Potential impacts to fisheries resources from standard vessel transit (such as from movements, lighting, and ballast water intakes) within the U.S. territorial sea, including Long Island Sound, would be minimized by adherence to industry standards, federal requirements, and international conventions applicable to the international shipping community. There are no known processes unique to LNG carriers that would result in a measurable impact on fisheries resources during transit beyond those for other cargo vessels of comparable size.

3.3.3 Fisheries of Special Concern

Fish species of special concern that occur in the vicinity of the proposed Project include federally and state-listed threatened and endangered species, those with essential fish habitat (EFH) designations in Long Island Sound, and those with commercial and recreational value. Only one federally or state-listed threatened or endangered fish species has been identified in association with the proposed Project (the shortnose sturgeon); it is discussed in Section 3.4.1.3 of this EIS. Species with EFH designations are discussed below in Section 3.3.3.1, and in greater detail in Appendix E "Essential Fish Habitat (EFH) Assessment." Commercial and recreational fish species are discussed in Section 3.3.3.2.

3.3.3.1 Essential Fish Habitat

This section provides a brief overview of the background, discussion, and conclusions reached in Appendix E, "Essential Fish Habitat (EFH) Assessment." The Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996, set forth a mandate for NMFS, regional Fishery Management Councils (FMCs), and other federal agencies to identify and protect EFH for economically important marine and estuarine fisheries. NOAA (2002) defines EFH as:

> "... those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity. For the purpose of interpreting the definition of essential fish habitat: 'Waters' include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; 'substrate' includes sediment, hardbottom, and structures underlying the waters, and associated biological communities; 'necessary' means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and 'spawning, breeding, feeding, or growth to maturity' covers a species' full life cycle."

EFH in the Proposed Project Area

The FMCs, with assistance from NMFS, are required to delineate "essential fish habitat" for all managed species. EFH-managed species and life history stages in the proposed Project area are identified in the *NOAA Guide to Essential Fish Habitat Designations in the Northeastern United States* (NOAA 2005b). The guide identifies EFH-managed species in selected 10-minute by 10-minute squares of latitude and longitude, as assigned by regional FMCs. The EFH squares in the Project area are depicted in Figure 3.3-2.

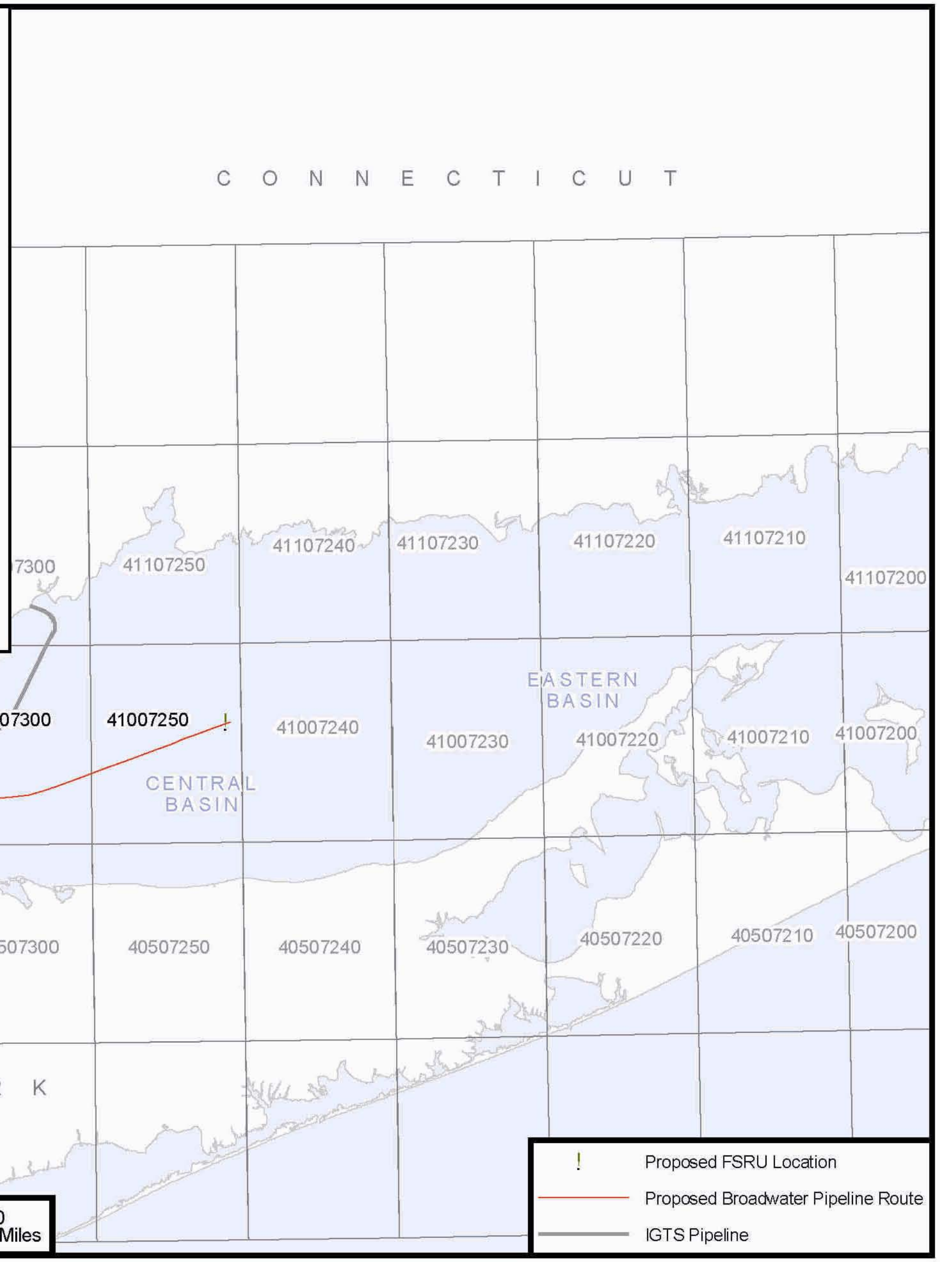
The habitats in the EFH associated with the proposed Project would include the seafloor sediment and water column because the proposed Project is sited in the central waters of Long Island Sound. Therefore, there would be no impacts to other types of EFH such as eelgrass beds, live hardbottom habitats, or vegetated wetlands. Minimal impacts to seafloor sediment and the water column could be associated with vessel docking and maneuvering at the dock for the onshore facilities. However, any impacts would be minor and negligible.

EFH-managed Species

Designated EFH occurs in the proposed Project area for various lifestages of 19 species (Table 3.3.3-1). Nine species have designated EFH for each lifestage. None of these managed stocks are listed as endangered or threatened under the ESA. Prey for managed fish species also comprise a critical component of EFH. Managed species are summarized in Table 3.3.3-1 and discussed below.

Block Reference Number	Study Area Locations (10' x 10' blocks)		
	41007310	41007300	41007250
EFH Species			
American plaice (Hippoglossoides platessoides)	JA	JA	JA
Atlantic mackerel (Scomber scombrus)	ELJA	ELJA	ELJA
Atlantic salmon (Salmo salar)	JA	JA	JA
Atlantic sea herring (Clupea harengus)	JA	JA	JA
Black sea bass (Centropristus striata)	J	J	J
Bluefish (Pomatomus saltatrix)	JA	JA	JA
Cobia (Rachycentron canadum)	ELJA	ELJA	ELJA
King mackerel (Scomberomorus cavalla)	ELJA	ELJA	ELJA
Ocean Pout (Macrozoarces americanus)	ELJA		
Pollock (Pollachius virens)	JA	JA	JA
Red hake (Urophycis chuss)	ELJA	ELJA	ELJA
Sand tiger shark (Odontaspis taurus)	L	L	L
Scup (Stenotomus chrysops)	ELJA	ELJA	ELJA
Spanish mackerel (Scomberomorus maculatus)	ELJA	ELJA	ELJA
Summer Flounder (Paralichthys dentatus)	J	J	J
Whiting (Merluccius bilinearis)	A	A	A
Windowpane flounder (Scopthalmus aquosus)	ELJA	ELJA	ELJA
Winter flounder (Pleuronectes americanus)	ELJA	ELJA	ELJA
Little skate (Leucoraja erinacea)	JA	JA	JA
Winter skate (Leucoraja ocellata)	JA	JA	JA

E = eggs, L = larvae, J = juvenile, A = adult



Source: NOAA 2005

Figure 3.3-2
Broadwater LNG Project
Essential Fish Habitats in the Vicinity of the Proposed Project

TABLE 3.3.3-1 Species with Identified Essential Fish Habitat in the Proposed Project Area[a]					
Species	Scientific Name	Egg	Larvae	Juvenile	Adult
Atlantic mackerel	*Scomber scombrus*	X	X	X	X
Atlantic salmon	*Salmo salar*			X	X
Atlantic herring	*Clupea harengus*			X	X
Black sea bass	*Centropristus striata*			X	
Bluefish	*Pomatomus saltatrix*			X	X
Cobia	*Rachycentron canadum*	X	X	X	X
King mackerel	*Scomberomorus cavalla*	X	X	X	X
Little skate	*Leucoraja erinacea*			X	X
Ocean pout	*Macrozoarces americanus*	X	X	X	X
Pollock	*Pollachius virens*			X	X
Red hake	*Urophycis chuss*	X	X	X	X
Sand tiger shark	*Odontaspis taurus*		X		
Scup	*Stenotomus chrysops*	X	X	X	X
Spanish mackerel	*Scomberomorus maculatus*	X	X	X	X
Summer flounder	*Paralicthys dentatus*			X	
Silver hake	*Merluccius bilinearis*				X
Windowpane flounder	*Scopthalmus aquosus*	X	X	X	X
Winter flounder	*Pleuronectes americanus*	X	X	X	X
Winter skate	*Leucoraja ocellata*			X	X

[a] Source: NOAA 2005b.

Species-specific life history information and detailed assessment of potential impacts to EFH-managed species as a result of the proposed pipeline and FSRU construction and operation are provided in the EFH assessment (Appendix E).

Potential Impacts to EFH and EFH-Managed Species

The majority of potential impacts of the proposed Project to EFH and EFH-managed species would be similar to the general habitat and fisheries impacts previously described in Sections 3.2.3 and 3.3.2.2. Project-related impacts to EFH would occur to the estuarine water column and the seafloor of Long Island Sound. The estuarine water column in the vicinity of the proposed Project serves as EFH for various lifestages of several managed species by providing habitat for spawning, breeding, feeding, growth, and shelter. Prey species for many of these species also occur within the water column. Operation of the FSRU would use a daily average water intake of 5.5 mgd, based on the annual water intake volume; water intake and discharge are discussed in detail in Section 3.2. Approximately 215.5 acres of the seafloor in the Project area would be disturbed during construction, resulting in localized and temporary turbidity and sedimentation.

Recovery of most of the disturbed EFH-designated seafloor along the proposed pipeline route could be expected to occur within 1 to 2 years, assuming successful active backfilling of the trench (at least 90 percent of the trench with native material). Broadwater has proposed to backfill approximately 2 miles of the trench with imported rock or gravel, which would result in conversion of approximately 0.6 acre of the surface substrate from softbottom to rock. This may result in an adverse impact to the softbottom community but could enhance habitat diversity and provide habitat for species that require or prefer rock substrate. Approximately 0.1 acre of softbottom habitat would be converted to a hard substrate (metal, rock) for the duration of the Project, due to the presence of the YMS.

During operations, the primary impact to EFH-managed species would be impingement/ entrainment of the eggs and larvae of EFH-managed species. As identified in Table 3.3.3-1, eggs and larvae of ten species have managed EFH in the general Project area. These EFH-managed species include Atlantic mackerel, cobia, king mackerel, ocean pout, red hake, scup, sand tiger shark (larvae only), Spanish mackerel, windowpane flounder, and winter flounder. Six of these species were not collected during the 2002 Poletti Ichthyoplankton Program or the 2005–2006 Broadwater ichthyoplankton surveys. The four species that were identified during these surveys included Atlantic mackerel, scup, windowpane flounder, and winter flounder. These species comprised less than 5 percent of the eggs and less than 1 percent of the larvae reported during the August, October, and February surveys. In March, 33 percent of the larvae collected were winter flounder. In April, winter flounder larvae were still the most abundant EFH-managed species (18 percent); in May, windowpane flounder eggs and larvae were the most abundant EFH-managed species (21 percent and 25 percent, respectively).

Broadwater has agreed to consult with NMFS to minimize potential impacts from construction and operational noise to EFH-managed species and to facilitate development of conservation recommendations by NMFS. The potential impacts to EFH-managed species are discussed in detail in Appendix E. None of the potential impacts would result in a significant impact to the populations of EFH-managed species in the Project area.

Broadwater's current Project design and methods, including Project siting, winter-time construction, and water intake and discharge procedures, would serve to largely offset impacts to EFH and EFH-managed species; these generally are in compliance with NOAA guidance for siting, design, and operation of LNG terminals (NOAA 2005a). We have recommended mitigation measures throughout this EIS that would further avoid and minimize potential impacts to marine habitats and marine resources, including EFH and EFH-managed species. As a result, we do not believe that construction or operational impacts to EFH or EFH-managed species would result in a substantial adverse effect on managed fisheries in the Project area.

3.3.3.2 Commercial and Recreational Fisheries

The commercial and recreational fisheries of Long Island Sound are important industries. Table 3.3.3-2 provides a list of representative commercial and recreational fish and shellfish species known to occur in Long Island Sound. The following discussion focuses on potential impacts to these species. Potential impacts to fishing-related livelihood, tourism, or socioeconomic conditions are discussed in Section 3.6.

Principal shellfish species commercially harvested in Long Island Sound include hard clams, eastern oyster, longfin squid, blue crab, and American lobster; quahog clams are the most abundant species (NOAA 2005d). In 2003, these species accounted for approximately 98 percent of the total weight of commercially harvested shellfish in Long Island Sound (NOAA 2005d). Shellfishing areas for bivalves within Long Island Sound are located primarily along the shoreline of Connecticut and New

York. Because the proposed Project would be located in the offshore waters of the Sound, impacts to commercial and recreational shellfishing for bivalves are not anticipated.

TABLE 3.3.3-2
Representative Recreational and Commercial Fish and Shellfish Species Known to Occur in Long Island Sound[a]

Common Name	Scientific Name
American lobster	*Homarus americanus*
Atlantic surf clam	*Spisula solidissima*
Bay scallop	*Aequipecten irradians concentricus*
Blue crab	*Callinectes sapidus*
Bluefish	*Pomatomus saltatrix*
Butterfish	*Peprilus triacanthus*
Eastern oyster	*Crassostrea virginica*
Goosefish	*Lophius americanus*
Longfin squid	*Loligo pealeii*
Menhaden	*Brevoortia tyrannus*
Quahog clam	*Mercenaria mercenaria*
Scup	*Stenotomus chrysops*
Sea scallop	*Plactopecten magellanicus*
Silver hake	*Merluccius bilinearis*
Striped bass	*Morone saxatilis*
Summer flounder	*Scophthalmus aquosus*
Tautog	*Tautoga onitis*
Tilefish	*Lopholatilus chamaeleonticeps*
Weakfish	*Cynoscion regalis*
Windowpane flounder	*Pleuronectes americanus*
Winter flounder	*Pleuronectes ferrugineus*

[a] Sources: NMFS 2006, Stone et al. 1994.

The proposed Project would be located in a dense lobster fishing area, and construction and operation of the proposed Project could affect the abundance of lobster within the footprint of the Project, especially during active construction. In general, impacts to lobsters primarily would occur only during active construction, although a negligible short-term impact to prey availability could occur along the pipeline corridor (which constitutes less than 0.1 percent of the available lobster habitat in Long Island Sound). In addition, Project construction and operation could enhance the local lobster population because of improving lobster habitat along some portions of the pipeline route by providing preferred substrate (rocks) and by eliminating fishing pressure within the Coast Guard-determined safety and security zone.

The principal fish species commercially harvested in the area include silver hake, scups or porgies, goosefish, tilefish, bluefish, summer flounder, striped bass, and skates. In 2003, these species accounted for approximately 82 percent of the total weight of commercially harvested fish (NOAA 2005d). The area that would be occupied by the safety and security zone surrounding the FSRU and berthed LNG carrier would total 1.5 square miles, and fishing would be prohibited within this boundary; the potential impacts of this change are discussed in Section 3.5.5.2.

In general, the impacts to commercially and recreationally important species would be comparable to those described in Section 3.3.1 (benthic communities) and Section 3.3.2 (finfish). Construction of the proposed Project would result in negligible adverse impacts to these species, and impacts would occur primarily during and immediately following active construction. Impacts associated with Project operations would be minor but would continue throughout the life of the proposed Project.

3.3.4 Marine Mammals

3.3.4.1 Existing Environment

Congress passed the Marine Mammal Protection Act (MMPA) in 1972. The MMPA prohibits, with certain exceptions, the take of marine mammals in U.S. waters (NMFS 2005a). "Take" is defined as the harassment, hunting, capturing, killing, or attempt to do any of these things to any marine mammal. Harassment is defined as "any act of pursuit, torment or annoyance which has the potential to injure a marine mammal, or has the potential to disturb a marine mammal causing disruption or behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering" (NMFS 2005a).

Pinnipeds

Harbor seals, gray seals, harp seals, hooded seals, ringed seals, and the common dolphin are representatives of marine mammals that are commonly found in Long Island Sound. Harbor seals are found in coastal areas of the North Pacific and North Atlantic. They are commonly found in Maine and eastern Canada during spring and summer. These seals feed primarily on schooling fish, such as bunker or herring, and also on squid, octopus, and crustaceans (Riverhead Foundation 2005a). Harbor seals have been reported in Long Island Sound year-round, with the highest abundance from November through May (Sadove and Cardinale 1993). Harbor seals are one of the most common pinnipeds in Long Island Sound.

Gray seals are found only in waters of the western North Atlantic. The majority of the gray seal population is found in eastern Canada, but the population extends southward to southern New England and eastern Long Island. They primarily feed on schooling fish, such as herring, mackerel, flounder, cod, and salmon, as well as squid, octopus, crustaceans, and even seabirds (Riverhead Foundation 2005a). Gray seals, along with harbor seals, are the most common pinnipeds found in Long Island Sound. Gray seals typically are found in Long Island Sound from November through May and are often seen with harbor seals (Sadove and Cardinale 1993).

Harp seals are the most abundant pinniped in the northern hemisphere. Harp seals primarily are found in the North Atlantic from Newfoundland to Northern Russia. Harp seals may make extensive migrations (traveling up to 1,600 miles) throughout the year. They move northward in spring and summer to feed. Harp seals feed on schooling fish, such as herring and cod, and crustaceans (Riverhead Foundation 2005a). Harp seals are commonly found in Long Island Sound during winter months (Riverhead Foundation 2005b).

The breeding range of hooded seals is limited to the central and western North Atlantic. Juveniles may migrate extensively from this area during the non-breeding season. Hooded seals feed on several schooling fish, squid, shrimp, octopus, and crustaceans (Riverhead Foundation 2005a). Hooded seals are commonly found in Long Island Sound during winter months (Riverhead Foundation 2005b).

Ringed seals are the smallest of the pinnipeds. They are commonly found in the Arctic Ocean; however, several large populations of ringed seals occur in Hudson Bay and in the Baltic and Bering Seas. Ringed seals are rare in Long Island Sound. These seals feed mainly on polar cod (Riverhead Foundation 2005a).

Cetaceans

Threatened and endangered whale species are discussed in Section 3.4. In contrast to the relatively rare occurrence of whales in Long Island Sound, the common dolphin is commonly found in Long Island Sound. The common dolphin can be found worldwide in tropical and warm offshore waters. They primarily feed on anchovies, deep sea smelt, lanternfish, and squid (Riverhead Foundation 2005c).

3.3.4.2 Potential Impacts to Marine Mammals and Mitigation

Potential construction and operational impacts to marine mammals are discussed below, focusing primarily on vessel traffic and noise. Additional information on marine mammals federally listed as threatened or endangered is provided in Section 3.4.1.1.

Construction

Vessel Traffic

Section 3.7 details an analysis that was completed for commercial traffic and tugs. These data provided counts, transit routes, and densities of commercial vessel during calendar year 2005 throughout Long Island Sound, including the Project area (Figures 3.7-1 and 3.7-2). Marine mammals could be affected by increased vessel traffic associated with the proposed Project in the Sound and open seas due to potential collisions with the vessels.

Collisions between boats or ships and toothed whales are uncommon; however, whales have been struck and killed by ships (Slijper 1962). In the presence of vessels, some marine mammals may exhibit no response; some may exhibit avoidance response; and others may exhibit behaviors that increase their susceptibility to collision, such as startle responses, more erratic surface movements, reduced surface time, fewer blows per surfacing, shorter intervals between successive blows, and increased frequency of dives without raised flukes (Whitehead et al. 1990, Cawthorn 1992, Gordon et al. 1992). Although the majority of documented vessel strikes may be caused by small, fast (greater than 15 knots) vessels with planing hulls, some larger vessels are associated with documented mortalities while others may go unnoticed or unreported.

The probability of marine mammals encountering LNG carriers in the open ocean is inherently low due to the small odontocetes' (toothed whales, dolphins, and porpoises) ability to avoid oncoming vessels and the overall rarity of baleen whales in the area of Long Island Sound. On other comparable projects, federal agencies have identified the need to (1) use biological monitors and avoid locations of reported marine mammal sightings during construction, and (2) maintain relatively slow speeds by all Project-related vessels (Coast Guard 2006d, 2006e). Broadwater has agreed to these procedures. With implementation of Broadwater's proposed measures, we have determined that vessel strikes associated with construction of the proposed Project would not result in a significant impact to marine mammals.

Noise

Noise associated with construction of the proposed Project may limit use of the Project area by marine mammals. Underwater sound level is highly variable, depending on vessel traffic and weather conditions. Ambient underwater noise in calm seas may range between 90 and 110 dB, depending on sea conditions (Woodside 2002). Average noise pressures of 80 to 110 dB in the Peconic Estuary along the eastern end of Long Island have been linked to human activity (Y et. al. 2005). It is expected that existing underwater noise levels in Long Island Sound would tend to be in the upper end of the range due to the volume of vessel activity.

The construction noise of primary concern would be pile-driving, which could adversely affect marine mammals in multiple ways. Potential impacts could range from masking of signals, startling, and displacement to potential injury (Richardson et al. 1995). The intensity of potential impacts would depend on the proximity of the marine mammal to the pile-driving. Marine mammals may suffer a temporary threshold shift, or temporary hearing loss, if exposed to shock of 180 dB or greater (Greene 1999). A temporary threshold shift can last from a few minutes to hours or days (Richardson et al. 1995). According to Richardson et al. (1995), no reports demonstrate that high levels of steady or impulse noise cause "discomfort" or nonauditory physiological effects in marine mammals.

Broadwater's preliminary noise estimates indicate that impulse noise levels during pile-driving may be as high as 190 dB up to 0.2 mile and up to 180 dB at 0.6 mile from the source. According to the Washington State Department of Transportation (WADOT 2006b), the underwater peak sound pressure from driving a 2-foot-diameter steel pile ranges between 202 and 210 dB; the diameter of the steel piles that would be used for the YMS would be 6.7 feet, which would likely generate sound pressures greater than those observed in the WADOT study. However, we have included a recommendation in Section 3.3.2 that Broadwater coordinate with NMFS to develop mitigation measures to minimize noise levels during construction activities, including pile-driving.

If geotechnical conditions allow successful use, vibratory hammers are the preferred method of pile-driving because sound levels generally are 10 to 20 dB lower than impact hammer driving (WADOT 2006b). Pending geotechnical surveys, Broadwater has not specified pile-driving methods but would consider use of vibratory hammers once geotechnical surveys are complete, in consultation with NMFS, COE, and NYSDEC.

The pile-driving activities would be completed during the daylight hours over approximately 4 weeks. In general, marine mammals would be expected to leave active construction areas and return when construction has ceased. Broadwater has proposed to use "ramp-up" procedures to reduce potential impacts. Pile-driving would commence with lower force and increase to full-capacity force to allow marine mammals to leave active pile-driving areas. Broadwater also would use trained observers to identify any marine mammals that may be present in active construction areas and would avoid active construction while the marine mammals were present. In addition, we have included a recommendation in Section 3.3.2 for Broadwater to coordinate with NMFS to develop appropriate mitigation in order to minimize impacts during construction and operation; this potentially may require underwater acoustic modeling to determine the need for permits under the MMPA. For these reasons, impacts to marine mammals from noise and acoustic shock during construction are considered insignificant and temporary.

Operation

During operation, potential impacts to marine mammals primarily would be associated with vessel traffic, including LNG carriers, and secondarily with noise.

Vessel Traffic

Impacts to marine mammals from vessel traffic during operation would be limited to impacts associated with LNG carriers, tugs, and support vessels. There are no known marine mammal aggregation areas or haul-out areas along the expected LNG carrier or support vessel routes (from the onshore facilities). The closest known seal haul-out areas to the LNG carrier routes are on Block Island and in the vicinity of the Race (but on the opposite side of Fisher Island). An average of approximately five to six vessels per day would transit from the existing industrial dock to the offshore area (FSRU or LNG carrier). During operation, Project-related vessel traffic would result in an approximately 1-percent increase in the vessel traffic in Long Island Sound (as discussed in Section 3.7.1.4). This minor increase in vessel traffic that would occur miles from known aggregation areas or haul-out areas locations would not be expected to substantially impact marine mammals, including seals.

Within Long Island Sound, escorted LNG carriers would be expected to travel at relatively slow speeds (as described in Section 3.7.1.4). Although LNG carriers do not normally travel at high speeds, they would be expected to travel at higher speeds in the open ocean, which could increase the likelihood of vessel strikes. In Section 3.4.1.1, we have included a recommendation for LNG carriers to adhere to the provisions in the NMFS Proposed Rule to protect right whales. The primary provision in the Proposed Rule is a seasonal speed restriction designed to protect right whales, which are federally listed as endangered. This speed restriction would extend from November through April in the waters off Long Island Sound; the slower speeds also would reduce the likelihood of the LNG carriers striking other marine mammals.

With implementation of our recommendation to adhere to the seasonal speed restrictions, any impact to marine mammals from the minimal increase in regional ship traffic associated with operation of the proposed Project would be negligible.

Lighting

Lights on the FSRU, LNG carriers, and support vessels would be necessary to ensure safe operation at all times. These light sources could attract species to the area. On the FSRU, Broadwater would utilize the minimal number of lights and wattage necessary, and would shield the light to focus the beams on the work at hand. Light shining into the water would be focused in the area around the vessels, except for navigational purposes. Lighting on the FSRU as well as the vessels would be consistent with other ship traffic, and it is not expected these lights would significantly alter the behaviors of marine mammals in the Project area.

Noise

Based on a similar FSRU project (C.J. Engineering Consultants 2004), it is anticipated that underwater noise generated from the FSRU during operations would attenuate to approximately 120 dB (at 1 microPascal) within 0.6 mile, 118 dB within 1 mile, and 108 dB within 1.9 miles of the FSRU. However, controls to adequately dampen noise for workers also would aid in minimizing noise impacts to surrounding marine resources. With implementation of our recommendation provided in Section 3.3.2.2 that Broadwater coordinate with NMFS to minimize potential impacts of Project-related noise, any impacts from operational noise are expected to be minor and localized, but would continue for the life of the Project.

3.3.5 Avian Species

3.3.5.1 Existing Environment

Several avian species utilize Long Island Sound throughout the year. The Sound is also an important wintering area and migratory route. Several avian species cross Long Island Sound when they migrate from New England to Canada. Bird use along the proposed pipeline route itself likely is limited to diving ducks and pelagic species. Typically, birds around the proposed FSRU or YMS would be open water species such as gulls. As discussed in Section 3.4, no federally or state-listed birds would be potentially affected by construction or operation of the offshore portion of the proposed Project. We have included a recommendation in Section 3.4 for Broadwater to coordinate with FWS and NYSDEC regarding potential listed species that could utilize the area of the onshore facilities, including birds. Because the proposed onshore facilities would be located in existing buildings and docks, it is expected that any avian species associated with onshore activities would be accustomed to human presence and disturbance, such as gulls or crows. Therefore, the following discussion focuses primarily on the offshore portion of the proposed Project.

3.3.5.2 Potential Impacts to Avian Species and Mitigation

The proposed Project would be located in the deeper waters of Long Island Sound. The nearest shoreline is approximately 9 miles from the proposed FSRU. Therefore, the proposed Project would not affect any nearshore wildlife habitats used by avian species for nesting, foraging, rearing young, resting during migration, or overwintering.

Construction

Construction of the proposed Project is not expected to result in any significant impacts to avian species because of the location of the construction activities in the middle of Long Island Sound. Onshore construction would be limited to a possible guardhouse and fence at an existing industrial facility. Therefore, no impacts to avian species would be expected from construction of the onshore portion of the Project.

Operation

During operation of the offshore portion of the Project, potential impacts could be associated with lighting and harassment of avian species at the proposed FSRU, as discussed below. Onshore activities would be consistent with existing use at the industrial warehouse and dock, and we have included a recommendation in Section 3.4 for Broadwater to coordinate with FWS and NYSDEC to identify any appropriate mitigation measures to avoid and minimize potential impacts to federally or state-listed birds.

Lighting

Exterior lighting at the proposed FSRU would be installed as necessary for general operations, worker and visitor safety, and security. This lighting could attract avian species. Broadwater proposes the following measures to minimize lighting impacts:

- •• Lighting used during operation activities would be limited to the number of lights and wattage necessary to perform the activities;

- Lighting would be shielded so that beams would fall only on the workspace and beams would not be directly visible more than about 3,300 feet (0.6 mile) from the source; and
- Lighting would not be shone on the water except in the area immediately around vessels or as required for safe navigation, personnel safety, or other safety reasons.

According to Broadwater, a detailed lighting plan would be provided prior to construction of the proposed Project. Implementation of these procedures would minimize any impacts to avian species from lighting.

Harassment

There is some evidence that pelagic avian species use offshore platforms for perching or roosting sites. Therefore, avian species of Long Island Sound may use the proposed FSRU for perching or roosting, similar to the use of other large ships in the area. The proposed FSRU would not contain any guy-wires, rotary blades, extensive windows, or other structures that could be a hazard to avian species. Therefore, adverse impacts to avian species from perching or roosting at the proposed FSRU are not expected.

3.4 THREATENED AND ENDANGERED SPECIES

Federal agencies are required by Section 7 of the Endangered Species Act of 1973 (ESA) (Title 19 USC Part 1536[c], as amended) to ensure that any actions authorized, funded, or carried out by the agency do not jeopardize the continued existence of a federally listed threatened or endangered species, or result in the destruction or adverse modification of the designated critical habitat of a federally listed species. The action agency (FERC, COE, and the Coast Guard) is required to consult with FWS and/or NMFS to determine whether federally listed threatened or endangered species or designated critical habitat are found in the vicinity of the proposed Project, and to determine the proposed action's potential effects on those species or critical habitats. For actions involving major construction activities with the potential to affect listed species or designated critical habitat, the federal agency must prepare a Biological Assessment for those species that may be affected. The action agency must submit its BA to FWS and/or NMFS and, if it is determined that the action may adversely affect a listed species, the federal agency must submit a request for formal consultation to comply with Section 7 of the ESA. In response, FWS or NMFS would issue a Biological Opinion as to whether or not the federal action would likely jeopardize the continued existence of a listed species, or result in the destruction or adverse modification of designated critical habitat. In compliance with Section 7 of the ESA, FERC staff has prepared this section of the EIS as the Biological Assessment.

Federal and state regulations protect a number of species that potentially occur in the vicinity of the Broadwater LNG Project. With assistance from Broadwater, consultation was conducted with FWS, NMFS, and the NYSDEC's New York State Natural Heritage Program to assess impacts to protected species. The species identified during these consultations are discussed in detail below.

3.4.1 Federally Listed Threatened and Endangered Species

Potential impacts to federally listed species could be associated with the offshore portion of the proposed Project or the onshore facilities. There is no critical habitat designated in the offshore or onshore Project area.

NMFS identified seven federally listed threatened or endangered species that potentially occur in the proposed offshore Project area (NMFS 2005b). The seven species include four reptiles (loggerhead sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, and green turtle) and three marine mammals

(North Atlantic right whale, humpback whale, and fin whale). FWS stated that, except for occasional transient individuals, no threatened or endangered species under the purview of FWS occur in the proposed offshore Project area (FWS 2005). Additionally, a federally and state-listed threatened and endangered species (the shortnose sturgeon) may occur in the proposed offshore Project area and will be considered. Table 3.4.1-1 summarizes our determinations of effect for all of the species identified.

TABLE 3.4.1-1
Federally Listed Threatened or Endangered Species and Protected Species Potentially Occurring in the Offshore Project Area

Species	Status	Preferred Habitat/Notes	Determination
Reptiles			
Kemp's ridley sea turtle (*Lepidochelys kempii*)	F – E NY – E	Shallow coastal and estuarine waters over sand or mud bottoms.	Not likely to be adversely affected
Loggerhead sea turtle (*Caretta caretta*)	F – T NY – T	Open seas over the continental shelf, bays, estuaries, lagoons, creeks, and mouths of rivers.	Not likely to be adversely affected
Green turtle (*Chelonia mydas*)	F – T NY – T	Shallow waters such as shoals and lagoons, inlets, bays, and estuaries.	Not likely to adversely affect
Leatherback sea turtle (*Dermochelys coriacea*)	F – E NY – E	Open sea, coastal waters, and sandy beaches with a deepwater approach.	Not likely to be adversely affected
Fish			
Shortnose sturgeon (*Acipenser brevirostrum*)	F – T NY – E	Anadromous fish that prefers nearshore marine, estuarine, and riverine habitats of large river systems. Rarely found in Long Island Sound.	Not likely to be adversely affected
Atlantic sturgeon (*Acipenser oxyrhynchus*)	F – NL NY – P	Anadromous fish that migrates from saltwater to freshwater to spawn. Spends most of life in the sea and returns to large coastal rivers in estuaries during spawning. Rarely found in Long Island Sound.	Not likely to be adversely affected
Mammals			
Finback whale (*Balaenoptera physalus*)	F – E NY – E	Winters in subtropical waters and summers in colder areas of Arctic and Antarctic.	Not likely to be adversely affected
Humpback whale (*Megaptera novaeangliae*)	F – E NY – E	Pelagic and coastal waters, sometimes frequenting inshore areas such as bays. Winters largely in tropical/subtropical waters near islands or coasts and summers in temperate and subpolar waters.	Not likely to be adversely affected
Northern right whale (*Balaena glacialis*)	F – E NY – E	Range extends from coastal waters off southeastern United States (winter) to New England waters and north to the Bay of Fundy (summer).	Not likely to be adversely affected

Status:
E = Endangered.
F = Federal.
NL = No listing.
NY = New York.
P = Protected.
T = Threatened.

The onshore facilities would be located at existing facilities and would include a warehouse, offices, and adjacent dock. The only onshore construction activities would be the possible installation of a fence and a guardhouse. Operational activities would include use of the existing office space and warehouse, as well as transit of marine vessels (tugs) between the dock and offshore areas, and berthing the vessels at the dock. Broadwater is considering two separate locations for the onshore facilities: Port Jefferson and Greenport. A description of the onshore facilities is provided in Section 2.4.4. Broadwater contacted NMFS, FWS, and NYSDEC in January 2006 regarding threatened and endangered species that could be affected by the potential onshore facilities at either location (E&E 2006a, 2006b, 2006c). On February 6, 2006, NMFS responded that the federally listed whales and sea turtles identified above for the offshore portion of the proposed Project could also possibly be present within 5 miles of the onshore facilities. NMFS concluded that whales would be expected to be very rare in this area, and there is very little site-specific information on sea turtle occurrence or density in Long Island Sound. On February 10, 2006, FWS reported that the federally listed (threatened) and state-listed (endangered) piping plover was the only federally listed species under FWS jurisdiction that occurs within 2 miles of either of the potential onshore facilities. Piping plover typically utilize coastal beaches or bare sand areas. The potential onshore facilities are currently used as office space, warehouse space, and commercial docks. Based on the currently available information on the use of an existing onshore facility for continued commercial use, it is anticipated that there would be no additional impacts to onshore threatened and endangered species; consequently, the following discussion focuses on potential impacts of the offshore portion of the proposed Project.

3.4.1.1 Whales

Three whales that are federally listed as endangered possibly could occur in the waters of Long Island Sound and in the waters traversed by the LNG vessel transit routes. These whale species include the finback whale, humpback whale, and northern right whale (Table 3.4.1-1).

Finback whales can be found in oceans worldwide. They are generally found in deeper offshore waters and prefer high latitudes and colder climates. These whales tend to migrate to warmer waters during winter and to colder areas to the north during summer (NYSDEC 2005b). Finback whales have been reported off the coast of Long Island Sound during summer but are rarely seen within the Sound (Durham 2005).

Humpback whales are distributed in oceans worldwide. Humpback whale populations historically were depleted by over-harvesting and continue to be threatened by marine pollution, disturbance by vessel traffic, and entanglement in fishing gear (NatureServe 2004). Humpback whales may be sighted off the coast of Long Island Sound during summer but are rarely seen within the Sound (Durham 2005).

Northern right whales are found in the north Atlantic and north Pacific Oceans. The population inhabiting the Atlantic Ocean is referred to as the Northern Atlantic right whale. There are five North Atlantic "high-use" areas: coastal Florida and Georgia, the Great South Channel east of Cape Cod in Massachusetts, Cape Cod Bay and Massachusetts Bay, the Bay of Fundy, and Browns and Baccaro Banks south of Nova Scotia. The majority of the northern right whale population in the Atlantic can be found off the coast of New England during spring and summer, and then they migrate to waters off of southern Canada for the end of summer and winter (NYSDEC 2005b). Northern right whales have been reported off the coast of Long Island Sound during summer but are rarely seen within the Sound (Durham 2005).

Potential impacts to whales could be associated with vessel strikes, noise, turbidity, and lighting during construction; and vessel strikes, noise, and lighting during operation. Although whales are relatively rare in Long Island Sound, they could be affected by increased vessel traffic associated with the proposed Project in the Sound and open seas. Documented collisions between vessels and toothed whales are uncommon; however, whales have been struck and killed by ships (Slijper 1962). In addition, a proportion of collisions is most likely undocumented.

In the presence of vessels, whales may exhibit no response to the vessels; they may exhibit avoidance response; or they may exhibit behaviors that increase their susceptibility to collision – such as startle responses, erratic surface movements, reduced surface time, fewer blows per surfacing, shorter intervals between successive blows, and increased frequency of dives without raised flukes (Whitehead et al. 1990, Cawthorn 1992, Gordon et al. 1992).

The probability of whales encountering Project-related vessels in Long Island Sound or LNG carriers in the open ocean would be inherently low due to the species' overall rarity. To reduce impacts during construction, Broadwater would use biological monitors to identify federally listed species present in the active construction area, monitor broadcasts for the presence of species within 5 miles of daily construction areas, and avoid areas with federally listed species present.

In June 2006, NMFS published a Proposed Rule to reduce vessel impacts to North Atlantic right whales. The Proposed Rule proposes a mandatory vessel speed restriction of 10 knots (11.5 miles per hour) or less in specific locations during times when North Atlantic right whales may be present. Under the Proposed Rule, the vessel speed restriction would be mandatory from November 1 through April 30 and would apply to all Project-related vessels over 65 feet in length. The area covered by the seasonal speed restrictions would be seaward of Long Island. The northwest boundary of the area would be a line between Montauk Point on Long Island to the western end of Martha's Vineyard and extending 30 nautical miles to the southeast. In addition, vessel speed restrictions could be enacted in other areas in the Atlantic Ocean and at other times of year by NMFS, based on the presence of North Atlantic right whales and especially congregations of right whales. Therefore, **we recommend that:**

- **Broadwater ensure that Project-related vessels adhere to the requirements identified in the June 26, 2006 NMFS Proposed Rule to protect right whales, including a maximum speed of 10 knots (11.5 miles per hour), or any subsequent rulemaking intended to protect the North Atlantic right whale.**

Noise associated with construction of the proposed Project could limit whale use of the proposed Project area during active construction. Installation of the proposed YMS would require four pilings. Installation of these pilings (known as pile-driving) would result in elevated noise, which could affect marine mammals. According to Broadwater, each piling would require approximately 1 week to install, and installation would occur over a period of 8 weeks. Potential impacts could range from masking of signals, startling, and displacement to potential injury (Richardson et al. 1995). The intensity of potential impacts would depend on the proximity of the marine mammal to the pile-driving. Marine mammals may suffer temporary threshold shift, or temporary hearing loss, if exposed to shock of 180 decibels or greater (Greene 1999). Temporary threshold shift can last from a few minutes to hours or days (Richardson et al. 1995). However, Richardson et al. (1995) conclude that no reports demonstrate that high levels of steady or impulse noise cause "discomfort" or nonauditory physiological effects in marine mammals.

Marine mammals would be expected to leave active construction areas and return to the area once construction has ceased. To reduce potential impacts to marine mammals, Broadwater would initiate pile-driving with lower force and then gradually increase to full force, to allow marine mammals (and other mobile organisms) to leave the active pile-driving area. Broadwater's preliminary noise estimates indicate that noise may reach 180 dB up to 0.6 mile from construction activities; Broadwater also has indicated that specific pile-driving methods would be dependent on the results of pending geotechnical surveys. NMFS has requested noise modeling to quantify Project-specific noise levels during construction and operation, and development of appropriate measures to avoid and minimize potential noise impacts. Broadwater has reported that it would continue to consult with NMFS, COE, and NYSDEC, once geotechnical investigations are complete, to develop construction procedures to further minimize impacts – such as the possible use of vibratory piling methods. We have included a recommendation in Section 3.3.2.2 that Broadwater coordinate with NMFS to identify noise thresholds protective of marine resources and appropriate mitigation measures to avoid and minimize impacts during Project construction and operation. A discussion of potential impacts to humans associated with Project construction and operation noise is provided in Section 3.9.

Localized increases in turbidity would be generated in the vicinity of active plowing during pipeline installation, and during periodic maintenance of the pipeline every 5 to 7 years during operations. As discussed in Section 3.2.3.1, these increases would be limited to the immediate construction area, would generally be less than 5 mg/L above ambient conditions, and would dissipate within 12 hours of sediment disturbance. Therefore, any impacts of increased turbidity on federally listed whales would be negligible and temporary.

As described for marine mammals in Section 3.3.4, potential impacts of lighting to federally listed whales would be expected to be minimal, based on the measures that Broadwater has proposed; these include downshielding lights on work areas, limiting the number and wattage of lights, and using the minimum amount of light necessary to provide safe navigation and a safe work environment.

With strict adherence to the measures identified by Broadwater and implementation of our recommendations outlined above, we have determined that whales would not likely be adversely affected by construction or operation of the proposed Project.

3.4.1.2 Sea Turtles

Four sea turtles within Long Island Sound are federally listed as threatened or endangered: the Kemp's ridley sea turtle, loggerhead sea turtle, green sea turtle, and leatherback sea turtle (Table 3.4.1-1). These sea turtles are known to occur in Long Island Sound during the warmer summer months (NYSDEC 2005b). The loggerhead and leatherback sea turtles also may be found in open ocean areas that would be traversed by LNG carriers. It is possible that any of these species could be present within the proposed Project area on a transient basis. There are no designated critical habitats or designated migratory routes for these species in Long Island Sound.

The Kemp's ridley sea turtle primarily inhabits coastal areas from Canada to Florida, and along the Gulf of Mexico. These turtles have a single primary nesting area on a beach near Rancho Nuevo in Tamaulipas, Mexico. Although hatching in Mexico, many juveniles travel with the Gulf Stream each summer to the waters of Long Island Sound. These waters provide important habitat for immature Kemp's ridleys during the early stages of life (2 to 5 years) (NYSDEC 2005b). Juvenile Kemp's ridley turtles that inhabit the Sound prefer feeding locations in relatively shallow water. These sea turtles migrate south to warmer waters by late fall. These turtles have been observed in relatively large numbers in Long Island Sound (Sadove and Cardinale 1993). Kemp's ridley turtles prey on crabs, fish, jellyfish, squid, snails, clams, starfish, and some marine vegetation.

Loggerhead sea turtles are widely distributed throughout temperate and subtropical waters. This species tends to inhabit warm waters of continental shelves, estuaries, coastal streams, and salt marshes. The loggerhead range extends from Canada to Argentina in the western Atlantic Ocean. Nesting primarily occurs on beaches from New Jersey to Texas (NYSDEC 2005b). Loggerhead sea turtles return to the Sound and Long Island's eastern bays every year in late June, as water temperatures rise, and then migrate south to warmer waters by late fall. Although some adults can be found along the ocean shore and in New York Harbor, juveniles occur throughout the coastal bays and the Sound. The loggerhead sea turtle feeds on crabs and other crustaceans, mollusks, jellyfish, and sometimes fish and eelgrass (NYSDEC 2005b).

Green sea turtles inhabit the Atlantic Ocean from Massachusetts south to Florida. They also can be found throughout the Gulf of Mexico and the Caribbean Sea. Green sea turtles prefer shallow waters with submerged vegetation, such as shoals, lagoons, inlets, bays, and estuaries. Nesting occurs in subtropical and tropical waters that remain above 68°F during the coldest months (NYSDEC 2005b). Green sea turtles are commonly found in the New York Bight but to a lesser degree than some other sea turtles. This species is found in Long Island Sound and generally inhabits shallow-water bays (Sadove and Cardinale 1993).

In the Atlantic Ocean, leatherback sea turtles are found off the coast of New England south to the Gulf of Mexico. This species also inhabits waters off the coast of Canada, the British Isles, Iceland, Spain, and other waters off Europe (NYSDEC 2005b). Leatherback turtles are commonly seen in the offshore waters of Long Island Sound during the late summer (NYSDEC 2005b). This species is found along the south shore of Long Island and Long Island Sound but rarely inhabits the bays (Sadove and Cardinale 1993). Leatherback sea turtles nest primarily on "high-energy" coarse sand beaches that are adjacent to deep water. Nesting primarily occurs at St. Croix, Puerto Rico, and the mid-Atlantic coast of Florida. However, some nesting has occurred along the coast from Georgia to North Carolina (NYSDEC 2005b).

Potential impacts to sea turtles could include vessel strikes, noise, turbidity, and lighting during construction; and vessel strikes, noise, and lighting during operation. Each of the sea turtle species discussed above has feeding, swimming, or resting behaviors that keep them near the surface, where they can be vulnerable to vessel strikes. In the open waters of Long Island Sound, the increase in vessel traffic associated with the proposed Project would represent a slight incremental increase in vessel traffic over current conditions. As discussed in Section 3.7.1.4, the proposed Project would result in less than a 1 percent increase in the vessel traffic in Long Island Sound.

Areas with regular vessel traffic, such as shipping channels, may be avoided by sea turtles. Construction vessels, LNG carriers, and support vessels would utilize existing shipping routes to the maximum degree practical. As described above for whales, the likelihood of vessel strike may be related to the speed of the vessel, and it is likely that turtles could avoid relatively slow-moving construction vessels, LNG carriers, and support vessels. In general, construction vessels, support vessels (primarily tugs), and LNG carriers operate at relatively slow speeds. It is anticipated that any nominal increase in the amount of ship traffic in the region associated with the proposed Project would have a negligible influence on vessel strikes.

During construction, Broadwater would use biological monitors, avoid the use of high-speed vessels, and avoid areas with observed or reported sea turtles or marine mammals. In addition, we have recommended that Broadwater adhere to NMFS' Proposed Rule to protect federally listed whales, including speed restrictions in designated areas. Therefore, any potential impacts associated with vessel strikes would be very infrequent, but potential impacts could occur throughout the life of the proposed Project.

Noise associated with construction of the proposed Project could temporarily limit sea turtle use of the proposed Project area during active construction. Most construction would occur between late fall and early spring, when sea turtles are not present in Long Island Sound. However, some preliminary construction activities during early fall could overlap with the occurrence of some turtle species. Noise would continue to some degree throughout operation of the proposed Project in association with operations on the FSRU and LNG carriers. As discussed in Section 3.3.2.2, we have recommended that Broadwater consult with NMFS to identify appropriate measures to avoid and minimize potential impacts of noise on marine resources during both construction and operation.

Turbidity would largely be associated with trenching activities during construction, which would occur during late fall and early winter – when sea turtles seldom occur in Long Island Sound. During operation, there could be periodic daylighting of the pipeline, primarily at the IGTS tie-in, to allow pigging operations every 5 to 7 years. The turbidity associated with these activities would be primarily located in the immediate vicinity of active plowing and would assimilate into Long Island Sound within approximately 12 hours of sediment disturbance. Thus, there would be a negligible impact of turbidity on sea turtles.

Potential impacts of Project lighting on federally listed sea turtles would be expected to be minimal, based on the physical location of the proposed Project and the measures that Broadwater has proposed. Lighting concerns for sea turtles typically are associated with potential interference with nesting behaviors on beaches. There are no nesting beaches for these species in the Long Island Sound area. Broadwater has proposed to limit potential impacts to sea turtles and other marine resources by downshielding lights on work areas and by limiting the number and wattage of lights.

Concerns have been expressed about the potential for Project-related thermal discharges to influence sea turtle behavior, based on previous instances of sea turtles and other species congregating at power plant discharges. As discussed in Section 3.2.3.2, the thermal discharges associated with Project operations would be substantially less (in frequency, volume, and temperature difference) than thermal discharges typically associated with power plants. The only thermal discharges associated with typical operations would be from occasional steam-powered LNG carriers berthed at the FSRU (the next generation of LNG carriers would be diesel powered and would not require as much cooling water). It is expected that thermal discharge associated with the LNG carrier cooling water would generally be 3.6°F above ambient seawater temperature. In addition, cooling water requirements of the LNG carriers would be similar to those of commercial vessels currently using the Sound, and any discharges would be conducted according to standard shipping practices. Therefore, minimal impact to sea turtles, if any, would be related to thermal discharges.

For these reasons, we have determined that sea turtles would not likely be adversely affected by construction or operation of the proposed Project.

3.4.1.3 Fish

The shortnose sturgeon is the only federally listed fish species that has been identified as potentially using the Project area. The shortnose sturgeon is federally listed as threatened and state listed as endangered. The Atlantic sturgeon is not federally listed but is listed as protected by the State of New York (Table 3.4.1-1). The Atlantic sturgeon is discussed here at the request of NMFS due to the potential consideration for future listing, and the similarity in its life history and transient occurrence in the Project area.

The shortnose sturgeon is a semi-anadromous fish. In April and May of each year, adult sturgeon migrate up the Hudson River from their mid-Hudson overwintering area to spawn in freshwater sites. Like the shortnose sturgeon, Atlantic sturgeon migrate to freshwater from April to June each year to spawn. However, newly hatched Atlantic sturgeon remain in freshwater until they are approximately 7 years old. Afterward, Atlantic sturgeon spend the rest of their lives at sea and in saltwater, except during spawning. Male shortnose sturgeon spawn every other year, while female shortnose sturgeon spawn every 3 years. The shortnose sturgeon inhabits estuaries and large coastal rivers within the

Atlantic seaboard of North America (NYSDEC 2005b). In New York, shortnose and Atlantic sturgeon are primarily found in the Hudson River (NYSDEC 2005b) and are rarely found in Long Island Sound (Stone et al. 1994).

Although these species are rarely found in Long Island Sound, they could theoretically be present as transients in the proposed Project area. Sturgeon are typically associated with the lower water column. Thus, there would be little likelihood of any potential impacts during operation of the Project. However, any impacts would be long term because they could occur throughout the life of the Project. We have determined that shortnose sturgeon and Atlantic sturgeon would not likely be adversely affected by construction or operation of the proposed Project.

3.4.2 State-listed Threatened and Endangered Species

The only additional species of concern identified by the State of New York for the offshore portion of the proposed Project is the Atlantic sturgeon. As mentioned above, the Atlantic sturgeon is not state listed as threatened or endangered, but it is categorized by the State of New York as protected. This species theoretically could occur as a transient in the Project area, but any impacts would be negligible and infrequent. NYSDEC's New York State Natural Heritage Program did not identify any other state-listed threatened or endangered species with known occurrences in the proposed offshore Project area.

On February 16, 2006, NYSDEC reported that the New York Heritage Program database identified various state-listed species that could be located within 4 miles of the potential onshore facilities. These species are identified in Table 3.4.2-1, including various bird and plant species at both the potential Port Jefferson location and the Greenport location. The database records provided by NYSDEC did not provide specific habitat information, but most of the species listed would not be expected to occur along the shoreline habitat of Long Island Sound associated with the existing dock and warehouse facilities at either proposed onshore locations.

Specifically, five state-listed species were identified within 4 miles of the potential Port Jefferson location, including two bird species and three plant species. Two bird species and 16 plant species were identified within 4 miles of the Greenport facility. Because both potential onshore facilities are existing facilities that are used as commercial docks, the proposed onshore activities are not expected to significantly affect state-listed species. Nevertheless, **we recommend that:**

- **Prior to construction, Broadwater coordinate with NYSDEC to identify any measures appropriate to avoid and minimize potential impacts to state-listed species.**

3.4.3 Conclusions and Recommendations for Threatened, Endangered, and Other Special-status Species

Broadwater has proposed a variety of measures to reduce potential environmental impacts to federally and state-listed species, including use of biological monitors during construction and coordinating with federal and state resource agencies to identify additional measures to reduce potential impacts of Project construction and operation. Additional measures have been identified by Broadwater to reduce the loss of aquatic habitats and reduce potential impacts to water quality. In addition to benefiting biological communities in the area, these measures would benefit listed species with the potential to occur in the vicinity of the proposed Project. Prior to and throughout construction, Broadwater would train all personnel on procedures that should be followed to comply with proposed and required environmental mitigation measures. In addition, we have included various recommendations to further avoid and minimize potential impacts to listed species, including complying with the speed

TABLE 3.4.2-1 Summary of State-listed Species within 4 Miles of Potential Onshore Facilities				
			Onshore Facility	
Common Name	Scientific Name	State Status	Port Jefferson	Greenpor t
Birds				
Least tern	*Sterna antillarum*	Threatened	X	X
Common tern	*Sterna hirundo*	Threatened	X	X
Plants				
Northern blazing-star	*Liatris scariosa* var. *novae-angliae*	Threatened	X	
Northern gamma grass	*Tripsacum dactyloides*	Threatened	X	
Slender pinweed	*Lechea fenuifolia*	Threatened	X	
Marsh fimbry	*Fimbristylis castanea*	Threatened		X
Swamp cottonwood	*Populus heterophylla*	Threatened		X
Seacoast angelica	*Angelica lucida*	Endangered		X
Seaside orach	*Atriplex glabriuscula*	Endangered		X
Slender crabgrass	*Digitaria filliformis*	Threatened		X
Fireweed	*Erechtites hieraciifolia* var. *megalocarpa*	Endangered		X
Plants				
Scotch lovage	*Ligusticum scothicum* ssp. *Scothicum*	Endangered		X
Saltmarsh aster	*Symphyotrichum sublulatum* var. *subulatum*	Threatened		X
Seaside bulrush	*Bolboschoenus maritimus* ssp. *Paludosus*	Endangered		X
Cat-tail sedge	*Carex typhina*	Threatened		X
Opelousa smartweed	*Polygonum hydropiperoides* var. *opelousanum*	Threatened		X
Swamp smartweed	*Polygonum setaceum*	Endangered		X
Cranefly orchid	*Tipularia discolor*	Endangered		X
Seaside plantain	*Plantago maritima* var. *juncoides*	Threatened		X
Dwarf glasswort	*Salicornia bigelovii*	Threatened		X
Green parrot's-feather	*Myriophyllum pinnatum*	Endangered		X

restrictions in NMFS' Proposed Rule, and consultation with NMFS to identify appropriate methods to minimize potential impacts associated with noise during construction and operation. To confirm that steps are taken to protect threatened and endangered species, **we recommend that:**

- • **Broadwater not begin construction activities at the LNG terminal or along the pipeline route until:**

a. **FERC completes any necessary consultations with FWS and NMFS; and**
b. **Broadwater receives written notification from the Director of OEP that construction and/or implementation of conservation measures may begin.**

If facilities are not constructed within 1 year of receiving authorization from the Director of OEP that construction may begin, Broadwater consult with the appropriate office of FWS and NMFS to verify that previous consultations and determinations of effect are still current.

In assessing impacts to federally listed species, issues and concerns that have been raised by FWS or NMFS during this process include:

- General impacts to whales, sea turtles, and other protected species; and
- Specific impacts associated with vessel strikes, underwater noise, lighting, and thermal discharges during construction and operation of the proposed Project.

We believe that we have addressed these issues through our environmental review process and have recommended certain measures, as appropriate. Based on Broadwater's proposed mitigation, and our additional recommendations, we have determined that the proposed Project would not be likely to adversely affect threatened or endangered species. With this document, we are requesting that NMFS and FWS provide written concurrence with this determination.

3.5 LAND USE, RECREATION, AND VISUAL RESOURCES

The potential impacts of the Project on land use, recreation, visual resources, and associated issues are addressed below. Section 3.5.1 provides summary information about the Project. Potential impacts are addressed for the following topics:

- Land use (Section 3.5.2);
- Residences (Section 3.5.3);
- Planned development (Section 3.5.4);
- Recreation and special use areas (Section 3.5.5); and
- Visual resources (Section 3.5.6).

Section 3.5.7 addresses regulatory compliance, including compliance with the New York State Coastal Management Program (CMP) and the Long Island Sound Coastal Management Plan.

3.5.1 Project Summary

The FSRU would be moored to a YMS located approximately 9 miles north of the nearest Long Island shoreline and about 10 miles from the nearest shoreline in Connecticut. The proposed 30-inch-diameter subsea pipeline would extend southwest from the base of the mooring tower to the IGTS pipeline. At its closest approach, the pipeline would be approximately 4 miles from the nearest shoreline.

The calculated area of impact for the Project, presented in Table 2.2-1 (Section 2.2), would total approximately 2,234.7 acres. That acreage includes approximately 197.3 acres along the pipeline route (75-foot-wide corridor consisting of the trench and adjacent spoil piles), 1.4 acres of additional work space for tie-ins and utility crossings, and 16 acres affected by anchor placement and removal. The proposed construction method also includes an additional 2,020 acres that could be affected by anchor cable sweep. However, we have included a recommendation for anchoring (see Section 3.1) that would eliminate the impact of anchor cable sweep.

Construction of the proposed Project also would require an easement to use lands held in public trust by the state of New York. Based on Minerals Management Service requirements, construction of the proposed pipeline would involve a 300-foot-wide construction easement along the length of the pipeline (approximately 789.1 acres). This easement would be reduced to about 30 feet in width (78.9 acres) during operation (Table 3.5.1-1).

TABLE 3.5.1-1
Easement and Safety and Security Zone Requirements

Project Component	Easement Requirement during Construction (acres)	Permanent Easement Required during Operation	Permanent Safety and Security Zone (around the YMS and FSRU)[a]	Safety and Security Zone (Surrounding Each LNG Carrier in Transit)
YMS/FSRU	--	--	950 acres[b]	--
Pipeline	789.1[c]	78.9	--	--
LNG carrier	--	--	--	2,040 acres[d]

[a] The safety and security zone would be measured from the center of the YMS mooring tower.

[b] Area of easement that would be established based on using a 300-foot-wide corridor from the YMS to the IGTS tie-in. The 300-foot width is in accordance with the requirements of Minerals Management Service. The actual spatial extent of easements would be determined by the New York State Office of General Services and the applicant. Areas of impact are listed in Section 2.2, Table 2.2-1.

[c] Area of easement that would be established based on using a 30-foot-wide corridor from the YMS to the IGTS tie-in. The 30-foot-wide corridor is based on Project requirements. The actual spatial extent of easements would be determined by the New York State Office of General Services and the applicant.

[d] LNG safety and security zone acreage is dependent on the size of the LNG carrier.

In addition, if the Project is authorized, the Coast Guard would establish a permanent safety and security zone during operation that would extend 0.7 mile (1,210 yards) from the center of the YMS mooring tower and would encompass an area of about 1.5 square miles (950 acres). The Coast Guard would also establish a moving safety and security zone around each incoming and outgoing LNG carrier. That zone would extend about 2.3 miles (4,050 yards) in front of the carrier, 1.2 miles (2,025 yards) behind the carrier, and 0.4 mile (750 yards) on each side. This moving safety and security zone would encompass an area of approximately 2,040 acres, with the actual area dependent on the size of the LNG carrier (Table 3.5.1-1). The safety and security zone would be established at the pilot station for the route used by the incoming carrier (a pilot would board each carrier offshore of either Point Judith Pilot Station or the Montauk Point Pilot Station).

Onshore support facilities would be required throughout construction and operation. Broadwater proposes to use an existing concrete coating facility outside of the New York/Connecticut area and a 10-acre pipe storage yard within an existing developed area at the Port of New York/New Jersey. In addition, Broadwater would lease existing facilities in either Port Jefferson or Greenport, New York to provide office support, warehousing, and waterfront access for tugs and vessels servicing the Project.

Visible components of the proposed Project would include the FSRU, the above-water portion of the YMS, and the LNG carriers – either in transit or while berthed at the FSRU. The FSRU would be approximately 1,215 feet long and 200 feet wide. The uppermost deck would extend approximately 80 feet above the water line, with other portions of the FSRU extending above that deck (see Figure 2.1-3 and Section 2.1.1.2 for additional FSRU dimensions). The YMS would extend about 134 feet above the water line.

Broadwater has developed a preliminary lighting plan for the FSRU and YMS, and would establish a final lighting plan during the detailed engineering phase of Project development. Lights would be required for night-time operation, including over-side lighting around the perimeter of the FSRU and YMS. During the night, LNG carriers and support vessels also would have operational lights turned on.

In addition, the Coast Guard would require that lights be installed on the FSRU and YMS as aids to navigation. These would consist of white lights that would flash at 30-second intervals and would be visible for 11.5 miles from a point 16.4 feet above sea level. Red warning lights would be installed along the port and starboard sides, and would be visible for 2.3 miles from a point 16.4 feet above sea level. Two flashing red "aviation obstruction" lights likely would be required by the Federal Aviation Administration (FAA), one on the emergency flare tower (approximately 280 feet above the water line) and a second on the radar mast adjacent to the helipad (approximately 180 feet above the water line). In addition, the FAA may require the emergency flare tower to be painted with alternating bands of orange and white. Lights also would be associated with the helipad; however, because a helicopter would be used only during emergencies, the lights normally would be turned off.

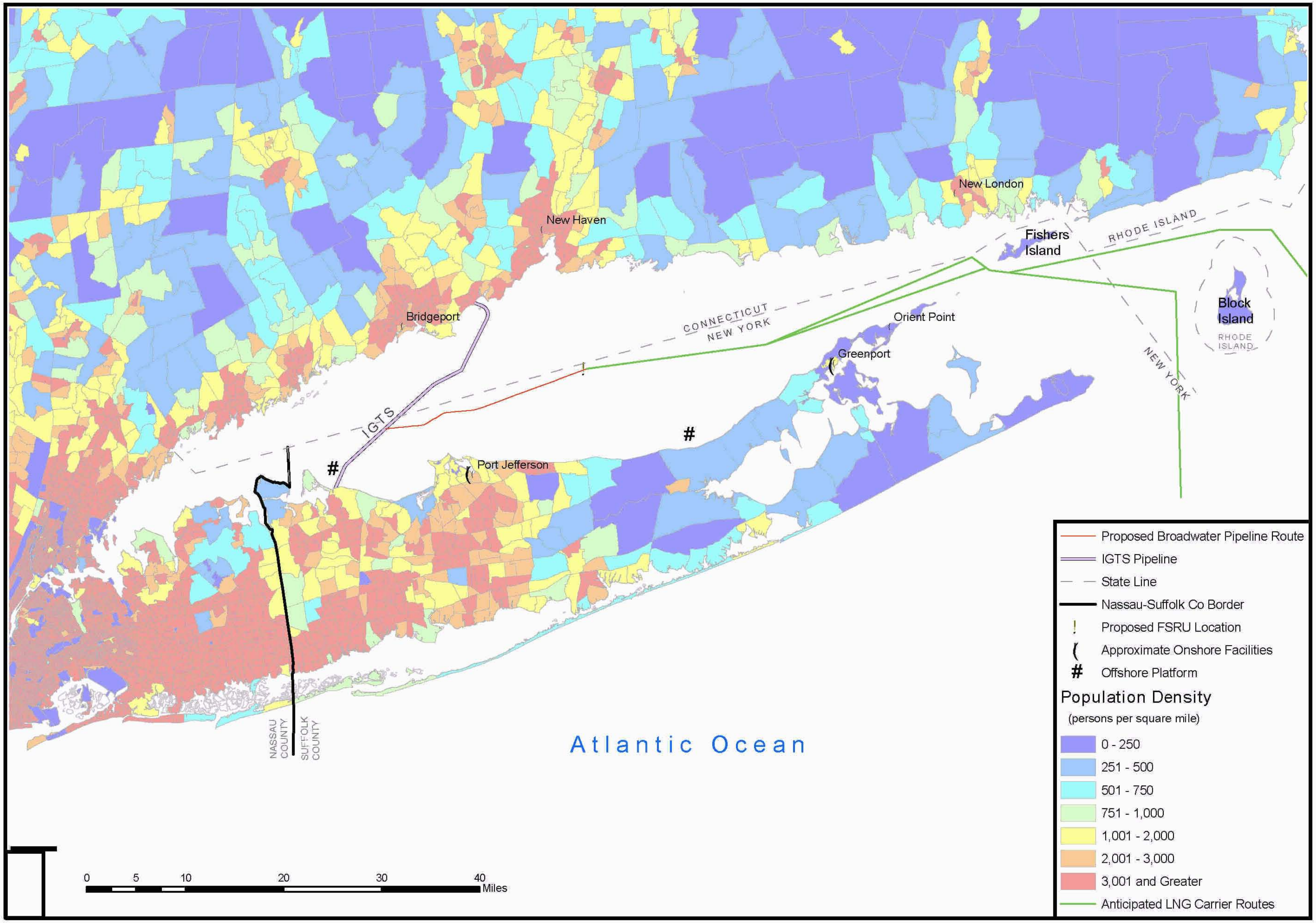
Two to three carriers per week would deliver LNG to the FSRU. These vessels would range in capacity from 125,000 to 250,000 m^3, with overall dimensions ranging from about 935 to 1,130 feet in length and about 145 to 180 feet in width. The LNG carriers would follow one of the two routes depicted in Figures 3.5-1 and 2.4-1, either the Block Island route (northern route) or the Montauk Channel route (southern route).

In examining the potential impacts of the Project on land use, a number of possibilities were identified. For example, the proposed Project could alter current land- and water-related uses due in part to establishment of easements and the safety and security zones. In addition, special use areas and waterfront development plans could be affected by the proposed Project. Recreation could be affected if construction or operation of the proposed Project resulted in more limited access to recreational sites or reduced enjoyment of those sites once access was gained. Impacts to visual resources would depend on the existing viewscape, the alteration to that viewscape, the sensitivity of viewers, and the number of potential viewers. The following sections consider these possible impacts and their levels of significance.

3.5.2 Land Use

3.5.2.1 Existing Conditions

The FSRU, YMS, and pipeline would be in the Suffolk County, New York waters of Long Island Sound. Potential impacts associated with the Project primarily would occur in this area, although the LNG carriers traveling to and from the terminal along the southern route would traverse the waters of Block Island and those using the northern route would traverse Block Island and Rhode Island Sounds. All LNG carriers would also transit portions of the U.S. Exclusive Economics Zone (EEZ), which is approximately 200 nautical miles from the U.S. shoreline. Located between Connecticut and New York, the Sound is approximately 112 miles long and 21 miles wide, covering an area of approximately 832,000 acres. The Sound extends from an area called "the Race" on the east to an area near Execution Rocks on the west. The Race is a channel about 3.5 miles wide that extends from the southwestern tip of Fishers Island to Little Gull Island. Within that area, a shipping channel for deep draft vessels approximately 1.4 miles wide separates the Race Rock Lighthouse on the north (off the southwestern tip of Fishers Island) and Valiant Rock on the south. Most large commercial vessels enter and exit the Sound through this channel, as shown in Figure 3.5-1.



Source: Paskevich and Poppe 2000

Figure 3.5-1
Broadwater LNG Project
Population Density in the Vicinity of Long Island Sound

The Sound is a multi-use waterway that has been designated by the U.S. Congress, at the request of New York State and Connecticut, as an Estuary of National Significance. The waters of the Sound support recreation, industry, and commerce.

More than 8 million people live along the estuary, resulting in a variety of shoreline uses. These include heavy industry; deepwater ports; nuclear- and fossil fuel-fired electricity generating plants; nearshore petrochemical platforms; residential areas of varying densities; and open spaces such as agricultural lands, parks, woodlands, and large estates.

As reported in the Long Island Sound Coastal Management Plan (NYSDOS 1999), the Sound's New York State shorelines include 17 waterfront communities that serve as focal points for commercial and recreational activity. In the densely populated western portion of the Sound, these commercial centers are woven into suburban residential development that is interspersed with some natural areas. In contrast, the Long Island shorelines along the eastern portion of the Sound are dominated by large estates, agricultural land, and open spaces that include some beaches.

In the mid-1800s, the whaling industry poured millions of dollars of revenue into Long Island communities. In 1846, the peak year for whaling in the Northeast, 730 ships carrying 10,000 seamen were hunting whales. Thousands more worked in supporting trades, such as coopers making barrels to hold whale oil and other supplies, carpenters, rope and sail makers, and boat builders. Long Island was the second-biggest whaling center outside of Massachusetts.

Suffolk County became New York's largest shipbuilding center outside of Manhattan and Brooklyn by the middle of the 19th century. By 1855, the 25 shipyards in Suffolk County employed 419 workers. Twelve of the shipyards were located in Port Jefferson. Shipyards were also major employers in Northport and Greenport, and in almost every deep, protected harbor along the North Shore and around Peconic Bay.

The third major maritime industry in the 19th century was shellfishing. By 1890, there were 25 oyster processing factories, mostly on the Atlantic shore of Long Island. After being shucked, the oysters were shipped in wooden barrels to New York, initially by boat, and then after the Civil War, by the Long Island Rail Road. By 1901, local oystermen were using boats with power dredges. Oyster Bay and other North Shore harbors also supported an oyster harvesting industry, until it was eliminated through over-fishing and pollution.

Following the peak industrial activity on Long Island after World War II, New York communities began to phase out certain industrial uses, including those on the waterfront, through comprehensive land and water use plans and zoning. As a result, the Long Island Sound waterfront in New York is now dominated by residential uses, recreation and open space, and tourism-related uses (Zappieri 2006).

In Connecticut, oyster harvesting was historically a significant industry. Harvesting and the sale of oysters grew dramatically by the 1850s, and commercial oyster harvesting developed into the dominant industry in Fair Haven. Throughout the 19th century, the oyster industry employed thousands of people in Fair Haven and surrounding communities. In following decades, the oyster industry slowly declined due to over-fishing, pollution, predation by starfish, and poor farming methods. Urbanization of the surrounding area also brought problems with pollution and habitat loss, which resulted in the closing of many shellfish beds. These factors caused a steady decline in oyster harvesting from the 1920s to the 1970s. By the 1930s, the oyster industry was nearly extinct. As the oyster business declined, heavy industry bought up the valuable land along the harbor and riverbanks. In the next three decades, factories and railroad tracks used to ship factory products surrounded the shores along Quinnipiac River, Mill River, and New Haven harbor.

Manufacturing also has been an important part of Connecticut history. For many years, industries dumped chemicals and toxic substances into area rivers and Long Island Sound. From the mid-1800s to the end of World War II, metal plating and fabricating factories were important industries in the Quinnipiac Valley. The discharge of metals during those times has left pollution problems that are present today. This past contamination of the Quinnipiac watershed continues to be found in the sediments of many harbors of the Sound (Rozan and Benoit 2001).

Current development along the Connecticut shoreline of the Sound decreases from west to east. New Haven and Bridgeport are the commercial and industrial centers along the central portion of the Connecticut shoreline. Between these population centers, land use includes light commercial and residential developments, towns, parks, and both public and limited-access beaches. The shoreline east of New Haven includes smaller coastal communities, suburban development, and open spaces up to the Thames River area. Uses along the Thames River shorelines include the U.S. Navy's Groton Submarine Base, Electric Boat (a division of General Dynamics) submarine fabrication facilities, a Hess Oil transfer and storage facility, a Coast Guard Station, and ferry terminals. The Sound is currently crossed by eight power cables, three fiber optic cables, and a natural gas pipeline; there are also three active and several inactive disposal sites. Although there are no formal shipping lanes in Long Island Sound, as described in Section 3.7 and Appendix D, an extensive amount of commercial traffic transits the Sound, including petrochemical tankers and barges. Five areas have been designated as lightering zones (areas set aside for ship-to-ship transfer operations, including the transfer of petrochemicals), and two offshore oil transfer platforms are on the Long Island side of the Sound. In addition, commercial fishing vessels and stationary fishing gear, particularly lobster pots, are common features throughout the Sound.

3.5.2.2 Potential Offshore Impacts

Construction

Most construction impacts would occur primarily within the approximately 75-foot-wide corridor on either side of the pipeline. This area would contain the trench and adjacent spoil piles. In addition, construction would require 1.9 acres of workspace for tie-ins and utility crossings, and 16 acres would be affected by anchor placement and removal. The proposed construction method also included an additional 2,020 acres that could be affected by anchor cable sweep. However, we have included a recommendation for anchoring (see Section 3.1) that would eliminate the impact of anchor cable sweep. As such, construction would affect a small portion of the seafloor and would represent a minor short-term impact.

The proposed pipeline route would cross the AT&T Cable once and the Cross Sound Cable once. Special construction techniques would be used to install the pipeline above these cables (see Section 2.3.2.2), and no impacts to these utilities are anticipated. To ensure that there is a minimal likelihood of affecting the services provided by these cables, **we recommend that:**

- • **Prior to construction, Broadwater develop, in consultation with AT&T and the Cross Sound Cable Company, site-specific construction plans that would avoid impacts to the utilities. The plans be filed with the Secretary, for review and written approval by the Director of OEP.**

Pursuant to the New York State Public Lands Law, Broadwater must apply for an easement for the state-owned underwater land that would be required during construction. The one-time fee associated with this action is designed to compensate the public for use of these lands. A construction easement of about 789.1 acres likely would be required. This easement would represent a minor, temporary land use conversion.

Operation

Conversion of Land Use

A permanent pipeline easement of about 78.9 acres of seafloor would be required. No restrictions would be associated with the permanent pipeline ROW that is outside the permanent safety and security zone. This would represent a minor land use alteration that would last for the life of the Project.

A permanent safety and security zone of about 950 acres of open water around the YMS and FSRU also would be required. Essentially all marine vessels not associated with the Project would be prohibited from entering the permanent safety and security zone around the YMS and FSRU. The Coast Guard may authorize some non-Project vessels to enter this area, although it is likely that few vessels would be given that authorization. This would result in conversion of 950 acres of open water to a restricted use area for the life of the Project. Activities currently occurring within those open waters include commercial lobster fishing and commercial trawl fishing, as well as occasional recreational boating and recreational fishing. Potential impacts to recreational fishing and boating are addressed in Section 3.5.5, and potential impacts to marine transportation are addressed in Section 3.7 and Appendix D.

Conversion of about 2,040 acres of open water surrounding each LNG carrier to a restricted use area would represent a temporary conversion of a relatively small area four to six times per week (two to three inbound carriers and two to three outbound carriers) for the life of the Project. These areas would be affected for the duration of the carrier's passage – approximately 15 minutes, depending on the speed of the carrier. After the carrier and its associated safety and security zone pass out of an area, land use would return to its previous condition; consequently, operation of the LNG carriers would result in minor, temporary impacts to land use that would continue for the life of the Project.

Potential for Stimulating Additional Industrial/Commercial Development

Commentors have expressed concern that approval of the Project could lead to "industrialization" of the Sound. We have assumed that they are concerned that authorization of the Project could be the initial step in widespread development of industrial and commercial structures or facilities in offshore portions of the Sound. To assess the potential for this to occur, we evaluated four potential factors that could lead to such development: secondary economic activity, economic clustering (or agglomeration), precedent, and entrepreneurial innovation.

Secondary Economic Activity. Secondary economic activity is associated with the re-spending of Project-related dollars. This includes indirect effects (changes in sales, income, or employment within backward-linked industries that supply firms participating directly in a project) and induced effects (increased sales from households spending income earned via a project). An example might include increased demand for security officers associated with securing onshore office space.

If implementation of the proposed Project resulted in a substantial amount of secondary economic activity, it could indicate the potential for industrialization. As reported in Section 3.6.3, some additional Suffolk County jobs may result from secondary activities associated with construction and the purchases made by non-local workers for food, clothing, gasoline, and entertainment. This secondary job creation likely would be limited. This is because most construction workers would be housed on barges for the duration of their employment and likely would make their expenditures near their permanent residences. Using assumptions that maximize potential secondary activity, an estimated 118 regional full-time equivalent positions could be associated with secondary economic activity during the construction period.

The majority of these jobs likely would be in non-industrial sectors. During operation, it is expected that secondary economic activity would result in the creation of approximately 30 full-time positions.

This level of secondary activity does not indicate a significant potential for industrialization.

Economic Clustering. Economic clustering (often termed "economic agglomeration") occurs when industries and businesses achieve cost savings by locating in proximity to one another or to essential infrastructure. For example, shipping and packaging facilities may cluster near ports because reduced transportation costs impart competitive advantage. Following discussions with cooperating agencies, we identified a single scenario under which proximity to the FSRU would result in cost savings or a competitive advantage. This may occur if future pipelines could tap into the FSRU output.

However, all FSRU sendout capacity is currently dedicated to the IGTS system. As such, there would appear to be little economic incentive to cluster pipeline infrastructure around the proposed Project.

Precedent. As described above, land use along the shorelines of Long Island Sound already includes many industrial and commercial areas, some of which have been operating for decades. In addition, transient commercial and industrial processes have taken place for many years on the open waters of the Sound. These consist of lightering, commercial fishing, ferry service, and commercial shipping, including extensive traffic of oil and petroleum-product tankers and barges. Although many of the vessels transporting oil and petroleum products deliver fuel to customers in the area, as many as 2,000 barges per year transship through the Sound, from refineries and storage facilities west of the Sound to customers in Rhode Island and Massachusetts.

Commercial and industrial structures in or under offshore waters of the Sound include cable crossings, natural gas and petrochemical pipelines, and two petrochemical platforms. KeySpan's Northport platform, located approximately 1.8 miles north of Northport, New York, has been in operation since 1967. This facility consists of an unloading platform, two mooring platforms (each about 50 feet square), and mooring buoys; in 2005, 82 vessels (barges and tankers) made deliveries to this facility, with oil transported by pipeline to onshore facilities (Fisher 2006). A ConocoPhillips platform is approximately 1 mile off the coast of Riverhead, New York. This facility has been in operation since 1974. Its 100- by 45-foot platform stands 24 feet above mean low water and is visited by approximately 50 tankers per year (Gianfalla 2006).

Although there are existing industrial and commercial uses of the Sound, approval of the Project would result in an industrial/commercial use of the Sound that would differ from most existing industrial or commercial uses for two reasons. First, the Project would be a permanent visible structure as opposed to most current industrial applications conducted on the shoreline, below the surface of the water, or as a transient activity on the surface of the water. Second, it would be farther offshore than the two petrochemical transfer stations currently in operation.

If the proposed Project is constructed, it is unlikely to represent a new trend in offshore industrial development of the Sound for several important reasons. First, offshore industrial projects require waterborne transportation or subsea infrastructure to provide the materials or supplies to produce products or goods, to take the products or goods to the marketplace, or both. Second, one siting criterion for an industrial project in the offshore waters of the Sound would be "remoteness" – that is, the developer would want to establish the facility far from population centers for safety or other reasons. Although that was one of the siting criteria for the Broadwater Project, very few types of industrial projects require the level of remoteness that can be achieved only by an offshore site while also requiring waterborne transportation. Thus, a new industrial project would need to include unique requirements (waterborne transportation and remoteness) to justify offshore development.

In addition, offshore construction is very expensive, and the financial justification for development of new offshore projects would require a high level of local/regional demand for the products or commodities that would be produced or transshipped to the market. Except for energy needs, there are no evident demands that suggest the need for major water-dependent industrial or commercial development in the Sound. If the Broadwater Project were approved and implemented, most of the fuel needs in the region would be met for the near future, thus reducing the probability of additional offshore fuel import, transfer, or storage facilities in the Sound.

Finally, any offshore facility proposed would need to comply with the laws, regulations, and policies administered at that time by federal, state, and local agencies, or by the towns and municipalities. This would include compliance with the CZM policies of New York or Connecticut, or perhaps both.

There are few types of facilities that we can postulate for the offshore area of the Sound. The most obvious possibilities are additional LNG terminals or storage facilities, additional offshore oil transfer platforms, and offshore electrical generating facilities. Construction of the proposed Project would appear to make additional offshore fuel import, transfer, or storage facilities in the Sound less likely. Approval and implementation of the proposed Project could serve as a permitting template for an offshore electrical generating station. However, the area's current facilities are located onshore, and all proposed non-wind peak and baseload facilities would be on land. Locating an electrical generating station offshore would avoid some siting and permitting issues associated with on-land construction. However, such a proposal would encounter other permitting issues associated with the offshore environment, as well as relatively high costs associated with engineering a floating generating platform, insuring such a platform against environmental events, getting the fuel to the station, and transmitting electricity back to the grid.

Based on these considerations, it is highly unlikely that a floating generation station, or any other industrial facility that is difficult to site on land, could be justified for the offshore waters of Long Island Sound due to approval of the Broadwater Project. Such siting would require a supply/demand imbalance, lack of viable substitutes, and high cost impediments associated with onshore sighting.

Entrepreneurial Innovation. Commentors also have noted that the process of permitting, constructing, and operating the proposed Project may spur others to identify or invent potential commercial/industrial applications that would derive cost benefits by being located in the open waters of the Sound.

By definition, innovation, and the motivation behind it, is difficult to predict. However, it is reasonable to assume that construction and operation of the proposed Project could lead to many innovations, and it is possible that an entrepreneur could be spurred to identify a new industrial application that gives the appearance of being appropriate for the open waters of Long Island Sound. If that were to occur, the new application would still require review by the appropriate federal, state, and/or local agencies to determine whether the project is consistent with environmental and other regulatory requirements. Projects that do not meet regulatory requirements would not receive permits from the reviewing agencies.

Industrialization Summary. FERC assessed the potential for industrialization of the Sound based on four factors. As discussed in Section 3.6.3, secondary economic activity associated with the Project would be minor and would not be sufficient to stimulate additional industrial growth. With respect to economic clustering, we were unable to identify situations where establishing a facility near the proposed Project would provide a profitable business environment and spur such activity. This evaluation considered the substantially greater costs of offshore development as compared to those of onshore facilities. Because the Broadwater Project is unique, its criteria for development would not be applicable to other industrial applications – particularly the criteria of remoteness and waterborne dependency. In addition, the greater costs of offshore development would be an obstacle to profitable development of other industrial facilities. Although we recognize that the Project could spur entrepreneurial innovation, new offshore development in the Sound would face the same obstacles listed above for the issue of precedence. Finally, even if new offshore projects are proposed in the future, they would need to be consistent with all existing laws and regulations, and each project would be under the jurisdiction of agencies tasked with protecting the environment and the health and welfare of citizens.

Other Land Use Issues

A commentor has expressed concern that the proposed pipeline could interfere with future dredging activities. The proposed pipeline does not traverse areas that are currently dredged, nor has the FERC staff identified any plans to dredge this area in the future.

Several commentors suggested that a no-fly zone might be established around the FSRU. The FAA generally establishes no-fly zones in response to specific threats or problems. In addition, the Area Maritime Security Subcommittee worked with the Coast Guard in evaluating the safety and security of the Project (as described in the WSR and in Section 3.10) and recommended that consideration be given to establishing flight restrictions around the FSRU and LNG carriers while in the waters of Long Island Sound. The purpose of flight restrictions would be to protect the FSRU and LNG carrier from external threats, not protect the public from a potential fire. Public safety and navigation concerns are addressed primarily through the use of a safety zone.

Flight restrictions currently exist around LNG Carriers as they enter Boston Harbor. However, the FAA generally does not establish no-fly zones around energy facilities such as oil or petroleum product storage tank areas, oil platforms, or nuclear plants.

Additional mitigation measures that contribute to managing risk are discussed in detail in the SSI portion of the WSR.

3.5.2.3 Potential Onshore Impacts

During construction, Broadwater would use one 10-acre pipe storage yard that would be located within an existing developed area at the Port of New York/New Jersey. From the storage yard, pipe segments would be loaded onto barges for transport to the pipe lay barge. Broadwater has not proposed any construction or land conversion in association with the pipe storage yard or the transport of pipe. Section 2.1.4 recommends that, prior to construction, Broadwater identify the specific site and confirm that no environmental impacts would result from the use of these facilities or, if impacts would occur, that all applicable environmental permits and approvals have been obtained.

During construction and project operation, onshore facilities would be needed to provide office support, warehousing, and waterfront access for tugs and vessels servicing the FSRU. Broadwater has stated that these facilities would be leased at existing waterfront developments in Greenport or Port Jefferson, Long Island. Each of the preliminarily identified sites is an existing marine facility and, apart from the installation of a perimeter security fence and guard post, Broadwater does not anticipate converting any land uses or modifying the existing facilities in any other way. Section 2.1.4 recommends that, prior to construction, Broadwater identify the specific site and confirm that no environmental impacts would result from the use of these facilities or, if impacts would occur, that all applicable environmental permits and approvals have been obtained.

The use of these onshore facilities, as proposed by Broadwater, would not result in land use conversions or impacts.

3.5.3 Existing Residences

There are no existing residences within 9 miles of the FSRU and YMS. The residence nearest the pipeline is more than 4 miles away. As a result, residences would not be affected by construction or operation of these facilities or LNG carriers except, potentially, alterations to the viewscape. Potential visual impacts to residents are addressed in Section 3.5.5.

The planned LNG carrier routes generally would maintain a distance of at least 3 miles from the shorelines of Rhode Island, New York, and Connecticut. Carriers transiting the northern part of the channel through the Race could come within about 1 mile of Fishers Island, New York (see Figure 3.5.1). This island has a year-round population of 250 residents; some residences are scattered along the southern shore of the island, generally on relatively large plots. These residences would not be directly affected by the Project due to both their distance from the transit corridor and the short duration of the transit (about 15 minutes).

Onshore activities, the pipe storage yard (located within an existing developed area at the Port of New York/New Jersey) and the staging and support service areas (located at an existing commercial site) would not affect residences.

3.5.4 Planned Development

Potential impacts on planned developments would be limited to other cross-Sound or offshore projects planned to be developed near the proposed Project. FERC staff and NYSDOS have identified only two such projects, the Islander East Pipeline Project and the Long Island Sound Waterborne Transportation Plan.

Islander East is designed to help integrate the natural gas systems of New England and New York, and could serve to reduce price variability and upward price pressure in both the New England and New York natural gas markets. The project would be several miles east of the proposed FSRU site and would not be crossed by the proposed pipeline, which extends west from the FSRU. As such, operation of either project would not directly affect the other.

The Long Island Sound Waterborne Transportation Plan project calls for an assessment of waterborne transportation to potentially reduce highway congestion and the development of a waterborne transportation plan through 2025 (Long Island Sound Ferry Coalition 2002). The proposed Project could interact with plan development by eliminating the potential for transportation through the FSRU safety and security zone and the occasional delays associated with LNG carrier transits. Given the relatively small areas associated with the FSRU safety and security zone, the typical transit routes of commercial shipping (see Section 3.7), and the short-term nature of LNG carrier delays, these potentially minor impacts could be minimized during further development of the Waterborne Transportation Plan.

We understand that, for several decades, there have been discussions and conceptual plans related to a cross-Sound bridge; however, we are not aware of any such plans that are currently being given consideration by the public. As such, construction of such a bridge does not appear to be a reasonably foreseeable event.

Many shoreline communities of Long Island have waterfront redevelopment or revitalization programs. These programs include protection and restoration policies that address issues such as cleanup of former industrial sites, incentives to attract businesses, and preservation or restoration of open and green spaces. The proposed Project would be located offshore in an area not addressed in these plans and therefore would not affect redevelopment or revitalization plans in any material manner.

3.5.5 Recreation and Special Use Areas

3.5.5.1 Recreation

Existing Conditions

Long Island Sound is a popular recreational boating area. Over 355,000 recreational marine anglers reside in Connecticut and New York; they take 1.5 million fishing trips per year (Long Island Sound Interim Task Force 2006). According to a New York Sea Grant study (Connelly et al. 2003), 529,844 boats were registered in New York in 2003. This represented a 20-percent increase over the previous 10 years. Among New York's recreation boaters, the waterbody that accounted for the largest single proportion of boating expenditures was Long Island Sound (Connely et al. 2003). Recreational watercraft typically are smaller vessels that navigate close to shore. As noted by the Coast Guard in its WSR (see Appendix D), recreational vessels generally use the areas of Long Island Sound that are about 3.5 miles off the shoreline. Exceptions to nearshore recreational navigation include occasional cross-Sound boating and regattas. Cross-Sound boating tends to be between major harbors. The cross-Sound navigation routes generally do not include the proposed location for the FSRU as addressed in Section 3.7.

As a component of their application, Broadwater conducted a boat traffic survey near the proposed FSRU and YMS location. During the 39 peak-use hours spent at the proposed site, 83 boats were observed transiting the waters within 0.6 mile of the proposed YMS location. The observations of low use of that area are consistent with FERC research indicating that the routes of boat-based sightseeing tours are generally in the nearshore areas of the Sound. Similarly, most recreational fishing from boats occurs in nearshore areas or near high-value, unique offshore sites. We are not aware of any such sites in the vicinity of the proposed location of the YMS and FSRU.

Many regattas are held in Long Island Sound during the boating season, some of which transit the central portion of the Sound; and some may traditionally include routes near the proposed FSRU security and safety zone. Representatives of local yacht clubs interviewed by Broadwater identified the following races as major regattas held during summer:

- Block Island Race Week – The Block Island Race Week consists of 4 fleets and 29 races off Rhode Island's Block Island. The race has no specific course but is raced on 2- to 3-mile courses in Block Island Sound. Those courses may cross the LNG carrier routes.
- Stratford Shoal Race – The Stratford Shoal Race originates at the Riverside Yacht Club in Riverside, Connecticut. In 2005, the race had two courses, with the starting line for each located off Flat Neck Point, southeast of Greenwich, Connecticut. The first course was the Stratford Shoal Light Course, a 45-mile route from Greenwich to the Stratford Shoal Lighthouse and back. The second course was the Cable & Anchor Course, a 27-mile route from Greenwich to the Cable and Anchor Reef and back. Neither course is near the proposed FSRU security and safety zone.
- Around Long Island Regatta – This regatta originates near Brooklyn, New York, and continues in the Atlantic Ocean along the southern Long Island shore to Montauk Channel at

the eastern end of the island, through Plum Gut (between Orient Point and Plum Island), then along the northern shore of Long Island to Glen Cove, New York. The race takes place over a 24-hour period, with a portion of the route passing near the proposed FSRU security and safety zone; the proximity depends on the specific course taken. The sailboats also could cross the proposed path for LNG carriers and the waters over the subsea pipeline.

- •• Vineyard Race – This race is generally held on Labor Day weekend on a 238-mile course from Shippan Point, near Stamford, Connecticut, through the central portion of the Sound and the Race, past Block Island, to the light tower at the entrance to Buzzard's Bay, and back. Thus, the course for this event runs the length of the Sound and through the Race twice. Depending on the specific course taken within the Sound, sailboats in this regatta could pass near the proposed FSRU security and safety zone. The sailboats also would cross the proposed route of the LNG carriers.

In addition to the larger Sound-wide regattas, many regattas and races take place on a more localized basis (see Appendix D). Local sailing events typically are held in proximity to the clubs sponsoring the events and are limited to areas nearer shore.

Potential Impacts

Construction

In addition to the overall low boating use near the proposed locations of the FSRU and pipeline, FERC notes that Broadwater is proposing to construct the pipeline between October and April, months when recreational fishing and boating activity are reduced. As a result, construction of the pipeline would result in a minor, temporary impact to recreational boating and fishing.

Operation

Recreational boating and fishing activities could be affected by the presence of the FSRU and YMS and the permanent safety and security zone. Although the majority of the regattas occur in nearshore waters, several regattas are known to pass through central portions of the Sound (as described above). Regattas include those with a fixed course and those with courses that vary from year to year. Regattas with fixed courses may require a course change to avoid conflict with the FSRU and its safety and security zone. The impact would be a one-time change in the established course; the change would establish a new course that would avoid the safety and security zone. Regattas that do not have a set course would not be affected by the presence of the FSRU and the safety and security zone. When the course is set for each event, the route could be established to avoid the safety and security zone. Because of its offshore location and the precautionary navigational aids that would be installed by Broadwater, and because the regatta routes could be altered without difficulty in the open waters of the central Sound, operation of the FSRU would not significantly affect recreational navigation. The overall impact to recreational boating of the permanent ROW easement and the safety and security zone around the FSRU and YMS is considered minor and permanent.

Recreational boating and fishing could be disrupted by passage of the LNG carriers and their associated safety and security zones. Disruptions could occur along all portions of the routes but could be particularly acute as carriers enter the Sound through the Race. The shipping channel through the Race is relatively narrow, and the area already experiences periodic marine traffic congestion. In addition, the Race is popular among recreational fishermen, who access the area from marinas and boat launching areas on eastern Long Island, Fishers Island, and Connecticut. In summer, particularly on weekends and holidays, dozens of recreational fishing boats may be in or near the Race at any one time.

Because the Race is relatively narrow, a significant proportion of the recreational vessels in the channel when a carrier is present could be required to leave the area until the moving safety and security zone passes (approximately 15 minutes at any location). The safety and security zone in front of each carrier provides vessels sufficient time to leave the area well before the carrier arrives in the area. In the area of the Race, this impact would range from minor and temporary if LNG carrier transit occurs at night, to moderate and temporary if LNG carrier transit occurs during a peak-use time.

Recreational vessels traveling across the area of the Race (essentially north-south traffic) may experience delays of up to 15 minutes. However, recreational vessels traveling through the Race (essentially east-west traffic) would not be significantly affected since they could travel outside of the safety and security zone. Based on the WSR, the maximum width of the safety and security zone around an LNG carrier would be approximately 1,560 yards (0.9 mile), which includes the width of the carrier, and the width of the most constricted part of the Race is approximately 1.4 miles (2,400 yards). As a result, even within the most constricted portion of the Race, there would be room available for use by other vessels when LNG carriers are passing through. The total distance between the edges of safety and security zone and the edges of the channel at its narrowest point would range from about 840 yards (0.5 mile) to 530 yards (0.3 mile), dependent on the angle of approach taken by the LNG carrier.(see Appendix D and Section 3.7). There are also several other passages adjacent to the Race that recreational vessels could use as alternative routes to transit the area while a carrier is passing through the Race. In addition, most recreational fishing vessels in the vicinity of Race Rock would likely be outside of the safety and security zone of the carriers passing through the Race and would not be affected.

At all other locations along the LNG carrier routes, the impact to recreational fishing and boating vessels would be, at most, minor and temporary but would occur periodically for the life of the Project.

The Coast Guard would require that the LNG carriers transiting the Race avoid, to the maximum extent, periods of peak usage. This would reduce impacts to recreational boating and fishing in the Race to the lowest level possible. LNG carriers would transit the Race once every 1 to 2 days on average, and the approximate duration of the anticipated traveling safety and security zone at any single point would be approximately 15 minutes. We would expect only intermittent and temporary disruption to normal traffic patterns. As noted above, shallow-draft recreational and commercial craft have the flexibility to move out of the deep channel and would be able to remain within the Race during an LNG carrier transit without intercepting the moving safety and security zone. However, some movement may be necessary during some carrier transits of the Race.

The number of recreational vessels affected by the safety and security zone around the carriers would depend upon the season, day, and time of LNG transit; and the Coast Guard has indicated that consideration of recreational activity would be a component of transit scheduling. In addition, LNG carriers, and thus the moving safety and security zone around them, would be present in the Race less than 1 percent of the year (approximately 60 hours per year). In other areas of Long Island, Block Island, and Rhode Island Sounds, there would be sufficient room for commercial and recreational vessels, including ferries, to avoid the safety and security zone around the carriers with only minor route modifications, at most.

As a result, the impact of LNG carrier transits on recreational boating and fishing is considered minor and temporary.

Regattas could be affected if their timing and location conflict with the approach of an LNG carrier. However, all regattas are subject to prior review and approval by the Coast Guard. It is anticipated that all attempts would be made to coordinate the transit of LNG carriers so that they would not conflict with a known regatta. The effect of LNG carrier transit on regattas would be minor and occasional but would occur for the life of the Project.

Activity at the onshore facilities during construction and operation are not expected to affect recreation.

3.5.5.2 Special Use Areas

Although the entire Sound has been designated as an Estuary of National Significance, no wildlife management areas; marine sanctuaries; or state, federal, or local parks are within 9 miles of the proposed locations of the FSRU and YMS or within approximately 4 miles of the proposed pipeline route. Issues related to the Estuary of National Significance designation are addressed in Section 3.5.7.2.

The seafloor below the safety and security zone of the FSRU and YMS, and submerged lands used for the permanent pipeline easement are currently held in public trust by the State of New York. The NYSOGS, with input from NYSDEC and NYSDOS, is responsible for negotiating compensation for the use of and any potential impacts to the public trust.

Broadwater stated that it intended to submit an application to NYSOGS in late November 2006 to obtain permission to use the seafloor (a ROW easement). Pending issuance of any other required state and federal permits, NYSOGS would issue an easement for the use and occupation of land underwater. NYSOGS and the applicant would determine the spatial extent, terms, and duration of any such easement. NYSDEC and NYSDOS also would review the application to make recommendations regarding natural resources and to address CZM issues. If the ROW easement were granted, an easement fee or another type of payment would be negotiated between Broadwater and NYSOGS.

The nearest special use area, a trawling lane for commercial fishing, is located just north of the proposed YMS location. Commercial fishermen informally set aside this lane and a second lane in Connecticut (see Figure 3.5-2) as areas where they do not use fixed gear (particularly lobster pots) to avoid conflicts with fishermen who trawl. From 2 to 12 fishermen use the trawl lane, depending on the season, with the primary use during August (Crismale 2006).

The trawling lane adjacent to the YMS (Figure 3.5-2) is approximately 0.3 mile (about 530 yards) wide and 12 miles long. The proposed YMS location is about one-third of the way between the western end of the lane and its eastern terminus. The permanent safety and security zone would extend through the entire width of the trawling lane in that area, and the Coast Guard would not allow trawling within the safety and security zone. This would result in shorter trawl distances east and west of the safety and security zone. If those distances are considered unacceptable to the trawl fishermen, trawling might be discontinued in that area or the lane may be shifted. A second trawling lane to the north would not be directly affected by the Project, but increased use of that lane might result. Project operation would result in a permanent impact to Long Island Sound's commercial trawlers. However, a maximum of 12 trawlers would be affected, and as addressed in Section 3.6.8, Broadwater would reduce the economic impact on trawl fishermen by providing compensation to the affected fishermen. Therefore, the overall impact would be minor.

The CTDEP conducts finfish and lobster sampling within survey transects established throughout the Sound, including within the trawling lane. The Coast Guard has stated that it likely would allow the agency to conduct sampling within the safety and security zone, assuming that proper procedures are followed to receive approval and that conditions related to safety and security at the time sampling is planned are acceptable. If sampling is not permitted in the safety and security zone, a small number of

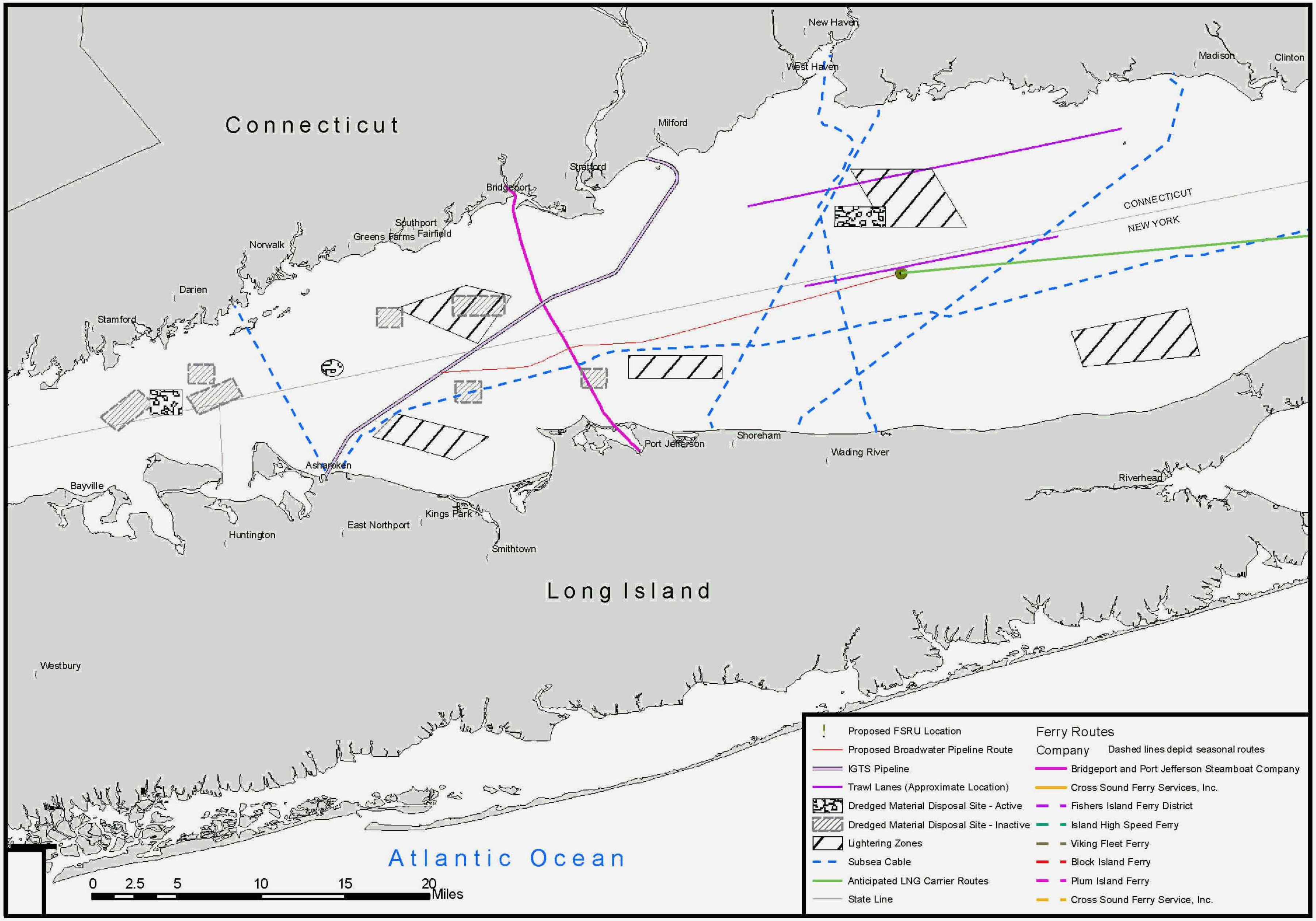


Figure 3.5-2
Broadwater LNG Project
Existing Use Areas in Long Island Sound

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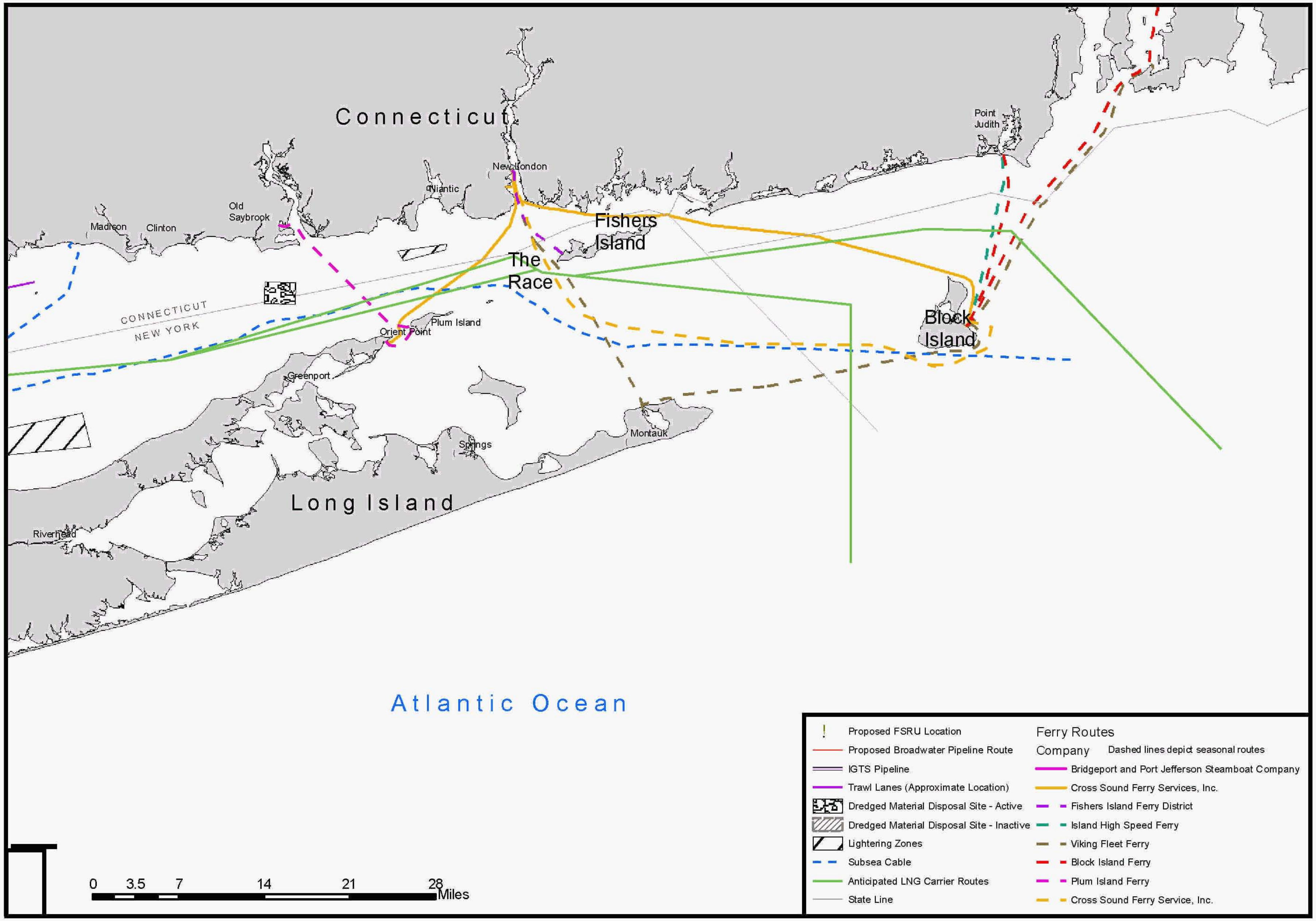

Figure 3.5-2
Broadwater LNG Project
Existing Use Areas in Long Island Sound

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potential transect locations would be eliminated from the pool of potential transect sites. Under these circumstances, the agency would need to make minor statistical adjustments in its analysis before interpreting the longitudinal data set. This would result in a minor, long-term impact on the State of Connecticut's survey program.

Commentors have expressed concern that the FSRU safety and security zone could increase fishing effort along the edge of the safety and security zone by displacing commercial lobstermen and trawlers to the perimeter of the safety and security zone, and that this increased activity may pose a hazard to navigation. FERC believes it reasonable to assume that the approximately five lobstermen potentially impacted by the safety and security zone may adjust by increasing pot density in the remainder of their territories. If this occurred, the fishing hours previously occurring within the proposed safety and security zone would be redistributed to adjacent areas. Because the potentially impacted trawling operations focus their effort within designated trawling areas, they would not redistribute effort to the perimeter of the safety and security zone. Given the Sound's existing use and navigation patterns, refocusing the effort of five commercial lobster boats to areas along the edge of the safety and security zone would represent a negligible, long-term impact on marine use of the area.

Commentors have also expressed concern that, if the safety and security zone acts as a de facto marine sanctuary and increases fish and lobster populations in proximity to the safety and security zone, this may induce existing commercial and recreational fishermen to focus efforts near the safety and security zone and it may also induce new entrants into the commercial and recreational fisheries. Further, they expressed concern that this increased activity may pose a hazard to navigation. The potential for increases in ground and pelagic fish densities at the perimeter of the safety and security zone is negligible. While there is some potential for an increase in lobster densities near the edge of the safety and security zone, the ability of commercial fishermen to enter the fishery and focus effort near the safety and security zone is limited by the current informal fishery regulation and potentially offset by the increased pot density that may occur due to displacement of lobstermen from within the safety and security zone. Therefore, it appears unlikely that small potential increases in population densities of target species would attract additional fishermen or concentrate fishing effort at the perimeter of the safety and security zone.

A commentor noted that NYSDEC designated 5-acre parcels of land close to the shore as Marine Use Assignment Areas. These parcels are for use by shellfishermen for off-bottom culture of shellfish. Because the pipeline is located at least 4 miles from the nearest shore and the FSRU would be about 9 miles from the shoreline, these special use areas would not be affected.

There are no hazardous waste storage or disposal sites, or active offshore disposal sites, within 3 miles of the proposed locations of the FSRU, YMS, or pipeline. Plum Island, home to a U.S. Government laboratory for animal disease research, is approximately 1.3 miles south of the planned LNG carrier route and would not be affected by normal operation of the Project.

No special use areas would be affected by the onshore staging and support service areas.

We have received specific comments regarding Crab Meadow and Soundview beaches, and Jerome Ambro Preserve. Crab Meadow Park, located just east of Northport, New York, offers hiking trails and a 1,060-foot-long beach (Eastern Long Island Beaches 2005). Soundview Beach has a small beach area but primarily serves as a marine facility with a boat ramp that is accessible Memorial Day through Labor Day (Bay Fisherman: Boating Ramps 2005). Jerome Ambro Memorial Wetland Preserve is located just west of Crab Meadow Park.

Of these coastal resources, Crab Meadow is closest to the proposed Project, approximately 7 miles from the IGTS interconnection with the proposed subsea pipeline and more than 27 miles from the FSRU. Consequently, potential impacts would be limited to alteration of views (Section 3.5.3). During construction, it would be possible for some viewers on the beaches to observe the construction vessels. However, because construction would take place during the late fall and winter, few people would use the beaches and the impact would be minor and temporary. Because the FSRU would not be visible from distances greater than 25 miles (as described in Section 3.5.6.1), there would not be a visual impact at any of these locations during operation of the Project.

We have received comments regarding potential impacts to submarine operations. The staff at the Naval Submarine Base New London, in Groton, Connecticut, has been working with the Coast Guard to represent and address U.S. Navy interests.

3.5.6 Visual Resources

Impacts to visual resources depend on the existing viewscape, the number of viewers, and the alteration to the viewscape. As described in Section 3.5.6.1, Broadwater conducted a visual resources assessment of the Project. The potential impacts to visual resources described below are based in part on information from that assessment and observations made by FERC staff during site inspections. Those inspections were conducted along and near the shorelines of Long Island, Connecticut, and Rhode Island, and from marine vessels. This evaluation of visual resources includes the following discussions:

- Applicant-prepared visual resources assessment (Section 3.5.6.1);
- Visibility limitations (Section 3.5.6.2);
- Existing viewscapes and viewers (Section 3.5.6.3);
- Viewscape alteration (Section 3.5.6.4); and
- Visual resources impact summary (Section 3.5.6.5).

3.5.6.1 Applicant-prepared Visual Resources Assessment

Broadwater conducted a visual resources assessment of the Project that followed the basic techniques of the NYSDEC Program Policy entitled *Assessment and Mitigating Visual Impacts* (NYSDEC 2000). The assessment focused on the FSRU, including the FSRU with an LNG carrier berthed. A copy of the assessment is available in the docket for the Project. The Broadwater assessment considered views of the Project from many locations on Long Island and in Connecticut within a 25-mile radius of the Project, including on-water views and views from shorelines and hillsides. Using photographs and computer programs, the analysis included "before" and "after" photographs taken from locations ranging from about 0.5 mile to 25 miles from the FSRU and depicted views during the day and at night.

The limit of 25 miles was established based on the line of sight that would be affected by the curvature of the earth, dependent on the elevation of the viewer. Viewers at 40 feet above sea level and 25 miles from the FSRU would be able to view only those portions of the facility more than about 145 feet above the water line (such as the emergency flare stack and the helipad) – although from that distance, it is likely that the visible portions of the FSRU would be indiscernible. From sea level, those portions of the FSRU that are at least 145 feet above the water line could be observed by viewers up to 20 miles from the facility; similarly, those structures would be barely noticeable from that distance.

3.5.6.2 Visibility Limitations

FERC and Broadwater reviewed meteorological data from three area airports (New Haven Tweed Airport in Connecticut, and Shirley Brookhaven Airport and Westhampton Gebreksi Airport on Long Island) and the National Weather Service station at Bridgeport Connecticut to determine the proportion of the time that the Project might be visible from land. The data suggest that the FSRU would be visible from at least one onshore location between 76 and 83 percent of the time. For the purposes of this EIS, we have assumed that the FSRU would be visible about 80 percent of the time.

3.5.6.3 Existing Viewscape and Viewers

Long Island Sound and its shorelines are part of a diverse viewscape seen by people who live, work, or recreate along or near the shorelines of Long Island Sound – and people on boats or ships on the Sound. Many are afforded shoreline views that include a mixture of industrialized areas and ports, city skylines, residential areas, and undeveloped open space. Other views of the Sound contain recreational and commercial marine traffic; open water; and commercial/industrial structures, including two offshore petroleum transfer platforms. One platform is 1.2 miles off the coast of Riverhead, New York; the other platform is approximately 1.8 miles north of Northport, New York. Night views of the Sound are generally dark, with dim flashes of navigational aids, lighthouse flashes, and lights from passing commercial and recreational vessels frequently visible. The prevalence of land-based lights increases as one moves from east to west within the Sound.

Potential viewing locations with viewscapes that include the proposed location of the FSRU are open areas along the shorelines, residences and other structures or locations with unobstructed views, and on the water. Those potential viewing locations are distributed along approximately 44 miles of Long Island coastline and 92 miles of Connecticut coastline, all of which are within 25 miles of the proposed location of the FSRU. At many locations in those areas, the viewers are screened by vegetation, topography, and man-made structures; from these locations, the proposed location of the FSRU is not visible.

3.5.6.4 Viewscape Alteration

Construction

During construction, offshore activities would be visible from many viewpoints on Long Island and Connecticut on most days. Construction vessel traffic would appear similar to the commercial vessels currently using the Sound, although many of the vessels would remain in the area longer than vessels that are usually in that viewscape. This altered viewscape would last approximately 6 months for pipeline construction and an additional 1 month for installation of the YMS and attachment of the FSRU to the YMS.

Operation

During operation, the Project's visible components would include the FSRU, YMS, service and support vessels, and LNG carriers; no visible plume would be emitted from the FSRU during normal operations. On the approximately 80 percent of the days when the FSRU and YMS would be visible, a side view of the FSRU and a berthed LNG carrier would present the largest image when viewed from the nearest shoreline. Combined, they would appear as a small two-dimensional rectangle on the horizon. This image would be about the same size as a standard paper clip held at arm's length (approximately 1inch long by 0.25 inch high). The primary visual difference between the FSRU and the Sound's existing commercial traffic would be its lack of substantial movement. Since the facility may be more noticeable is there is a substantial color contrast with the surrounding area, Broadwater is evaluating color schemes for the FSRU that would minimize its contrast with the water and skyline.

Passengers on the Bridgeport-Port Jefferson ferry would be about 15 miles from the FSRU at the ferry's closest approach and would be able to view the FSRU/YMS as a relatively small structure that breaks the horizon to the east. Passengers on the Orient Point and Block Island Ferries would be more than 30 miles east of the FSRU and would not be able to see the structure.

At night, the lights on the FSRU and YMS (aid-to-navigation lights, aviation obstruction lights, and operational lights) would be visible from at least some shoreline locations about 292 nights per year. Lights on LNG carriers at berth or transiting the Sound and on support vessels also would be visible. Broadwater stated in its visual resources assessment that, on clear nights and at distances greater than 9 miles, Project lighting would appear as a dim white or yellow/orange cluster on the horizon and would have a shimmering effect due to optical refraction. However, when the EIS was being prepared, Broadwater had not finalized the FSRU lighting. Therefore, **we recommend that:**

- **Prior to placing the FSRU into operation, Broadwater file the final FSRU lighting plan with the Secretary, for review and written approval by the Director of OEP.**

Implementation of the Project would result in an increase in the number of commercial vessels viewed due to the presence of LNG carriers transiting the Sound to and from the FSRU. LNG carriers in transit to and from the FSRU would appear similar to other commercial vessels in Eastern Long Island Sound, Block Island Sound, and Rhode Island Sound, during both day and night.

In Long Island Sound, commercial shipping includes barges, tugs, articulated tug barges, freighters, tankers, and passenger ships. Section 3.7.1.3 addresses the number of annual transits and port visits for these vessels, as well as for commercial fishing vessels. In addition to vessels transiting the Race and the central portion of the Sound on the way to or from ports in New York or Connecticut, tank ships and barges deliver bulk petroleum cargoes to the ConocoPhillips transfer platform in the town of Riverhead, which is about 1 mile from the shoreline. As a result, large tankers, similar in size and shape to the LNG carriers, and barges are present within 1 mile of the shoreline.

As described in Section 3.7.1, there are also 2,000 to 4,000 vessel transits through the Sound each year, that is, vessels that do not stop at ports in the Sound. The vast majority of these vessels are tug-and-barge combinations traveling between the Port of New York/New Jersey and ports in Rhode Island and Massachusetts. These include both container barges that have a relatively large visual profile and petroleum barges, which are low profile vessels.

Additional information on the types of commercial vessels currently using Long Island Sound is presented in Section 3.7.1, particularly Table 3.7.1-4).

The visual aspects of onshore Project components would not be altered in any meaningful way.

3.5.6.5 Visual Resources Impact Summary

Construction

Construction activities at the FSRU and along the proposed pipeline route would be visible about 80 percent of the time from at least some unobstructed viewpoints along shorelines and on hillsides near the construction zone. Because of the number of vessels involved in construction (including transport and supply vessels traveling between harbors and the construction zone), viewers looking toward the Sound likely would be drawn toward the vessels as a point of visual interest. This temporary alteration (about 6 months for pipeline construction and 1 month for YMS and FSRU installation) to views likely would be perceived by some as detrimental. Because construction would occur during the winter months, the number of people using the Sound for recreational purposes would be reduced relative to summer months. The overall impact of construction activities on visual quality in the area is expected to be minor and temporary.

Operation

Although it is not possible to estimate the number of people who would have views of the Project, it is reasonable to assume that, at any given moment, a large number of people living or working within 25 miles of the Project would have obstructed views and would not be able to see the FSRU and YMS. Other viewers, such as people at Wildwood State Park in Long Island, which would be about 9 miles from the FSRU and YMS, would have unobstructed views.

The FSRU, YMS, support vessels, and service vessels would be visible from at least some shorelines about 80 percent of the time. They generally would appear as a single, relatively small object on the horizon that would be similar in appearance to other vessels. The relative size would decrease as the distance between the Project and the viewer increases. Beyond about 25 miles, the FSRU and YMS would not be visible. However, vessels currently plying the waters of Long Island Sound are usually transitive components of the viewscape, whereas the Project-related structures would be stationary and would remain in approximately the same location for the life of the Project.

Daytime viewers with unobstructed views of the Project along the nearest shorelines would notice the Project on the horizon. Some viewers likely would consider the Project detrimental to the viewscape. With increasing distance between the viewer and the Project structures, the ability of viewers to see the Project would diminish; at some point, Project structures would go unnoticed or be perceived as a part of the general commercial traffic on the Sound.

At night, viewers along the nearby shorelines would detect the FSRU and YMS as a small stationary cluster of lights on the horizon and likely would see the flashing red lights on the radar tower and emergency flare tower. The latter would appear similar to the flashing lights on other towers along the Sound's shorelines. As viewing distance increased toward 25 miles, the visibility of the FSRU and YMS would diminish.

LNG carriers in transit to and from the FSRU would appear similar to other commercial vessels. This would be true under both daylight and night-time conditions. When berthed at the FSRU, carriers would appear to be a component of the FSRU. The LNG carriers would increase commercial vessel traffic in the Sound by about 0.3 percent; therefore, the increased number of sightings of commercial vessels likely would not be noticeable to viewers.

Overall, implementation of the proposed Project would result in a moderate impact to visual resources for the life of the Project. Our determination of the impact as moderate is based largely on the distance of the Project from the nearest shoreline and on the results of the visual modeling study, which assessed daytime views, night-time views, and the potential for light pollution.

We have received comments expressing concern that the introduction of a permanent man-made structure to the Long Island Sound viewscape may reduce the public value of the viewshed. To assess the potential for the loss of public value associated with viewshed alterations, FERC noted that a component of private property values includes the value associated with the quality of the ocean views afforded by the location (Wakefield 2001). As discussed in Section 3.6.5, we reviewed the effects of other industrial projects on private property values and did not observe property value reductions at distances greater than about 3.5 miles. Based on that observation, and noting that the vast majority of viewers would be more than 9 miles distant, the data do not suggest that construction and operation of the proposed Project would alter the public value of the Long Island Sound viewshed. Based on the conclusion that property values would not likely be affected by the proposed Project (Section 3.6.5), it is unlikely that the proposed Project would result in a significant reduction in public value derived from the Long Island viewshed.

Commentors have expressed concern regarding the potential night-time visibility of the lighted aids to navigation that would demarcate the FSRU's safety and security zone. While the final configuration of these lights has not been determined, they would not be visible to persons located along the Long Island shoreline at or around sea level due to the curvature of the earth. While the earth's curvature would not block views from elevated shoreline locations, the Coast Guard reports that the lights employed would likely be visible from distances between 1 and 3 miles. As such, lights would not be visible from shore under most viewing conditions.

3.5.7 Regulatory Compliance

3.5.7.1 Consistency with the Coastal Management Program

The Coastal Zone Management Program is authorized by the CZMA and is administered at the federal level by the Coastal Programs Division of NOAA's Office of Ocean and Coastal Resource Management (OCRM). The consistency provisions of the CZMA require federal agency actions to be consistent with each state's federally approved Coastal Management Program (CMP). States with federally approved CMPs, such as New York, have the responsibility of reviewing federal agency actions and activities to ensure that they are consistent with the goals and policies of the state's program. Applicants for federal permits in coastal areas must provide the federal agency with a consistency certification, stating that the proposed Project is consistent with the state's CMP. Because all permanent components of the Project and local staging areas are located entirely within the state of New York's coastal zone, Broadwater is responsible for documenting that the Project is consistent with New York's CMP, including the Long Island CMP (NYSDOS 1999). NYSDOS is responsible for the coastal zone consistency review.

In a letter to FERC dated October 27, 2005, the CTDEP requested that FERC facilitate a coastal zone consistency review of the Project by Connecticut. In response, we notified CTDEP that the OCRM would need to authorize the extension of existing CZMA review authorizations.

On October 6, 2005, the CTDEP submitted comments on both FERC's public notice for preparation of an EIS and the Coast Guard's August 16th notice to prepare a Letter of Recommendation. The letter specifically requested consideration of the impacts on commercial vessels, recreational and commercial fishing, and pleasure crafts due to anticipated safety and security zones to be established in and around the proposed facility and LNG vessel transit routes. For the purposes of the CZMA, the Coast Guard determined that because an applicant is not able to construct or operate an LNG facility without a Letter of Recommendation from the Coast Guard, a Letter of Recommendation should be considered a federal permit.

CZMA regulations require a state to list federal license or permit activities that affect any coastal use or resource and which the state would like to review for consistency with its approved plan. Preparation of a Letter of Recommendation was not listed in Connecticut's approved management plan. For non-listed activities, a state must notify the OCRM, the permitting federal agency, and the applicant of the unlisted activities affecting any coastal use or resource that the state would like to review. The state must bring its request to review the non-listed permitting activity within 30 days of receiving notice of the license or permit application; otherwise the state waives its right to review the unlisted activity.

The CTDEP letter did not specifically request to review the project for consistency nor was it submitted to FERC and the Coast Guard within the 30 days required by the regulations. There is no other indication that Connecticut made a request to OCRM to review the Letter of Recommendation as a non-listed permitting activity. As such, the Coast Guard determined that the CTDEP had effectively waived its right to seek a consistency certification review for the Letter of Recommendation. Consequently, issuance of a Letter of Recommendation under the present circumstances triggers no CZMA requirements for the Coast Guard. The Coast Guard would evaluate the establishment of future safety and security zones discussed in the Letter of Recommendation under the CZMA provisions as direct federal activities.

Broadwater has consulted with NYSDOS on CMP consistency issues and submitted its consistency application to NYSDOS on April 4, 2006. In addition, Broadwater submitted the WSR to NSYDOS as a supplement to that document. NYSDOS is currently reviewing the Broadwater document and will determine whether it will accept or reject Broadwater's assertion that the Project is consistent with the New York and Long Island Coastal Management Programs. NYSDOS will not make a consistency determination prior to the issuance of this draft EIS. Therefore, **we recommend that:**

- **Prior to construction, Broadwater file with the Secretary documentation of concurrence from NYSDOS of the Project's consistency with the New York Coastal Management Program.**

To be deemed consistent with the New York State CMP, the Project must meet the requirements of the 13 coastal zone policies of the Long Island Coastal Management Plan. These 13 policies (which supersede the state's more general 44 coastal policies) are listed below, along with summaries of key information from the applicant's CZM consistency determination and an indication of where the impact analyses associated with the policies are presented in the EIS. Broadwater's complete consistency determination is included in the docket for the Project (CP06-054).

1. *Foster a pattern of development in the Long Island Sound coastal area that enhances community character, preserves open space, makes efficient use of infrastructure, makes beneficial use of a coastal location, and minimizes adverse effects of development.*

   Because the Project's visible components are located 9 miles offshore, implementation of the Project would result in minimal impacts on coastal communities or community character. The Project would help to meet the region's energy demands while using existing infrastructure. In its consistency determination, Broadwater indicated that the Project would enhance the community by introducing a reliable supply of new natural gas to the region and satisfy a need for additional, cleaner-burning energy sources required to promote patterns of development that would protect and enhance the character of Long Island's coastal communities. The supply also is intended to enable existing coal- and oil-fired electric generating facilities to re-power using natural gas.

   As noted previously, the Long Island Sound coastal communities have a history of mixed commercial, residential, recreational, and industrial uses. Vessel traffic within the Sound has long included delivery of a substantial portion of the region's energy supply, including petroleum and coal.

   Land uses in the Sound's coastal area relative to the Project in eastern Long Island comprise a mix of agriculture, open space, and rural/low-density residential development. While some densely developed commercial and industrial uses occur along eastern Long Island (outside of organized maritime centers), the predominant urban development occurs in the defined maritime centers such as Port Jefferson and the Village of Greenport, where the Project's onshore facilities would be located. Existing uses and those proposed by Broadwater appear to be consistent with applicable zoning and land use requirements.

As addressed in Section 3.7, thousands of vessels supporting regional commerce and industry traverse both sides of long Island Sound on an annual basis. The Project appears to be consistent with the commercial and recreational marine use of the Sound, and the Coast Guard has indicated that the Sound is suitable for use by the Project provided that specifically identified mitigation measures are incorporated into the Project.

The Waterborne Transportation Plan for the Sound shows that historical water-based commercial/industrial activities (that is, use of the Sound for waterborne freight transportation) are balanced with the Sound's development as a recreational resource. In addition, in the maritime centers of New York (inclusive of Port Jefferson) and Connecticut (for example, Bridgeport, New Haven, and New London), historical commercial/industrial uses are expanding. Vessel traffic is anticipated to grow approximately 1.7 percent per year from 2000 through 2025.

2. *Preserve historic resources of the Long Island Sound coastal area.*

There are no historic or special use areas near the proposed Project. Potential impacts to cultural resources are addressed in Section 3.8. In summary, the offshore portions of the Project, as proposed and with our recommendations, would not have an adverse effect on cultural resources. Onshore facilities would be sited in areas already zoned for and used in commercial and industrial applications. NRHP-listed sites are in proximity to both sites, but only the Greenport site was determined of concern to the SHPO. If the Greenport site is selected, the SHPO has recommended that Broadwater submit design documents to the SHPO for review due to the presence of two NRHP-listed historic districts adjacent to the site (Greenport Village Historic District and Greenport Railroad Complex).

3. *Enhance visual quality and protect scenic resources throughout Long Island Sound.*

Potential impacts to visual resources are described in Section 3.5.6. The FSRU has been located near the center of the Sound, near its widest point, in part to maximize the distance from coastal viewpoints and to minimize the potential visual impact on coastal resources. Because of its distant location, in most cases the LNG terminal would not be visible from urban areas or historic maritime communities and would not adversely affect dynamic scenic elements of the coastal area. The offshore elements of the Project would appear similar to an ocean-going vessel on the horizon.

The proposed onshore facilities would be located at existing commercial buildings, thus avoiding introduction of structural features to the landscape. These onshore facilities would provide support operations for construction and operation, primarily the transfer of people and supplies, and would also serve as a homeport for the tugs associated with the Project. Since Broadwater would use facilities that have been used for similar activities in the past, it does not appear that use of the onshore facilities would affect visual quality.

4. *Minimize loss of life, structures, and natural resources from flooding and erosion.*

Broadwater has indicated that the onshore and offshore portions of the Project, including material storage areas, have been designed so that the Project would not result in loss of life, structures, or natural resources from flooding and erosion. The onshore portion of the Project would take advantage of existing infrastructure within currently operable harbor areas and therefore would avoid activities associated with digging or moving soils and clearing vegetation that are typically part of land development and construction. The use of operable harbors also eliminates the need for new dredging or creation of additional navigation channels within the harbors of the Sound. In addition, the project does not propose construction or reconstruction of erosion protection structures.

As described in Sections 3.1 and 3.2, the Project would not affect the probability of flooding or erosion, or the magnitude of such events. Construction of the proposed pipeline would not interfere with natural coastal processes, and nearshore areas would not be affected. The Project would not interfere with natural coastal processes that supply beach materials to land adjacent to such waters and would not result in flooding or erosion. By siting the FSRU in the central portion of the Sound, the Project would avoid the need for dredging or construction that could affect the normal processes of the Sound.

5. *Protect and improve water quality and supply in the Long Island Sound coastal area.*

   As described in Section 3.2, Project construction would result in temporary increases in suspended sediment primarily in the bottom of the water column. Turbidity would dissipate within 24 hours and would have only a minor, localized, and temporary impact on water quality.

   The proposed closed-loop vaporization system would not require withdrawal of water from the Sound for use in the vaporization process. All discharges from the FSRU would meet the requirements of the SPDES permit. Broadwater proposes to use a membrane bioreactor system to treat all generated black and grey water, if approved by NYSDEC. If not approved by NYSDEC, all black and grey water generated on the FSRU would be containerized and shipped to shore for disposal at an approved treatment facility.

   Nonpoint discharges from deck areas in contact with soil and grease would be controlled by designed control structures used to isolate these specific deck areas and route stormwater to bilge tanks for appropriate disposal onshore. Uncontaminated nonpoint discharges from deck areas would be allowed to discharge to the Sound.

   Operation of the Project would result in minor impacts to water quality that would occur periodically for the life of the Project.

6. *Protect and restore the quality and function of the Long Island Sound ecosystem.*

   Broadwater indicated that the Project would protect the Sound in a variety of ways, including siting the FSRU 9 miles from the nearest shoreline and using existing onshore facilities to avoid new development on the shoreline. The onshore facilities would have little or no effect on the Sound's ecosystem because use of the onshore facilities would be similar to current and past use of the facilities.

   The Project would also preserve the Sound's water quality by using a closed-loop vaporization system that avoids the need for water withdrawal from the Sound. The use of water from the Sound for ballast and cooling water during operation (see Section 3.2) would result in a minor amount of impingement and entrainment of planktonic organisms and would not result in a significant impact to fisheries resources or invertebrate species.

   Construction of the offshore pipeline would result in short-term impacts on marine habitats, and most disturbed areas are expected to return to pre-construction conditions following completion of construction, assuming that our recommendations are implemented.

By siting the FSRU offshore, the Project would protect the Sound's inshore coastal areas, including wetlands and spawning and nursery grounds. The largely homogeneous substrate in the central portion of the Sound provides no unique habitats.

In summary, as described in Sections 3.2, 3.3, and 3.4, the Project would not result in significant impacts to the Long Island Sound ecosystem.

7. *Protect and improve air quality in the Long Island Sound coastal area.*

   Section 3.9 describes the potential impacts to air quality in the Long Island Sound area. Broadwater indicated that the Project would provide the opportunity to enhance regional air quality through the introduction of additional, clean-burning natural gas into the region. Natural gas supplied by the Project would be available to replace coal and oil fuels currently serving much of the region's energy needs.

   Construction of the Project is expected to result in minor, short-term effects on regional air quality. During the construction period, air emissions from the construction vessels (lay barges, pipe barges, and supporting vessels) would add to regional emission levels. The ambient effects from these vessels would be minor and temporary, and their effects would be minimized through the use of pollution control equipment and other mitigation measures. In addition, the majority of construction would be completed during non-summer months and would avoid emissions during the summer ozone season. Construction and emissions (including visible emissions) from the equipment would quickly dissipate, and because emissions would occur several miles from shore, the effects on onshore areas would be minimal.

   Emissions generated by equipment on the FSRU, including process heaters and generators, and emissions generated by the LNG carriers during unloading would be evaluated by NYSDEC's pre-construction permitting program and also may be subject to EPA's program.

8. *Minimize environmental degradation in the Long Island Sound coastal area from solid waste and hazardous substances and wastes.*

   All solid waste generated onboard the FSRU would be containerized and shipped to shore for appropriate disposal at an approved facility. Hazardous materials would be required for some operational activities on the FSRU. These materials would be managed in accordance with regulatory requirements to prevent discharge to the Sound. Aqueous ammonia and odorant would be the two primary bulk materials used during operation that would require regular trans-shipment. Odorant would be transported and stored using tanks approved by the International Standards Organization, which are commonly used for the intermodal transport and storage of freight. These containers are issued with a container safety certificate provided by the manufacturer that must be renewed every 30 months after a review by a certified inspector. These reviews ensure the structural integrity of the container, thereby minimizing the potential for spills and associated releases to the aquatic environment.

   On-deck equipment requiring maintenance (such as oiling and greasing) would be curbed so that stormwater can be routed to appropriate holding tanks and shipped to shore for disposal. Diesel fuel would be stored in storage tanks that would be integrated into the hull of the FSRU.

   A site-specific SPCC Plan and a Facility Response Plan would be prepared for all Project-related activities to address scenarios of releases to the Sound. These plans would be reviewed and approved by FERC, the Coast Guard, and NYSDEC prior to initiation of facility operations.

9. *Provide for public access to, and recreational use of, coastal waters, public lands, and public resources of the Long Island Sound coastal area.*

   Section 3.5.5 addresses potential impacts on recreation and access. Overall, the Project would result in a minor impact on public access and uses of public lands in and around the Sound.

   The Project would preserve public access to and recreational use of coastal waters, although there would be restrictions on public access within the safety and security zone around the FSRU and YMS. This area of restricted access would be less than 1 percent of the total area of the Sound. The location and design of the Project were in part selected to minimize impacts to other commercial and recreational water-dependent users of the Sound.

10. *Protect Long Island Sound's water-dependent uses and promote siting of new water-dependent uses in suitable locations.*

    Broadwater proposes to site a new, water-dependent supply of natural gas to help meet the energy needs of the target market. As described in Section 3.7, overall the Project would have a minor impact on existing water-dependent uses.

11. *Promote sustainable use of living marine resources in Long Island Sound.*

    As described in Sections 3.3 and 3.4, the Project would have a minor impact on some marine species. In its determination, Broadwater stated that locating the FSRU 9 miles from the nearest Long Island shoreline would limit impairment and be respectful of the living marine resources of the Sound, thereby promoting their sustainability. The Project would maintain commercial and recreational use of the Sound's living marine resources, including finfish, shellfish, crustaceans, and marine plants.

12. *Protect agricultural lands in the eastern Suffolk County portion of Long Island Sound's coastal area.*

    Agricultural land would not be affected by the proposed Project.

13. *Promote appropriate use and development of energy and mineral resources.*

    As stated in the purpose and need for the proposed Project in Section 1.0, the Project would introduce a new supply of natural gas into the region.

    Section 3.1 addresses potential impacts to mineral resources. There are no known current or future mineral leases or mining activities in Long Island Sound (CTDEP 2006a).

3.5.7.2 Estuary of National Significance

At the request of New York and Connecticut, the U.S. Congress has designated Long Island Sound as an Estuary of National Significance. Established in 1987, the National Estuary Program requires establishment of a Comprehensive Conservation and Management Plan to meet the goals of Section 320 of the Clean Water Act. Considering a broader spectrum of issues than traditional regulatory approaches, the National Estuary Program serves to maintain the integrity of the whole system, through cooperative efforts from local, state, and federal governments, as well as members of the community (EPA 2005b). The Plan for the Sound was developed to protect "…and improve the health of Long Island Sound while ensuring compatible human uses within the Sound ecosystem" (EPA 2005c). Areas of concern identified as top priorities include low DO levels, toxic contamination, pathogen contamination, floatable debris, and land use and development – along with their associated impacts to water quality, living resources, and habitat degradation.

A cooperating group of researchers, regulators, user groups, and individuals is working toward implementing the Sound's Comprehensive Conservation and Management Plan. Since its inception, over $80 million has been appropriated for nitrogen removal projects, sewage plant upgrades, non-point pollution control efforts, and habitat restoration. In 2004, in combination with several cooperating agencies and organizations, over $1 million dollars in grants were made available to implement projects consistent with the Plan.

The proposed Project would not affect DO levels, introduce new toxic contaminants, increase pathogen contamination, generate floating debris, or result in a net degradation of habitat. Further, the Project appears to be consistent with the Plan's stated objective of encouraging environmentally sensitive development and land use planning.

3.6 SOCIOECONOMICS

3.6.1 Region of Influence

As described in Section 2.0, the Project would be located in Long Island Sound within Suffolk County, New York. The FSRU, which would be constructed overseas, would be towed into the Sound and connected to a YMS, approximately 9 miles north of the nearest Long Island shoreline. Carriers delivering LNG to the FSRU would travel routes that would extend from international waters to pilot stations near either Block Island (Rhode Island) or Montauk Point (New York) and enter the eastern end of Long Island Sound through the Race. Natural gas would be transported from the FSRU to the existing 24-inch-diameter IGTS pipeline through a 21.7-mile, 30-inch-diameter offshore subsea pipeline. At its closest approach, the pipeline would be approximately 4 miles north of the Long Island shoreline (see Figure 3.5-1).

Onshore support facilities would be required throughout construction and operation. Broadwater proposes to use an existing concrete coating facility outside of the New York/Connecticut area. Coated pipe would be transported, likely by rail, and temporarily stored at a 10-acre pipe storage yard. The pipe storage yard likely would be within an existing developed area of the Port of New York/New Jersey with adequate rail access and land-to-sea transfer capabilities. The locations of both the concrete coating yard and the pipe storage yard would be determined during the detailed design stage.

In addition, Broadwater would lease existing facilities in either Port Jefferson or Greenport, New York to provide onshore office support, warehousing, and waterfront access for tugs and vessels servicing the Project. These facilities would be required during both construction and operation. Other than the potential installation of a perimeter fence and a security checkpoint/guard station, modifications are not expected at these facilities.

Potential socioeconomic effects that could be associated with construction of the proposed Project include increases to the local population, increased employment opportunities, increased demand for housing, altered property values, increased government revenue associated with ROW acquisition and the associated increased tax base, and increased demand for provision of public services. In addition, economic activity associated with Project operation could include changes to local marine commerce, increased employment opportunities, local expenditures by Broadwater, and increased government revenue. Operation of the Project also could reduce the rate of price increase for energy in the region or reduce energy price volatility by diversifying the source of gas supplied to the region.

FERC regulations identify the requirements for the socioeconomics sections of applications for major aboveground facilities and major pipeline projects in its *Guidance Manual for Environmental Report Preparation* (FERC 2002a). This includes the requirement that existing socioeconomic conditions within a project area be described and that impacts to employment, housing, local government services, and local tax revenues within a project area be quantified. Broadwater elected to assess the potential for socioeconomic impacts using the IMPLAN[1] software program and used assumptions in its input to the model that tended to maximize potential socioeconomic impacts. In our assessment of impacts, we considered the results of the IMPLAN analysis and have reported key aspects of the analysis in this EIS. The magnitude and duration of those maximum potential impacts are consistent with our assessment of the magnitude and duration of potential socioeconomic impacts, which are based on assumptions that are more likely to occur, as described below.

3.6.2 Population

3.6.2.1 Existing Conditions

According to the U.S. Census Bureau, approximately 1.4 million individuals resided in Suffolk County, New York at the time of the 2000 census (U.S. Census Bureau 2005). This represented a 7.4-percent increase in population since the 1990 census. Approximately 85 percent of the residents described themselves as white. Population density in Suffolk County is indicative of an urbanized environment (see Table 3.6.2-1). U.S. Census projections suggest that the county's population expanded to about 1.5 million by 2004. These projections also suggest that the markets the Broadwater Project would serve • •New York, Long Island, and Connecticut • •are expected to continue to expand through 2010 (U.S. Census Bureau 2005).

TABLE 3.6.2-1
Existing Socioeconomic Conditions[a]

Location	Population: 2000 Census	Percent Change in Population between 1990 Census and 2000 Census	Proportion of Population That Was Non-White: 2000 Census	Population Density: 2000 Census (persons per square mile)
New York State	18,976,457	5.48	32.10	402
Suffolk County	1,419,369	7.38	15.40	1,556

[a] Source: U.S. Census Bureau 2005.

3.6.2.2 Potential Impacts

Preconstruction surveys and pipeline construction are planned to take place from September 2009 through April 2010. There would be a peak workforce of about 400 workers for the 95-day period when

[1] IMPLAN is an analytical software tool used, owned, and administered by Minnesota IMPLAN Group, Inc. IMPLAN attempts to capture the total monetary impacts associated with a given project's spending by tracking the effects of that spending as it trickles through vendors, suppliers, households, and government entities. In doing so, the model relies on a social accounting matrix that takes into account non-industrial transactions such as payment of taxes by businesses and households. The predictive portion of the model calculates a multiplier that describes the economy's change in final demand associated with project-related spending. It is used to estimate a change in regional employment, output, income, and taxes. County- and state-level data sets used in the model are continually updated by the U.S. government and Minnesota IMPLAN Group, Inc.

the lay barge is onsite and the main pipe lay and plowing operations take place, and when installation of the tie-in devices at the IGTS pipeline and FSRU occurs.

Among the peak workforce's 400 members, about 380 would work offshore and be housed on the lay barge, where catering and support services would be provided. The peak offshore workforce would include 350 laborers on the marine lay barge spread (including support vessels) and 20 to 30 inspection and management personnel overseeing construction. An additional 20 onshore workers would be required for support activities. Construction would take place 24 hours per day, 7 days per week, with crews working in 8- or 12-hour shifts. When available, suitably skilled local workers would be hired from the local labor pool. However, Broadwater anticipates that as much as 60 percent of the construction jobs would require workers with specialized skills not available in the local labor pool. These workers would be brought in from other areas.

In the fourth quarter of 2010, the YMS would be installed, the FSRU would be connected to the YMS, and the final tie-ins at both ends of the new pipeline would be accomplished. These offshore activities would require about 30 days, with construction expected to be completed by December 2010. The peak workforce during this period would be approximately 64 workers during a 14-day period, with a total of about 132 individuals employed at some point during the YMS installation and FSRU connection period.

Because the pipeline construction period and the YMS/FSRU installation period are relatively short (6 months and 30 days, respectively) and because all but about 20 workers would be housed on the barges at the construction site, FERC believes that it is unlikely that non-local workers would relocate their family members to Long Island during construction. However, to assess the maximum potential impact, the IMPLAN assessment includes the assumption that 40 workers and their families would relocate to the area in late 2009 and remain there throughout 2010. With either assumption, Project construction would result in a minor, temporary increase to a Suffolk County population that exceeded 1.4 million in 2000.

Approximately 60 full-time workers would be employed to operate the Project. About 50 of the workers would operate the FSRU, with 25 of those workers on the FSRU/YMS at any given time. The remaining 10 workers would conduct a variety of support activities. Essentially all of the positions would require specialized skills that may not be available in the Suffolk County or Long Island labor pool. As a result, we assume that all 60 workers required for operation would be hired from outside of the Long Island Sound area and would move into the area. These workers and their families would represent a minor, permanent increase in population.

3.6.3 Employment

3.6.3.1 Existing Conditions

The U.S. Census Bureau (2005) reported that, at the time of the 2000 census, the 712,000-person Suffolk County workforce was concentrated in the education, health, and social service industries – with an average per capita income of $26,577 (see Table 3.6.3-1). The U.S. Census Bureau estimated that, by 2004, this workforce had expanded to 739,000 and the per capita income had increased to $30,542. However, the proportion of individuals living below the poverty level remained constant at about 6.0 percent. Suffolk County's average annual rate of unemployment in 2004 was 4.2 percent (U.S. Department of Labor 2005). Comparison of the county- and state-level statistics indicates that the county is slightly more affluent than the rest of the state.

TABLE 3.6.3-1 Labor Statistics					
Location	Civilian Labor Force: 2000 Census[a]	Per Capita Income: 2000 Census[a]	Proportion below Poverty Level: 2000 Census[a]	2005 Unemployment Rate[b]	Top 3 industry Sectors: 2000 Census[a]
New York State	9,023,096	$23,399	14.6	5.0	Education, health, and social services (24.3%); retail trade (10.5%); professional, scientific management, administrative, and waste management services (10.1%)
Suffolk County	711,625	$26,577	6.0	4.2	Education, health, and social services (22.6%); retail trade (12.1%); professional, scientific management, administrative, and waste management services (10.3%)

[a] Source U.S. Census Bureau 2005.

[b] Source: U.S. Department of Labor 2005.

3.6.3.2 Potential Impacts

As noted above, the main pipe lay would require a peak workforce of about 400 workers for a 95-day period between October 2009 and April 2010. Tower and FSRU installation would require a total workforce of 132 workers in the fourth quarter of 2010, with a peak workforce of 64 workers for 14 days during that period. In total, construction would require approximately 205 full-time equivalent positions for 1 year (where a full-time equivalent position provides the opportunity to work about 261 days). Assuming that 60 percent of the workforce would be from outside of the local labor pool, local workers could fill approximately 82 of these full-time equivalent positions.

Some additional Suffolk County jobs may result from secondary activities associated with construction and the purchases made by non-local workers for food, clothing, gasoline, and entertainment. This secondary job creation likely would be limited within Suffolk County because many construction workers, who would be housed on barges for the duration of their employment, would make most of their expenditures near their permanent residences. In assessing the maximum potential impacts, the IMPLAN analysis estimated that as many as 118 regional full-time equivalent positions would be associated with secondary economic activity during the construction period.

Under either set of assumptions, Project construction would result in a minor, temporary increase in the number of employment opportunities in a county with a civilian workforce that exceeds 712,000.

The Project would require 60 full-time employees during operation, with many of these positions likely filled by people from outside the local labor pool. In addition, Broadwater's IMPLAN assessment estimated that an additional 30 full-time positions would be created due to secondary economic activity during operation. The creation of approximately 90 positions, many of which would be filled by people from outside the local labor pool, would have a negligible effect on the Suffolk County unemployment situation.

3.6.4 Housing

3.6.4.1 Existing Conditions

The numbers of vacant housing units for rent; units for seasonal, recreational, or occasional use; and hotel/motel rooms in representative Suffolk County towns and villages are presented in Table 3.6.4-1. The County's median monthly rental contract is for $861.

TABLE 3.6.4-1
Temporary Accommodations Available in the Project Area

Towns and Villages in Suffolk County, NY	Vacant Housing Units for Rent: 2000 Census	Units for Seasonal, Recreational, or Occasional Use: 2000 Census	Motel/Hotel Rooms	Total Units
Brookhaven	909	4,194	1,286	6,389
Huntington	332	415	1,368	2,115
Islip	815	2,664	1,964	5,443
Riverhead	103	1,165	478	1,746
Smithtown	117	195	656	968
Total	**2,276**	**8,633**	**4,752**	**15,661**

[a] Source for rental and seasonal units: U.S. Census Bureau 2005.

[b] Source for hotels and motels: Suffolk County Department of Planning 2006.

At the time of the 2000 census, Suffolk County contained 374,371 housing units – with median prices raging from $151,000 to $900,000 depending on the township (U.S. Census Bureau 2005). Since that time, average housing prices have appreciated approximately 74 percent (New York State Office of Real Property Services 2005).

3.6.4.2 Potential Impacts

As noted above, all but about 20 workers would be housed on the offshore barges during construction. Even with the assumption used in the IMPLAN model of 40 workers moving their families into the area, the impact of construction-related housing demands on a county housing market that serves more than 1.4 million residents would be negligible and short term. Similarly, the housing needs of the 60 workers employed during Project operation would result in a negligible, but in this case long-term, impact on the Suffolk County housing market.

3.6.5 Property Values

Commentors have expressed concern that views of the FSRU combined with public perceptions of risk may negatively affect property values and the value of recreational sites. We are aware of only one other similar proposal, the proposed Cabrillo Port LNG Project that would include an FSRU moored approximately 14 miles from the shoreline offshore of Ventura County, California. In its revised Draft Environmental Impact Report (EIR) for that proposed project, the California State Lands Commission (2006) indicated that an LNG port located this far from shore was unlikely to affect property values.

However, because that project has not been built, it is not possible to identify actual changes in property values.

As such, FERC reviewed the existing economic literature to assess the potential for property value diminution. Clark and Nieves (1994) conducted an analysis of eight types of large industrial facilities, including LNG storage facilities. They found that the presence of LNG facilities increase housing values in the regions in which they are located; this somewhat unexpected result may be due to the employment opportunities the facilities represent relative to rural labor markets. In a 2004 review of economic literature, RESI (2004) examined the effects of sites that are associated with industrial activity, visual alterations to the landscape, and perceived risks to human health on property values. The facilities they reviewed included the smokestack industries, production facilities, and generation facilities as well as nuclear facilities and Superfund sites. The meta-analysis suggests that, all else equal, some industrial facilities may increase surrounding property values, while others appear to decrease values.

Anstine (2003) suggested that diminution in property value, when present, is associated with facilities that emit noticeable byproducts such as odors or vapor plumes. This observation was based on observations of two manufacturing facilities located in Tennessee. One plant used depleted uranium in its manufacturing process but emitted no detectable emissions. The other emitted an odor and a small visible plume but was not perceived as posing a significant risk to human health. Anstine reviewed surrounding property values and noted that the presence of the plant that utilized depleted uranium did not appear to affect surrounding property values whereas the strong-smelling plant did appear to depress surrounding property values.

Because the proposed Project would not emit vapors or noises detectable from shore, the data do not suggest the potential for property value diminution.

However, because an FSRU located 9 or more miles from the nearest shorelines would be a unique occurrence, FERC conducted additional analysis. We reviewed the literature and have identified three project types that we believe represent reasonable proxies upon which we can assess the potential effect of the Project on property values. They are wind turbine projects, high-voltage transmission lines, and landfills.

- Wind turbine projects may provide a lower bound on potential impacts in that they affect the view of the water from shore. However, the public is unlikely to misperceive human health risks associated with wind turbines.
- High-voltage transmission lines may be a relevant proxy in that the public perceives close proximity to the lines as a potential health risk and they represent an industrial application often placed in a rural setting. However, to the extent that these lines generally cannot be viewed at distances as great as 9 miles, their use as a proxy may understate potential impacts somewhat.
- Landfills likely represent an upper bound on potential property value diminution. This is because they can often be seen from great distances, are perceived by the public as a potential risk to human health, and are associated with observable industrial activities such as truck traffic and flaring.

3.6.5.1 Wind Turbine Facilities

In its Draft EIS for the Cape Wind Energy Project, COE (2004) reviewed the literature describing the impacts of wind turbine projects on property values. COE reported that the Cape Wind Farm applicant interviewed real estate agents and assessors in four communities in the Northeast that were adjacent to existing wind turbine projects. No property value reduction was reported for any community or by any agent. The COE also reported that researchers in Denmark found no evidence of financial impacts to residents in viewsheds that include wind turbine facilities. Finally, the COE EIS cited the Sterzinger et al. (2003) report that described reviews of the impacts of 10 wind farms, including 2 in New York and 2 in Pennsylvania. The study found no evidence of property devaluation when wind farms were introduced to the viewshed. The COE further reported that offshore wind turbine facilities in Europe and several onshore facilities in the United States actually have stimulated local tourism.

3.6.5.2 High-voltage Transmission Lines

The effect of high-voltage transmission lines on property values has been the subject of economics research since the late 1970s. Nearly a dozen published papers have used an econometric method referred to as a "hedonic price study" to assess the potential for property value fluctuations as a result of visual impacts and perceived health risks associated with high-voltage transmission lines. Ignelzi and Priestly (1991) and Colwell (1990, cited in Des Rosiers [2002]) reported a reduction in property value among parcels with direct views of pylons or in close proximity to the corridors. However, the effects tended to disappear at distances greater than about 200 yards and faded over time. Presumably this occurs as the magnitude of perceived risk diminishes among those who live in proximity and as they become more accustomed to the viewshed. Des Rosiers (2002) conducted a detailed analysis and confirmed the assertion that effects tended to diminish with distance and disappear within about 200 yards. Sims and Dent (2005) also confirmed this pattern, using observations in the United Kingdom and Scotland.

3.6.5.3 Landfills

The effect of landfills on property values also has been the subject of economics research since the 1970s. Again, studies generally rely on hedonic price methods to assess the potential for property value fluctuations because of visual impacts, activity associated with the landfill, and perceived health risks associated with proximity to a landfill. Although the literature is less uniform than for high-voltage transmission lines, there does appear to be a tendency for reduced property values among parcels in proximity to landfills (Adler et al. 1982; Havlicek 1985; and Pettit and Johnson 1987, cited in Nelson et al. 2002). According to Nelson et al. (2002), the literature indicates that the negative price effects tend to disappear at about 2.25 miles from the landfills; in their own study, the negative effects disappeared at about 2.5 miles. Hite et al. (2001) reviewed home prices within a 3.5-mile radius of several landfills and identified a negative price gradient; they also noted that, when the industrial processes could no longer be observed, prices partially rebounded.

3.6.5.4 Property Values Summary

Because the Broadwater Project would be a unique facility and would be 9 miles from the nearest shoreline, and even greater distances from most properties, it is not possible to directly compare the Project's potential impacts on property values to those of similar projects. However, based on the findings reported above for other types of projects that could affect property values, the visual impacts assessment reported in Section 3.5, the risk assessment reported in Section 3.10, and the conclusion reached for the impacts of the Cabrillo Port Project's FSRU (CSLC 2006), it is unlikely that construction and operation of the proposed Project would affect property values.

We have received comments expressing concern that insurance premiums may increase if the proposed Project were constructed. FERC has previously consulted with insurance professionals to determine whether construction of an LNG terminal would likely increase homeowners' insurance rates

(FERC 2004). Based on this review, FERC has determined that homeowners' insurance rates would not likely increase as a result of construction and operation of the proposed Project.

3.6.6 Economy and Tax Revenues

3.6.6.1 Existing Conditions

The annual budget for the state exceeds $100 billion (New York State 2005), and the Suffolk County annual budget exceeded $2.3 billion for the year ending December 31, 2004 (Suffolk County 2005). State and local revenues include property taxes, easement fees, income taxes, and sales taxes. New York State's sales tax in 2006 is 4.25 percent, and additional sales taxes in Suffolk County and in municipalities can total up to 4 percent above the state sales tax.

According to the Suffolk County Comptroller (2004), the single largest expenditure in the county, at approximately 33 percent of the 2004 annual expenditures, is public safety. This is followed by economic assistance and opportunity (27 percent), and general government services (11 percent). The remaining 29 percent of the budget consists of 10 other spending categories, including approximately 1 percent of expenditures that go to servicing of long-term debt. Revenues for the county in 2004 totaled $2.4 billion. The largest portion of revenues, 43 percent, came from sales and use taxes. This was followed by property tax and operating grants at 21 percent each. The remaining 15 percent of revenue came from charges for services, capital grants, and other sources.

3.6.6.2 Potential Impacts

The Project likely would result in three direct effects on tax revenues: (1) an increase in government revenue to the State of New York associated with ROW acquisition, (2) an increase in sales tax revenues during construction, (3) and an increase in payroll and facility taxes during construction and operation.

Pursuant to the New York State Public Lands Law, Broadwater must apply for an easement for the state-owned underwater land that is associated with the proposed Project. The one-time fee associated with this action would be negotiated between Broadwater and New York State. It would likely represent a minor increase in New York State revenue.

During construction, worker payrolls would be subject to state and federal income tax. Some construction materials would be purchased locally; the majority of these construction-related expenditures would be subject to New York State's sales tax and additional sales tax in Suffolk County and in municipalities. Expenditures for the purchase of housing, food, gasoline, and entertainment would be limited due to the offshore housing, catering, and support services provided on the lay barges.

Using the IMPLAN software program, Broadwater estimated that the Project-related federal tax revenues would be $864,000 during construction. They also estimated that, during construction, the Project would contribute $1,061,000 in state and local tax revenues. These Project-related government revenues generated during construction would represent a minor, temporary increase in government revenues.

As noted above, the vast majority of construction workers would be housed offshore for the duration of the construction period, and few if any family members would accompany offshore construction workers to the area. Therefore, during construction, the state and local governments would experience little if any increase in expenditures associated with the provision of public services to construction workers. The IMPLAN assessment conducted by Broadwater assumed a worst-case condition, with 40 workers moving to the area with their families for the duration of construction. With that assumption, the net increase in government revenue (increase in revenue minus the cost associated with increased expenses for public services) in Suffolk County was calculated by the IMPLAN model to be $150,000, which would be a minor positive impact to county finances.

FERC believes that, during construction, state and local government would experience a minor increase in expenditures associated with the provision of public services to construction workers. This is because the vast majority would be housed offshore for the duration of the construction period and we believe that few, if any, family members would accompany offshore construction workers. In slight contrast, the IMPLAN assessment assumes that 40 workers would move, with their families, to the area for the duration of construction. Under these assumptions, the net increase in government revenue (increase in revenue minus the cost associated with increased expenses for public services) in the host community is expected to be $150,000.

During operation, the Project's taxable payroll would range from about $5 to $7 million annually. A portion of the payroll would go to federal and state income tax. In addition, workers would spend a portion of their pay locally for the purchase of housing, food, gasoline, entertainment, and other expenditures that would be subject to state and county sales taxes. Components of the Project also would be subject to property tax, other taxes, or payments in lieu of taxes. Using the IMPLAN software program, Broadwater estimated that, during operation, the annual Project-related federal tax revenues would be $1,763,000. The IMPLAN assessment also estimated that, during operation, the annual Project-related state and local tax revenues would be $3,426,000. Currently, Broadwater is proposing a payment in lieu of taxes to local government authorities of approximately $15 million per year. This would represent a minor increase in tax revenues that would continue for the life of the Project.

Assuming that all 60 of the workers required during operation are non-local, the IMPLAN assessment conducted by Broadwater indicated that the net increase in government revenue (increase in revenue minus the cost associated with increased expenses for public services) in Suffolk County is expected to be $25,534,000 (present value) over the life of the Project.

3.6.7 Public Services

There are over 18,000 fire, police, and medical full-time equivalent positions in Suffolk County (U.S. Census Bureau 2005). They serve a population that is slightly in excess of 1.4 million. This ratio is indicative of a somewhat affluent community in a highly developed area.

The U.S. Census Bureau (2005) reports that, at the time of the 2000 census, Suffolk County was home to approximately 305,000 students from pre-school age through grade 12. These students are served by several hundred schools that are divided into 71 school districts (New York School Tree 2006).

Because all but about 20 construction workers would be housed on the offshore vessels where basic support and medical services would be provided, it is unlikely that family members, including school-age children, would accompany the construction workforce to the area. Hence, the increase in the demand for onshore public services would be limited to a potential minor, temporary impact on fire, police, social, and medical services associated with response to construction accidents or medical emergencies that may occur. Even with the assumption in Broadwater's IMPLAN assessment that as many as 40 workers would relocate their families to the area for the duration of construction, the net increase in government revenues associated with construction was calculated to more than offset any increase in the costs for public services.

The Project's long-term impact on demand for community services would primarily be limited to fire, police, and emergency responders. During normal operation, the probability that these agencies would be required to respond to an incident would increase minimally. This represents a minor increase in the demand for public services that would last for the life of the Project. If an incident were to occur that resulted in a fire on or in the vicinity of the FSRU or an LNG carrier, equipment on the vessels and on the support tugs would be used to fight the fire. If the incident resulted in injuries, there would be an increased need for emergency responders and medical aid once the injured were brought to shore. To address this potential need, Broadwater would be required by the DOT and the Coast Guard to establish and maintain liaison with the appropriate fire, police, and public officials (see Section 3.10 and Appendix D for additional information on emergency response plans).

Any increased demand for community services associated with the addition of up to 60 full-time workers and their associated families, including an increased demand on schools, would be minor in a community already serving 1.4 million county residents and over 305,000 students. This minor increase is expected to be offset by an increase in government revenues attributable to the Project.

Commentors have expressed concern that Suffolk County or municipalities on Long Island would be required to enforce the safety and security zone around the FSRU and the inbound LNG carriers. The Coast Guard would be responsible for enforcement of the safety and security zones, and the assistance of local authorities would not be required under normal operating conditions. Cost sharing of any emergency response activity is discussed in the WSR (Appendix D).

3.6.8 Effects on Commerce

Long Island Sound generates an estimated $5.5 billion a year to the local economy by supporting such activities as commercial and recreational fishing; sightseeing; and ferry transport serving Connecticut, New York, and Rhode Island (EPA 2005d). Potential economic adverse impacts on commerce could result from disruption to commercial fisheries, disruption to recreational boating/fishing activity, and disruption to transportation. In addition, the proposed Project could benefit commerce and industry in the region by reducing the rate of increase in energy costs and by reducing the volatility of energy prices in the region.

3.6.8.1 Commercial Fisheries

Existing Conditions

Long Island's commercial fisheries include hard clams, Eastern oysters, American lobster, and finfish. Only the latter two are present at or near the proposed offshore locations of Project facilities. Currently, 575 licenses are issued to 474 fishermen (Long Island Sound LNG Task Force 2006).

Commercial shellfishing is conducted in nearshore areas and is not conducted in the waters near the proposed FSRU and pipeline. The central portion of the Sound, including the area near the proposed location of the Project, is heavily used for lobster fishing. This industry has realized below-average returns since a 1998 lobster die-off and has experienced an approximately 75-percent reduction in the number of participants since that time. Long Island Sound lobster landings currently are valued at about $5.1 million per year.

In addition, the proposed YMS location is on the southern edge of a commercial trawling lane. Commercial fishermen who use fixed gear have informally set aside this lane and a second lane in Connecticut (see Figure 3.5-2) as areas where they do not used fixed gear (particularly lobster pots) to avoid conflicts with fishermen who trawl. However, only 2 to 12 fishermen use the trawl lane (Crismale, 2006).

Potential Impacts

Because commercial shellfishing is not conducted in the area proposed for use by the Project, this activity would not be affected by either construction or operation of the Project. Commercial lobster fishing would be affected by both construction and imposition of a safety and security zone around the FSRU that would preclude use of the area for fishing. Finfishing in the trawl lane also would be affected by the safety and security zone.

As part of its fishermen outreach program, Broadwater identified 26 commercial lobster fishermen who, by informal agreement, have established fishing areas in the vicinity of the proposed locations of Project components. Fifteen of these fishermen expressed the belief that at least some of their fixed fishing gear would need to be removed during pipeline construction.

To minimize impacts to these fishermen during construction, Broadwater would provide them notice of the anticipated construction schedule and the size of the construction zone. To partially offset commercial lobster fishing losses during construction, Broadwater would hire local lobster fishermen to work as spotters during pipeline construction. Broadwater also indicated that it would coordinate activities to determine which pots would need to be removed and to minimize the duration of those removals. Further, Broadwater would regularly communicate its construction schedule with the Coast Guard, and the Coast Guard would issue periodic Notices to Mariners that would provide relevant information regarding potential obstructions to navigation during construction.

Because the construction area is small relative to the total area of the lobster fishing grounds in Long Island Sound, and because the removal of fixed gear due to construction would be limited to several days per pot (the pipeline construction spread would move approximately 1 mile per day), impacts during construction are considered minor and temporary.

As a part of its outreach program, Broadwater determined that as many as five lobstermen have been setting pots in the area proposed for the FSRU safety and security zone. These fishermen would need to relocate pots or reduce the number of pots they fish for the lifetime of the Project. Broadwater has estimated that the present value of all economic activity associated with lobsters likely to have been harvested from the area within 1,000 yards of the FSRU over the next 30 years would be less than $400,000. Further, the applicant has indicated that they would compensate the affected lobstermen sufficiently to avoid long-term financial impacts due to Project operation.

In addition, the safety and security zone would extend through the entire trawling lane that is just north of the YMS. The Coast Guard would not permit commercial fishing within the safety and security zone. This would result in shorter trawl distances east and west of the safety and security zone or, if those trawling distances were considered unacceptable to the trawl fishermen, trawling might be discontinued in the lane, or the lane might be moved. Although the trawling lane to the north would not be directly affected by the Project, increased use of that lane might result. Consequently, Project operation would result in a moderate, permanent impact to Long Island Sound's commercial trawling operations.

Broadwater would reduce the impact to the trawl fishermen who use the trawl lane by providing compensation to the affected fishermen.

However, when the EIS was being prepared, Broadwater had not negotiated the compensation package for lobster or trawl fishermen. Therefore, **we recommend that:**

- **Prior to initiation of operation, Broadwater file with the Secretary documentation of completion of the final compensation agreements between Broadwater and the commercial lobster and trawl fishermen from their usual fishing grounds within the fixed safety and security zone.**

3.6.8.2 Recreational Boating and Fishing

Over 335,000 marine anglers reside in Connecticut and New York; they take 1.5 million fishing trips a year (Long Island Sound LNG Task Force 2006). Recreational boaters and fishermen contribute to the estimated $5.5 billion in economic activity generated by the Sound (EPA 2005d). For this EIS, "recreational boating" is defined as commercially operated sightseeing boats, boats participating in regattas, and the use of private or rented crafts for activities other than fishing; "recreational fishing" is defined to include shore-based fishing and fishing from privately owned, rented, chartered, or party boats.

Potential economic impacts to recreational boating and fishing could result from changes to the stocks of targeted fish species or changes to fishing/boating practices that would be the result of construction activity or establishment of the safety and security zone.

As described in Section 3.3.3.2, construction and operation of the proposed Project would not significantly affect the stocks of fish species targeted by recreational fishing. As described in Section 3.5.5, construction and FSRU operation are unlikely to affect large numbers of recreational boaters or fishermen due to relatively low use in these areas and the relatively small proportion of the Sound that would be involved (about 0.07 percent). Further, because these areas do not possess unique or high-value sites or structures, all areas not within the safety and security zone represent easily accessed substitute sites. Consequently, construction and operation of the FSRU, YMS, and pipeline, including imposition of the safety and security zone around the YMS and FSRU, would not likely result in a significant change in recreational behavior nor would they result in a measurable economic effect on these industries.

As discussed in Section 3.5.5, enforcement of safety and security zones around LNG carriers as they transit the Race could result in moderate disruptions to recreational boating and fishing, dependent on the time of the carrier transit through the Race, including the time of day and season. However, the disruption would be temporary, lasting for the time that the LNG carrier and its safety and security zone was in the area of the Race and the total time required for the boats to move from their positions and either return after the carrier passes or relocate to another area. In addition, there would be room within the Race between the edge of the safety and security zone and the limits of the deepwater channel (see Section 3.7) as well as areas adjacent to the channel for shallow-draft vessels. The LNG carriers would be in the Race for approximately 15 to 20 minutes under normal operating circumstances, and boat movements to avoid the safety and security zone and return to their previous location, if required, could last an additional 10 to 15 minutes. This disruption to recreational fishing and boating would occur up to six times per week (a maximum of three incoming carriers and three outgoing carriers per week).

After reviewing the recreational economic literature, FERC believes that disruptions of this nature are not likely to affect, in any quantifiable manner, participation levels among recreators in the Race. As such, businesses and sectors supporting area recreation are unlikely to be affected.

3.6.8.3 Onshore Recreation

Several commentors have expressed concern that visual impacts associated with construction and operation of the proposed Project could diminish the quality of onshore recreational activities within the Sound and that this diminished recreational experience could result in a negative effect on the economy.

Potential visual impacts are qualitatively discussed in Section 3.5.6. To assess the potential for economic impacts, FERC noted that a component of home and property values includes the value associated with proximity to high-quality recreational experiences. As such, and based on the conclusion that property values are not likely to be affected by the proposed Project, it is unlikely that the proposed Project would affect economic activity associated with onshore recreation.

3.6.8.4 Transportation

Potential impacts to marine transportation, including ferry service, are addressed in Section 3.7.1. Impacts with potential economic implications are limited to potential schedule alterations or disturbances of ferries operating in Long Island Sound east of the FSRU and ferries that operate in Block Island Sound. Because, at most, only minor and occasional impacts to ferry service would be caused by LNG carrier transits, operation of the Project would result in no more than minor economic impacts to marine transportation for the life of the Project.

Potential impacts to ground transportation are discussed in Section 3.7.2.

3.6.8.5 Effects on Commerce via Energy Prices

The proposed Project would provide a means of supplying the region with natural gas from several of the world's gas-producing regions. This would add diversity to the region's energy portfolio and also would increase the volume of natural gas available in the region. These factors could combine to reduce both price and price volatility that could occur without the Project. These changes could result in conditions that would be conducive to continued economic growth and regional productivity, which would result in a minor, positive effect on the regional economy that would last for the life of the Project.

3.7 MARINE TRANSPORTATION AND ONSHORE TRAFFIC

This section addresses the potential impacts of the Project on marine transportation and onshore traffic, including an analysis of potential navigation safety risks associated with the proposed facility and LNG vessel transits, and strategies for managing potential navigation safety risks. The potential impacts associated with recreational boating, recreational fishing, and sightseeing boats on the Sound are described with other aspects of recreation in Section 3.5.5.1.

3.7.1 Marine Transportation

3.7.1.1 Project Summary

The proposed LNG terminal and sendout pipeline would be in the New York State waters of Long Island Sound, approximately 9 miles from the nearest shoreline of Long Island (see Figure 2.1-1). LNG vessels headed to and from the FSRU would transit the waters of Long Island Sound, Rhode Island Sound, and Block Island Sound, as well as the Atlantic Ocean off the coasts of Long Island and Rhode Island.

FSRU and Yoke Mooring System

The FSRU would be moored to a YMS that includes a mooring tower secured to the seafloor. If the Project is authorized and implemented, the Coast Guard would establish a safety and security zone around the FSRU that would extend 1,210 yards (0.7 mile) from the center of the mooring tower, encompassing a 950-acre (1.5-square mile) area. This area would be marked by a lighted buoy pattern.

The FSRU would be considered an offshore structure; the Coast Guard would regulate the facility in the same manner as a similar shore-side facility. Broadwater would be required to comply with regulatory and statutory requirements for facility operations, environmental and operational safety, and security. The Coast Guard would regulate the FSRU for navigation and waterways safety purposes under the Ports and Waterways Safety Act (PWSA), 33 USC 1225 and 33 CFR 126, 127, 154, 156, 160, and 165. With regard to security issues, the following regulations would apply: PWSA Section 1226; the Marine Transportation Security Act, 46 USC Chapter 701; and 33 CFR Part 105, Subchapter H.

Under these statutes, the Coast Guard has the authority to enforce the necessary safety and security measures that are deemed appropriate. Through a risk-based approach, the Coast Guard would evaluate compliance with the above regulations on an annual basis and would conduct other inspections and oversight as required.

The mooring tower and the FSRU would be fabricated outside of the area, towed into Long Island Sound, and installed at the proposed location. Construction also would involve installing piles that anchor the mooring tower structure to the floor of the Sound. Construction vessels would include barges, tugs and other support boats, and service boats. The installation process for the mooring tower and FSRU would require approximately 1 month, with installation currently planned to occur in November and December of 2010.

LNG Carriers and Transit Routes

LNG would be delivered to the terminal in LNG carriers with cargo capacities ranging from 125,000 to 250,000 m^3, at the frequency of 2 to 3 carriers per week and an estimated average of 118 carriers per year. Typical dimensions of the two categories of carriers are presented in Table 3.7.1-1.

TABLE 3.7.1-1
LNG Carrier Dimensions

	LNG Capacity			
	125,000 m^3		250,000 m^3	
Dimension	**(feet)**	**(meters)**	**(feet)**	**(meters)**
Length overall	886	270	1,132	345
Beam	131	40	180	55
Draft (laden)	36	11	39	12
Draft (ballast)	30	9	33	10

The LNG carriers would travel from international waters into the EEZ, then into the U.S. territorial sea, and into state waters (see Figure 2.4-1). Mariners are required to comply with the International Regulations for Preventing Collisions at Sea of 1972 (COLREGS) when transiting in waters east of the COLREGS demarcation line, which is located at the Race.

Long Island Sound consists entirely of internal waters of the United States that are within the state boundaries of either New York or Connecticut. As inland waters, Long Island Sound west of the COLREGS demarcation line is governed by the Inland Navigation Rules; vessels transiting Long Island Sound are required to comply with those regulations. The Sound has two natural exits: to the east is the Race, connecting the Sound to Block Island Sound and the Atlantic Ocean; the western end of the Sound joins the East River, which extends into the Port of New York/New Jersey.

The LNG carriers would follow one of the two routes depicted in Figure 2.4-1, either the Block Island route (northern route) or the Montauk Channel route (southern route). Carriers on the northern route would travel through the waters of the EEZ, enter Rhode Island Sound along the existing traffic separation scheme, and proceed to the Point Judith Pilot Station. After pilot boarding, they would transit Block Island Sound and enter Long Island Sound through the Race. LNG carriers using the Block Island route would briefly enter Rhode Island state waters near the edge of the state's 3-mile limit north of Block Island.

Carriers using the southern route would pass through Montauk Channel and proceed to the Montauk Point Pilot Station. After pilot boarding, they would transit the southwestern portion of Block Island Sound and would enter Long Island Sound through the Race.

The Coast Guard prepared the WSR in accordance with U.S. Coast Guard Navigation and Vessel Inspection Circular (NVIC) 05-05, "Guidance on Assessing the Suitability of a Waterway for Liquefied Natural Gas (LNG) Marine Traffic" (Coast Guard 2005b). The WSR is presented in Appendix D, and relevant portions of it are summarized in this section. As noted in the WSR (see Appendix D), the transit of LNG carriers through the Race would be the most navigationally constrained portion of transit to and from the FSRU. The most constricted portion of the general area referred to as the Race is the 1.4-mile-wide (2,465-yard-wide) area between Race Rock (marked by Race Rock Light) and Valiant Rock (marked by Valiant Rock Lighted Whistle Buoy [LWB]). This is the channel used by most deep-draft vessel. The center of the recommended vessel route running through this portion of the Race is approximately 0.7 mile (1,232 yards) north of Valiant Rock LWB. Due to the configuration of the Race, LNG vessels likely would transit in a northwesterly direction through the Race when inbound and southeasterly when outbound. Under ideal conditions, LNG carriers would transit the Race at speeds between 12 and 15 knots; at this speed, , it would take approximately 15 minutes for the proposed safety / security zone around LNG vessels to pass a given point. Weather, sea state, and vessel traffic could require reduced vessel speed and a resultant increase in transit times.

In the area west of the Race, LNG carriers generally would transit waters that are within the boundaries of the state of New York. Under some circumstances, such as when an outbound commercial vessel is approaching the Race from the west, LNG carriers may take a more northerly route and transit waters within the boundaries of the state of Connecticut. LNG carriers may also enter Rhode Island waters while transiting Block Island Sound.

Based on its findings in the WSR and on the findings of the PAWSA (Coast Guard 2005a), the Coast Guard would establish a safety and security zone around each LNG carrier if the Project is authorized and implemented. The safety and security zone would extend about 2 nautical miles (2.3 miles) in front of the bow, about 1nautical mile (1.2 miles) behind the stern, and about 750 yards (0.4 mile) to each side of the vessel. All marine traffic not related to the Project would be excluded from the safety and security zone, unless an exception is granted by the Coast Guard Captain of the Port. For example, commercial ferries may be allowed within an LNG carrier safety and security zone under certain conditions.

Broadwater has proposed that each LNG carrier would be escorted by one or two Project-related tugs when traveling between the pilot stations and the FSRU. These tugs would travel within the safety and security zone. However, the Coast Guard would determine how many tugs would be required to escort the carriers. LNG carriers would be scheduled so that no more than one LNG carrier would be in Long Island Sound at any time. Incoming LNG carriers would be required to notify the Coast Guard and the pilots association 96 hours in advance of their planned arrival time at the pilot boarding area. The LNG carriers would be under pilot navigational advisory control from the pilot boarding area through Block Island Sound, the Race, and in Long Island Sound. The pilots would remain with the LNG carriers during unloading, and the carriers would remain under pilot navigational advisory control on the return transit to the pilot debarking area.

After obtaining Coast Guard permission to proceed, an LNG carrier would enter the Sound from the east, proceed through the Race, then follow the typical track taken by other large commercial traffic (as shown in Figure 2.4-1). Three or four tugs (depending on LNG carrier size) would assist with the berthing operation. Two tugs would remain in attendance during unloading (see Section 2.4), and two or three tugs would assist with deberthing (see Appendix C).

Pipeline

A 21.7-mile-long, 30-inch-diameter subsea natural gas pipeline would be installed between the mooring tower and the existing IGTS pipeline. The subsea connecting pipeline would be installed using a lay barge, tugs, and other support and service vessels. Broadwater estimates that a minimum of six assist tugs would be required to haul the pipe barges between the pipe storage yard at the Port of New York/New Jersey and the pipeline construction location, with the number of tugs dependent on the distance between the pipe storage yard and the pipeline construction site. An area approximately 4,000 feet (0.8 mile) from the lay barge would be restricted to Project-related vessels during construction. Pipeline construction is scheduled for October 2009 through April 2010.

Onshore Support Facilities

Support tugs would use either Port Jefferson or Greenport, both of which are on Long Island, as a home port (see Figures 2.4-2 and 2.4-3). The tugs would periodically travel from those ports to the LNG carriers or the FSRU, but generally would be in place at the FSRU or accompanying an LNG carrier traveling toward the FSRU from the pilot station or on the reverse trip.

3.7.1.2 Data Sources for the Analyses

To develop a better understanding of the number of commercial vessels and what routes the vessels generally use in the Sound, we used the four primary sources of vessel traffic data for Long Island Sound, three provided by the Coast Guard and one by COE. In addition to specific data sources, public input regarding vessel traffic in the Sound was collected through Project-specific public meetings and formal working groups established by the Coast Guard. Each source presents the data differently, and there are some overlaps. Nevertheless, the data provide a reasonable overview of vessel traffic on the Sound. The data sources are described briefly below.

Coast Guard Automated Identification System

The Coast Guard maintains an Automated Identification System (AIS) database at its Research and Development Center. Requirements of 33 CFR Section 164.46(a) indicate that the following vessels on international voyages must have a properly installed and operational AIS: (1) self-propelled vessels of 65 feet or more in length and in commercial service, other than passenger and fishing vessels; (2) passenger vessels of 150 gross tons or more; (3) tankers regardless of tonnage; and (4) vessels other than passenger vessels or tankers of 300 gross tons or more. FERC and Coast Guard staff extracted 2005 data for Long Island Sound from the AIS database as a part of the marine transportation analysis for the Project. The AIS data analysis provides specific information on routes traveled; the other data sets capture only port calls, not specific routes taken between ports. As described below, the AIS data from 2005 were used to generate a map of vessel transit density that indicates the intensity of use of various parts of the Sound and a map of vessel transit lines that illustrates general shipping routes. AIS data also were used to estimate the number of vessels that transit through the Sound without making a port call.

Ports and Waterways Safety Assessment

The PAWSA conducted for Long Island Sound in May 2005 provided a baseline for analysis of navigational safety concerns for the Sound (Coast Guard 2005a). A PAWSA is a systematic assessment designed to identify major waterway safety hazards, estimate risk levels, and evaluate potential mitigation measures to reduce risk for a waterway. Long Island Sound and the approaches to the Sound were considered in the PAWSA. The PAWSA helped highlight several risk areas that need to be addressed for the Sound, including traffic congestion, waterways mix, visibility (for example, fog), and waterways configuration, particularly at the Race. The PAWSA covered all navigational safety concerns for Long Island Sound, including those that could be anticipated if the proposed Broadwater facility is constructed. While not focused on the Broadwater proposal, the PAWSA provided a baseline for our analysis of the Broadwater proposal, as well as for addressing other navigational concerns within Long Island Sound. At the PAWSA, the Coast Guard provided vessel arrival data for the significant harbors in Long Island Sound. Vessels required to provide a Notice of Arrival under the Vessel Traffic Service were included in the data; these generally include foreign-flagged vessels and tugs. The PAWSA data for specific ports count only vessel arrivals, not departures.

COE Institute for Water Resources, Waterborne Commerce of the United States

Waterborne Commerce of the United States is an annual report assembled by the COE Institute for Water Resources. Each report includes a count of foreign and domestic commercial vessels by vessel draft and vessel type. The most recent report (COE 2003) was used to obtain data for ports within Long Island Sound as a part of our assessment. The COE collects and compiles these data pursuant to Section 11 of the Rivers and Harbors Appropriations Act of 1922 (42 Stat. 1043), as amended, and codified in 33 USC 555. The Act provides that essentially all vessels transporting passengers and goods in the navigable waters of the United States furnish statements relative to vessels, passengers, freight, and tonnage. The COE data provide a comprehensive accounting of incoming and outgoing vessel traffic by port, sorted by vessel draft and vessel type. These data include vessel arrivals and vessel departures, with the result that a single visit to a port by a vessel results in two vessel counts. The COE data include passenger ferry transits, but the other data sources do not.

Waterways Suitability Report

The WSR meets the intent of paragraph 6.b.1 of NVIC 5-05 which establishes Coast Guard policy for assessing the suitability of a waterway to support LNG vessel traffic. The public portion of the WSR is presented in Appendix D of this EIS. In Table 2-1 in Appendix D of the WSR, the Coast Guard presents vessel data for ports within Long Island Sound based on the Coast Guard's Marine Information for Safety and Law Enforcement Analysis and Reporting System. These data provide records of vessel arrivals at Long Island Sound ports from ports outside of the Captain of the Port Long Island Sound Zone. Therefore, it does not include arrivals of ferries or other vessels whose transits are between ports located on Long Island Sound.

Public Input

FERC and the Coast Guard held four public scoping meetings for the EIS in Connecticut and on Long Island. In addition, FERC and Coast Guard representatives attended open houses and public information sessions held by Broadwater, and information sessions held by local groups and environmental organizations. As part of its assessment of the safety and security of this Project, the Coast Guard convened safety and security working groups. For each of these working groups, a balanced group of individuals from both New York and Connecticut were chosen to ensure that concerns of both sides of Long Island Sound were considered.

The Coast Guard formed a Harbor Safety Working Group (HSWG) composed of waterways users and other stakeholders. The HSWG participants included representatives from shipping companies, commercial fishing associations, port city fire departments, the local pilots association, ferry operators, state and county representatives from Connecticut and New York, NOAA, the Navy, and EPA. The HSWG was formed to review the safety risk assessment and proposed risk mitigation measures compiled by the Coast Guard. The HSWG reviewed and validated those measures. The safety risk assessment and risk mitigation measures are discussed in more detail in Section 4 of the WSR. In addition, the Coast Guard has conducted significant outreach with local and state agencies and concerned citizens groups, including the State of Connecticut Long Island Sound LNG Task Force.

The Coast Guard conducted its security assessment in conjunction with a subcommittee of the Area Maritime Security Committee. This subcommittee included representatives of the Department of Homeland Security and other federal agencies; the Navy; New York and Connecticut state agencies; local county, harbor, and city emergency management representatives; fire and police officials; and ferry operators. The security risk assessment and risk mitigation measures are discussed in more detail in Section 5 of the WSR.

3.7.1.3 Existing Conditions

Vessel traffic in Long Island Sound and Block Island Sound includes commercial shipping, ferry services, sightseeing tours, commercial fishing, recreational boating and fishing, and Navy and Coast Guard vessels. All marine traffic in Long Island Sound and in Connecticut and New York state waters in Block Island Sound is under the jurisdiction of the Coast Guard Sector Long Island Sound, which is based in New Haven, Connecticut. Sector Long Island Sound includes waters off the southern shoreline of Long Island and extends out to the limits of the EEZ. All marine traffic in Rhode Island waters, including portions of Block Island Sound, is under the jurisdiction of the Coast Guard Sector Southeastern New England, which is based in Woods Hole, Massachusetts. Sector Southeastern New England includes waters off portions of the Massachusetts shoreline and extends out to the EEZ. Coast Guard duties, responsibilities, and regulatory and law enforcement authorities include search and rescue, vessel safety, oil transfer and hazardous cargo operation oversight and pollution prevention, homeland security, ice breaking, and management of aids to navigation.

The scope of enforcement of regulatory activities under the authority of the Coast Guard includes, but is not limited to, general authority for maritime enforcement of U.S. laws, 14 USC 89; the PWSA of 1972; the Port and Tanker Safety Act of 1978; the Oil Pollution Act of 1990; and the Maritime Transportation Security Act of 2002.

Regulatory Requirements for Vessel Operation and Transit

Many regulatory requirements are imposed on vessels. Some apply to all vessels operating in U.S. waters; some apply to certain classes of vessels, such as cargo or tank vessels operating in U.S. waters; and some are unique to Sector Long Island Sound. The requirements applicable to all vessels are discussed below, along with the additional or unique regulations specific to LNG vessels.

Regulations Generally Applicable in U.S. Waters

All U.S. and foreign vessels bound for or departing from ports or places in the United States must submit an Advance Notice of Arrival (ANOA) to the Coast Guard's National Vessel Movement Center. ANOAs must be submitted at least 96 hours prior to entering a port or place of destination or, if the voyage time for the vessel is less than 96 hours, the ANOA must be submitted at least 24 hours in advance. These notices are forwarded to the office of the Coast Guard's Captain of the Port for the zone in which the vessel will arrive. Prior to receiving approval to enter U.S. waters, all foreign vessels must comply with a number of requirements prescribed by international convention and U.S. laws and regulations applicable to vessel security, safety, and environmental compliance. (An example of this process and the associated timeline is depicted in Figure 2-8 of the WSR in Appendix D.)

Upon receiving a request for entry into a U.S. port through the ANOA process, the Coast Guard has the ability to conduct reviews of the vessels with regard to safety, law enforcement, and previously collected intelligence data. The Coast Guard can deny or grant entry and take actions to mitigate the potential risk that the vessel may pose to the port.

Through its Port State Control Program, the Coast Guard verifies that foreign-flagged vessels operating in U.S. waters comply with applicable international conventions and U.S. laws and regulations. This program ensures that vessels meet security, safety, and environmental compliance standards. Any foreign-flagged vessel entering U.S. waters is subject to boarding and examination by Coast Guard boarding teams to verify compliance with applicable laws and regulations. Vessels that are not in compliance with a relevant convention, law, or regulation may be subject to certain action regulated by the Coast Guard, including requesting appropriate information, requiring the immediate or future correction of deficiencies, detaining the vessel, or allowing the vessel to proceed to another port for repairs. When the condition of the ship or its crew do not correspond substantially with applicable conventions, vessels are detained to ensure that the ship will not sail until it can proceed to sea without presenting a danger to the ship or persons onboard, or without presenting an unreasonable threat of harm to the marine environment.

Under the Maritime Transportation Security Act of 2002 and the International Ship and Port Facility Security Code of 2002, vessels are required to have in place vessel security plans that are in compliance with either the International Ship and Port Facility Security Code (for foreign-flagged vessels) or the Maritime Transportation Security Act (for U.S.-flagged ships). All LNG vessels, as well as other cargo vessels 300 gross tons and larger, and the ports servicing those regulated vessels, must adhere to the International Maritime Organization and the International Convention for the Safety of Life at Sea (SOLAS) standards.

Tank vessels entering U.S. waters must also comply with requirements that are in addition to those of the Port State Control Program described above. As required by 46 USC Section 3714, each foreign tank vessel must undergo a full safety examination at its initial U.S. port of call and at least annually after that. The annual examination is referred to as a tank vessel exam. The Coast Guard is required by 46 USC Section 3711 to issue to each foreign tank vessel a Certificate of Compliance that is valid for 24 months. The Coast Guard has determined that a tank vessel exam letter will be issued to tank vessels carrying oil and oil products every 12 months; and a Certificate of Compliance will be issued to chemical and gas carriers every 24 months, with an annual mid-period exam. According to 46 CFR Section 154.1802, all foreign-flagged, self-propelled vessels with onboard bulk liquefied gases as cargo, cargo residue, or vapor (this includes all LNG carriers) must have (1) an International Maritime Organization certificate issued by the flag administration that is endorsed with the name of the cargo that it is allowed to carry, and (2) a Certificate of Compliance issued by the Coast Guard that is endorsed with the name of the cargo that it is allowed to carry.

Naval vessel protective zones exist at all times within 500 yards of any U.S. naval vessel greater than 100 feet in overall length in the navigable waters of the United States to provide for their safety and security. While within the protective zone, vessels are required to operate at a minimum speed necessary to maintain a safe course, unless required to maintain speed by the Navigation Rules, and may not enter within 100 yards of the naval vessels.

Regulations Unique to Sector Long Island Sound

As defined in 33 CFR Section 165.153, a regulated navigation area (RNA) exists for Sector Long Island Sound out to 12 nautical miles from the territorial sea baseline (essentially the shoreline). Within this RNA, there are requirements on vessels, dependent on their size and last port of call. This includes inspection and authorization requirements by the Coast Guard before vessels are permitted to enter the area within 3 nautical miles of the territorial sea baseline. Additionally, vessels over 1,600 gross tons operating within the RNA and within 3 nautical miles of the territorial sea baseline must receive authorization from the Coast Guard prior to transiting or conducting any intentional vessel movements, such as shifting berths, departing anchorage, or getting underway from a mooring. Within the RNA, the Coast Guard also imposes no-entry areas for (1) vessels greater than 300 gross tons within a 1,200-yard radius of ferries, and (2) all vessels within 100 yards of a vessel engaged in commercial service. For each of these situations, entry is permitted within the RNA if express prior authorization is obtained from the ferry vessel licensed operator, licensed master, or the Coast Guard.

Several safety and security zones exist within the Sector Long Island Sound. These include zones surrounding the Naval Submarine Base in New London, Connecticut; General Dynamics Electric Boat Shipyard; Dominion Millstone Nuclear Power Plant; and all anchored Coast Guard vessels. In addition, safety and security zones have been proposed surrounding the Northport and Riverhead Offshore Platforms. Safety zones also are imposed for several fireworks events each year.

Six lightering zones exist within Long Island Sound as designated by the Coast Guard's Captain of the Port Policy Letter 03-99, not by regulation (see Figure 3.5-2 of this EIS and Figures 2-3 and 2-4 in the WSR). The Coast Guard is in the process of establishing these areas as formal anchorage grounds and lightering zones in accordance with Coast Guard regulations in 33 CFR Parts 110 and 165, respectively. This process is independent of the Broadwater proposal. These anchorage grounds and lightering zones are being developed to provide for general navigation safety, security, and environmental protection.

State Pilotage Requirements

Registered foreign and American vessels transiting to ports or places within Long Island Sound must use a New York- or Connecticut-licensed marine pilot while transiting Long Island Sound. Marine pilots must embark and disembark vessels at one of two designated pilot boarding stations, either the Point Judith Pilot Station or the Montauk Point Pilot Station (see Figure 2.4.3). Point Judith Pilot Station is considered the primary pilot boarding station, with Montauk Point Pilot Station considered an alternate. Vessel draft and weather conditions limit the use of the Montauk Point Pilot Station: vessels with a draft in excess of 38 feet may not be piloted through Montauk Channel; and pilots using Montauk Channel may not pilot a vessel if weather conditions, sea state, or vessel traffic "pose a threat to the safety of any person, vessel, prudent navigation, or safety of the environment." Broadwater has indicated that the same pilot that boards the LNG carrier for transit to the FSRU would complete the docking and undocking operations at the FSRU, remain onboard throughout the discharge operation, and pilot the carrier back to the pilot station.

Commercial Shipping

History of Shipping in Long Island Sound

Long Island Sound has long been used for commercial shipping. Wiegold (2004) described the history of shipping in the Sound, which has been cyclical in response to the period use of other transportation alternatives. During the late 1700s, settlements began around various natural harbors. Over-land travel was difficult, and waterborne transportation provided village-to-village links. The relatively sheltered waters of the Sound allowed local transportation using smaller vessels. Steamships ran primarily passenger routes through the Sound between New York City and Hartford, New London, and Providence. As on-land transportation developed, the steamships lost business to the railroads, and subsequently to trucks and cars on highways. Ferry services sprang up in the early 1900s, in response to the popularity of the automobile. Most of the ferry services ended in the 1930s, as highways expanded and driving times were reduced. The ports of Boston and New York, from the 1700s through today, have been the dominant ports for trans-Atlantic trade. Mainland railroads and highways have provided faster domestic freight transport than ships. The trend has been for Long Island Sound commercial shipping to generally be limited to energy supplies (oil and coal) for local consumption. There is pressure for commercial vessel traffic on the Sound to increase beyond current levels as a means of reducing truck traffic on the region's roadways. Based on the Coast Guard's Marine Information for Safety and Law Enforcement Analysis and Reporting System, there has been an increase in the number of total vessel arrivals at ports located on Long Island Sound from 2003 to 2005 (See Section 2.2.1 of the WSR).

General Vessel Traffic Routes

Long Island Sound is a thoroughfare for commercial vessels transiting to and from the Port of New York/New Jersey for ports north and east of the Race, as well as for vessels arriving at ports within the Sound. Traffic patterns within Long Island Sound are discussed in more detail in Section 2.2.2 in the WSR (Appendix D). According to the WSR, there are no formally designated traffic separation schemes or traffic lanes in Long Island Sound or Block Island Sound. In addition, Long Island Sound, Block Island Sound, Rhode Island Sound, and Montauk Channel are not established as vessel traffic service areas. In April 2004, a recommended vessel route was added to NOAA charts for the area from Buzzards Bay to the Race. Although not a formally designated International Maritime Organization routing measure, this recommended vessel route designates the preferred transit areas for deep-draft vessels, including tug and barge traffic, transiting between Buzzards Bay or Narragansett Bay and Long Island Sound. Commercial fishermen, including lobstermen and trawlers, also frequent this area from ports in southeastern Connecticut and Rhode Island. The majority of commercial traffic transiting this area, not destined to or from Block Island or Newport, generally follows the recommended vessel route.

The Race is the main entrance to Long Island Sound from the east and was the subject of many public comments. As described in the WSR, the Race is typically defined as the waters between Race Rock Light, near the southwestern tip of Fishers Island, running southwest to Little Gull Island Light. All LNG carriers would transit the Race to enter the Sound and again to exit the Sound.

Within Long Island Sound, general traffic patterns for commercial vessels have developed, based in large part on natural features and obstructions and on mariner experience. Generally, obstructions such as rock shoal areas are marked with navigational aids that are maintained by the Coast Guard. In general, traffic flow in Long Island Sound runs in an east-west direction down the central portion of Long Island Sound. North-south traffic patterns generally exist from the general routes to the major ports, as well as cross-Sound traffic servicing the offshore platforms in Riverhead and Northport, New York. Outside of Long Island Sound, running up to and through the Race, there is a recommended vessel route for deep-draft vessels and tug-barge combinations. Weather also can factor into whether vessels transit along a more northerly or southerly route in the Sound, with vessels favoring one coast or another dependent on the prevailing winds, taking advantage of the lee afforded by the land. Because there are no restrictions regarding vessels anchoring within Long Island Sound, vessels may be found anchored anywhere within the Sound, based on bottom conditions and obstructions. Ocean-going vessels tend to use one of the six established lightering zones as anchorages. As also discussed in the WSR, these lightering zone areas are being proposed as anchorage ground regulations within Long Island Sound. Restrictions on anchoring do exist for some harbor areas.

Commercial vessels approaching Block Island Sound from the Atlantic Ocean and departing to the Atlantic Ocean generally follow the existing traffic separation scheme associated with Narragansett Bay and Buzzards Bay (see Figure 2.4-1). Rhode Island Sound, which is east of Block Island Sound, must be transited to access Narragansett Bay, Buzzards Bay, and the Cape Cod Canal. The entrance to Rhode Island Sound is managed by a precautionary area southeast of Block Island, which terminates two pairs of traffic separation scheme traffic lanes – one pair each for Narragansett Bay and Buzzards Bay. The precautionary area is managed via a long-distance very high frequency (VHF) navigational communications system that is operated by the State of Rhode Island. This vessel traffic management system monitors and coordinates the movements of approaching vessels and arranges pilot boarding.

In support of the Coast Guard WSR and our analysis, AIS data from calendar year 2005 were analyzed for vessels transiting along the anticipated LNG vessel transit route (namely in Block Island Sound), including Montauk Channel, the Race, and within Long Island Sound. Under Coast Guard regulations, several classes of commercial vessels are required to be equipped with operable AIS equipment. AIS automatically broadcasts vessel- and voyage-related information that is received by other AIS-equipped ships and shore stations. This includes such information as vessel name, position, course, and speed. In the absence of formally designated shipping lanes, AIS data were used to analyze the actual routes used by commercial vessels.

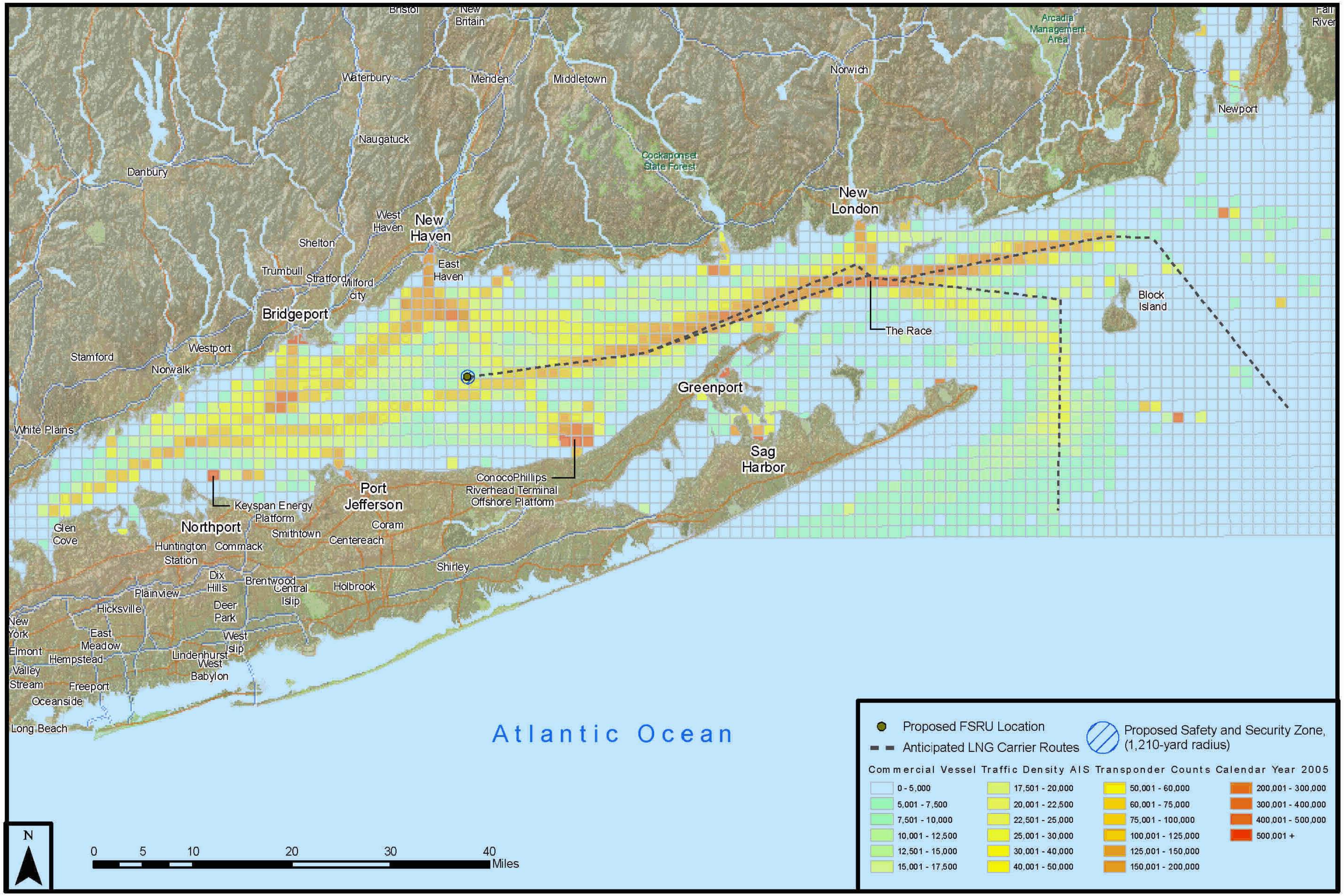
Commercial Shipping Routes and Densities

Water-dependent activities are very important to the economies of New York and Connecticut. Commercial navigation addressed in this section includes vessels involved in domestic and foreign trade, ferries providing local transportation service, and commercial fishing boats. Because of the greater depths through the central portion of Long Island Sound (greater than 66 feet), maintained navigation channels are restricted to nearshore areas and within the rivers and harbors along the Sound. The locations of ports within the Sound and the presence of Stratford Shoal, which is centrally located in the Sound, largely dictate the paths followed by large vessels on the Sound.

The density of vessel traffic, based on AIS data for all of 2005, is presented in Figure 3.7-1. The vessel transit density map presents the intensity of use of Long Island Sound and Block Island Sound in 2005. The pattern of intense use areas indicates the primary shipping routes. Figure 3.7-2 depicts a sampling of actual vessel routes in the central portion of the Sound during 2005, and Figure 3.7-3 depicts actual vessel routes through the area of the Race.

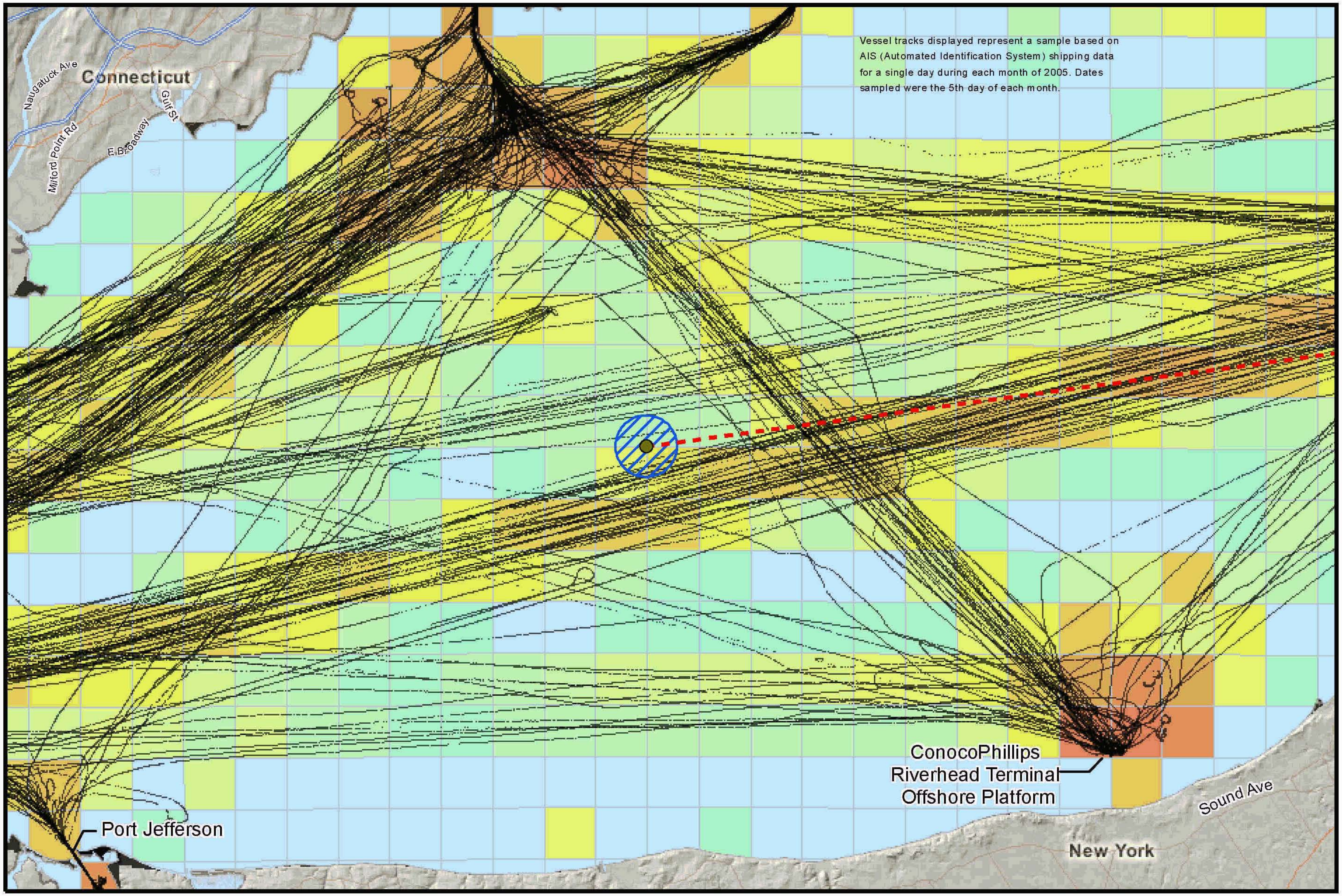
The main shipping routes in Long Island Sound presented in Figure 3.7-2 were developed from AIS data for 2005. The main shipping route extends in a generally east-west direction through the center of the Sound, on a straight course from deepwater areas in the eastern Sound inside the Race through to the Stratford Shoal area. From this main route, vessel traffic branches to the north and south to enter ports throughout the Sound. Due to the greater port development in Connecticut, more routes branch toward Connecticut than New York.

The commercial vessel tracks and density derived from AIS data for 2005 indicate a predominance of east-west traffic transits south of the proposed FSRU location. Much of this east-west traffic is either through-traffic (using Long Island Sound as a thoroughfare to or from the Port of New York/New Jersey) or is heading toward Bridgeport, Connecticut or Port Jefferson, New York. In addition, there is a concentration of north-south traffic east of the proposed FSRU site. The majority of this traffic is tug and barge traffic transiting to or from the Riverhead Offshore Platform.



Source: U.S. Coast Guard - Automated Identification System, 2005

Figure 3.7-1
Broadwater LNG Project
Vessel Traffic Density



Source: U.S. Coast Guard - Automated Identification System, 2005

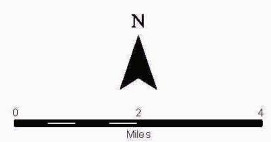
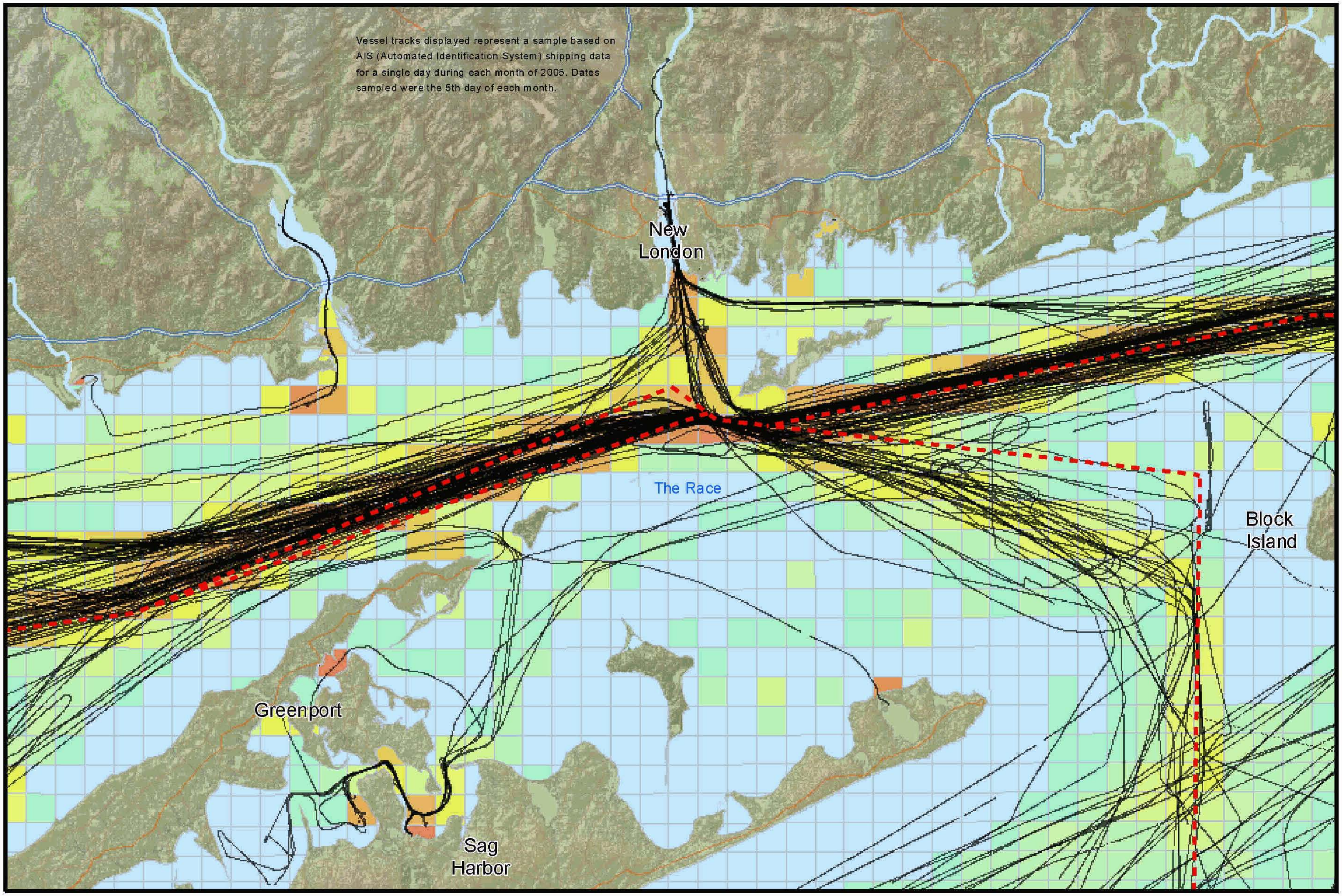


Figure 3.7-2
Broadwater LNG Project
Vessel Tracks in the Vicinity
of the FSRU

- Proposed FSRU Location
- Proposed Safety and Security Zone (1,210-yard radius)
- Anticipated LNG Carrier Routes
- Commercial Vessel Tracks

Commercial Vessel Traffic Density AIS Transponder Counts Calendar Year 2005

0 - 65	1,060 - 1,361	4,653 - 6,269	23,445 - 32,630
66 - 210	1,362 - 1,703	6,270 - 8,336	32,631 - 45,473
211 - 377	1,704 - 2,135	8,337 - 10,738	45,474 - 68,429
378 - 566	2,136 - 2,751	10,739 - 13,934	68,430 - 156,793
567 - 789	2,752 - 3,524	13,935 - 18,108	156,794 - 228,771
790 - 1,059	3,525 - 4,652	18,109 - 23,444	228,772 +



Source: U.S. Coast Guard - Automated Identification System, 2005

N

0 3 6
Miles

Figure 3.7-3
Broadwater LNG Project
Vessel Tracks and Traffic Density
in the Race

Anticipated LNG Carrier Routes
Commercial Vessel Tracks

Commercial Vessel Traffic Density AIS Transponder Counts Calendar Year 2005

0 - 65	1,060 - 1,361	4,653 - 6,269	23,445 - 32,630
66 - 210	1,362 - 1,703	6,270 - 8,336	32,631 - 45,473
211 - 377	1,704 - 2,135	8,337 - 10,738	45,474 - 68,429
378 - 566	2,136 - 2,751	10,739 - 13,934	68,430 - 156,793
567 - 789	2,752 - 3,524	13,935 - 18,108	156,794 - 228,771
790 - 1,059	3,525 - 4,652	18,109 - 23,444	228,772 +

Most of the vessel traffic approaching the Race transits Block Island Sound. Although the AIS data set used in the analysis did not cover all of Block Island Sound, Figure 3.7-1 clearly indicates that the majority of vessel traffic associated with the Race originates from or transits into the north side of Block Island, in Block Island Sound. Most commercial vessel traffic entering the Race from the Atlantic Ocean through Block Island Sound and Rhode Island Sound uses the formal north/south shipping lanes (with a separation lane) that are established east of Block Island, and are therefore within the established vessel traffic control scheme. From the north end of the shipping lanes, vessels diverge to various ports in Massachusetts or Rhode Island, or they pass through the Race to approach ports in Connecticut and New York.

Port Activity

Table 3.7.1-2 presents 2003 commercial vessel traffic counts for selected ports in Long Island Sound (COE 2003). The table also includes data that Broadwater obtained from discussions with the Coast Guard Vessel Traffic Service New York and pilots from New York, and included in its application. Table 3.7.1-3 presents 2003 commercial vessel traffic counts for selected ports accessed through Rhode Island Sound (COE 2003). Domestic and foreign traffic are included in both tables, but fishing vessels and escort tugs associated with barges or other vessels are not. Table 3.7.1-4 presents the Coast Guard data used for the 2005 PAWSA (Coast Guard 2005a); vessel arrival data are presented for 2003, 2004, and through April 21, 2005.

TABLE 3.7.1-2
2003 Commercial Vessel Traffic to and from Long Island Sound Ports[a]

Deepwater Port	Vessel Trips per Year[b]	Transit Tankers[c]
Bridgeport, CT	21,695	27
New London, CT	10,933	12
New Haven, CT	3,639	470
Port Jefferson, NY[d]	22,515	4
Northville, NY[e]	1,207	31
Asharoken, NY[e]	282	11
Northport, NY	68	0
Flushing Bay and Creek, NY[f]	4,681	111
East River, NY[g]	90,960	72

[a] Source: COE 2003, unless indicated otherwise.

[b] Includes inbound and outbound vessel count. Foreign and domestic traffic were totaled for deepwater ports; fishing vessels and escort tugs were not included.

[c] Self-propelled bulk tanker vessels; excludes barges used to transport bulk liquid cargo.

[d] Vessel traffic received at Port Jefferson is significant; however, vessels range in size from less than 500 to 25,000 gross registered tons.

[e] Data from Broadwater application.

[f] The draft of all vessels reported for Flushing Bay and Creek is 18 feet or less. The portion of these vessels that may transit Long Island Sound was not identified.

[g] The draft of all vessels reported for East River is 18 feet or less. The portion of these vessels that may transit Long Island Sound was not identified.

TABLE 3.7.1-3 2003 Commercial Vessel Traffic to and from Ports in Block Island Sound and Rhode Island Sound[a]		
Deepwater Port	**Vessel Trips per Year[b]**	**Transit Tankers[b]**
Greenport, NY	56,174	0
Providence, RI	1,858	270
Newport, RI	172	4
Block Island, RI	4610	0
Harbor of Refuge, Point Judith, RI	4,350	0
Fall River, MA	801	20
Harbor of Refuge, Nantucket, MA	18,271	24
New Bedford and Fairhaven Harbor, MA	4,018	0

[a] Source: COE 2003.

[b] Self-propelled bulk tanker vessels; excludes barges used to transport bulk liquid cargo.

In its WSR, the Coast Guard presents vessel data for ports within Long Island Sound based on the Coast Guard's Marine Information for Safety and Law Enforcement Analysis and Reporting System. The Coast Guard estimates an average of 2,300 commercial vessel arrivals at Long Island Sound ports each year.

COE data (Table 3.7.1-2) suggest that the Long Island Sound ports with the greatest vessel activity are Port Jefferson, New York and Bridgeport and New London, Connecticut. Although all the vessel counts for Port Jefferson, Bridgeport, and New London are heavily skewed toward domestic shallow-draft vessels, some deeper draft tankers/barges and other vessels are included. The intensity of use at these ports is high because of passenger ferry operations. The PAWSA data (Table 3.7.1-4) indicate that non-ferry shipping at ports in Long Island Sound mainly involves vessels arriving and departing the ports of Bridgeport, New London, and New Haven in Connecticut and Riverhead in New York.

Vessel activity at ports in Block Island Sound and Rhode Island Sound, based on COE data, is presented in Table 3.7.1-3. Data from the Coast Guard are not currently available for Block Island Sound and Rhode Island Sound. The AIS data reviewed did not include the area east of Block Island. The Greenport, New York area, located on the north fork of eastern Long Island, had a high level of vessel activity. Nantucket, Massachusetts was the next busiest port in either Block Island Sound or Rhode Island Sound. A much higher level of vessel traffic was reported for those two ports than for other ports in the area.

Each of the deepwater ports receives tankers that are similar in appearance and can be similar in size to LNG carriers. Tankers using New Haven, Bridgeport, and Northport are known to carry oil, petroleum products, and other chemicals. Cargo vessels using Asharoken, New London, and Northville likely contain oil, petrochemicals, and other chemicals. Tables 3.7.1-2 and 3.7.1-3 present the number of self-propelled bulk transit tanker trips reported for each port, based on the COE data. Table 3.7.1-4 presents similar information based on the PAWSA data. Based on the number of tankers reported in the respective data sets, the COE vessel count appears to be approximately double the PAWSA vessel count. However, the COE counts incoming and outgoing vessel trips, which results in one port visit counting as an arrival, and one vessel leaving counting as a departure. PAWSA counts only port calls. Thus, one PAWSA-recorded port call would be recorded as two calls in the COE data (one arrival and one departure). The indicated transit tanker count excludes barges used to transport bulk liquid cargo.

TABLE 3.7.1-4
Ports and Waterways Safety Assessment Vessel Arrival Data[a]

Location	Total Number	Barge	Freight Ship	Passenger Ship	Tank Ship	Towing Vessels	Other
2005 (ends April 21)							
Bridgeport, CT	139	110	22	0	2	0	5
Bridgeport Anchorage, CT	9	2	7	0	0	0	0
Groton/New London, CT	77	34	11	18	5	1	8
New Haven, CT	266	193	26	0	30	9	8
Stamford, CT	35	15	0	0	20	0	0
Long Island (North Shore), NY	53	11	0	1	40	0	1
Northport, NY	14	10	0	0	4	0	0
Riverhead, NY	94	74	0	0	20	0	0
Total	**687**	**449**	**66**	**19**	**121**	**10**	**22**
2004							
Bridgeport, CT	363	246	86	3	13	0	15
Bridgeport Anchorage, CT	22	1	20	0	0	0	1
Groton/New London, CT	190	64	34	58	11	3	20
New Haven, CT	164	474	81	0	140	27	42
Stamford, CT	60	29	0	1	29	0	1
Long Island (North Shore), NY	141	55	0	1	72	0	13
Northport, NY	54	31	0	0	18	0	5
Riverhead, NY	270	199	0	0	70	0	1
Total	**1,264**	**1,099**	**221**	**63**	**353**	**30**	**98**
2003							
Bridgeport, CT	312	189	103	5	14	0	1
Bridgeport Anchorage, CT	18	3	12	0	3	0	0
Groton/New London, CT	151	64	33	37	9	0	8
New Haven, CT	673	279	95	5	242	14	38
Stamford, CT	58	21	0	0	37	0	0
Long Island (North Shore), NY	122	50	1	5	60	0	6
Northport, NY	59	36	0	0	19	0	4
Riverhead, NY	207	150	2	0	53	0	2
Total	**1,600**	**792**	**246**	**52**	**437**	**14**	**59**

[a] Source: Coast Guard 2005a.

ConocoPhillips owns and operates an offshore oil products receiving platform that is located in the Sound about 1 mile offshore of the shoreline of the town of Riverhead in the Northville area. The facility has also been known as the Northville Industries platform. Bulk petroleum cargoes are delivered by tanker to the platform, unloaded, and transferred via subsea pipeline to an onshore tank farm.

Through Transits for Long Island Sound in 2005

The volume of through traffic is not well documented for Long Island Sound. Some commercial vessel use of the Sound is not captured by the primary data sources we used or by any other known data source. Vessels may transit the entire length of the Sound without calling on any port. Without a port call, they would not be included in the COE, PAWSA, or Coast Guard Marine Information for Safety and Law Enforcement Analysis and Reporting System data. We were able to estimate the number of through transits by vessels carrying an AIS transponder; however, through transits by vessels that are not required to use an AIS transponder would not be tracked in the AIS data.

In the WSR, the Coast Guard estimates that from approximately 2,000 to 4,000 of these types of vessel transits occur on the Sound each year. That estimate is based on information provided to the Coast Guard by vessel operators. Using AIS data from 2005, our analysis indicated that the number of through transits was 1,607. That number was developed by counting vessels passing through central Long Island Sound, after deleting from the count any vessels whose AIS identifier appeared in a Long Island Sound port on the same day. This method could miss some through transits that do not follow the central route through Long Island Sound. Based on the methodology used, this number is considered to be conservative.

The vast majority of these vessels are tug-and-barge combinations traveling between the Port of New York/New Jersey and ports in Rhode Island and Massachusetts. These include both container barges that have a relatively large visual profile and petroleum barges, which are low-profile vessels.

Ferry Systems

Three year-round commercial ferry services operate in Long Island Sound: (1) Cross Sound Ferry Service, Inc. (Cross Sound), which provides service between Orient Point, New York and New London, Connecticut; (2) the Bridgeport & Port Jefferson Steamboat Company, providing service between Port Jefferson, New York and Bridgeport, Connecticut; and (3) Fishers Island Ferry District, which serves passengers traveling between New London and Fishers Island, New York (see Figure 3.7-1). The Department of Homeland Security owns and operates year-round ferry service from Plum Island to Old Saybrook, Connecticut. Several seasonal ferry services operate in Long Island Sound, Block Island Sound, and Rhode Island Sound. Block Island Express, a subsidiary of Cross Sound, provides high-speed ferry service between New London, Connecticut and Block Island, Rhode Island from late May through early October. Viking Fleet operates seasonal passenger ferry service between Montauk Point in New York and New London in Connecticut, Block Island in Rhode Island, and New Bedford and Martha's Vineyard in Massachusetts. Viking also operates seasonal passenger ferry service between Block Island and Martha's Vineyard and between Block Island and New Bedford. Block Island Ferry provides seasonal service between Block Island and Point Judith and Newport, Rhode Island. Island Hi-Speed Ferry provides seasonal high-speed ferry service between Block Island and Point Judith. North Ferry Company, Inc. provides year-round service to Shelter Island from Greenport, on the north fork of the east end of Long Island. Primary ferry routes are depicted in Figure 3.5-2. Actual routes may vary depending on weather and vessel traffic conditions.

Regularly scheduled ferry services that could be affected by the proposed Project are summarized in Table 3.7.1-5. The Bridgeport & Port Jefferson Steamboat Company operates approximately 16 miles west of the proposed FSRU site and crosses the proposed marine pipeline route. The ferry routes of the Cross Sound, Fishers Island Ferry District, and other seasonal ferry service providers are more than 30 miles east of the proposed FSRU location. All ferry routes, except the Fishers Island ferry route and the North Ferry Company route between Greenport and Shelter Island, cross the proposed transit route of the LNG carriers.

Table 3.7.1-5 shows that the year-round ferry services are also the ferry routes with the greatest frequency. The New London/Orient Point route has the highest transit frequency, with up to 58 crossings per day. The Bridgeport/Port Jefferson route has up to 32 crossings per day.

Commercial Fishing Vessels

Long Island's commercial fisheries include hard clams, Eastern oysters, American lobster, and finfish. Shellfishing occurs in the relatively shallow nearshore habitats and would not be affected by the Project. Lobster and finfishing occur in many locations of the Sound, including in the vicinity of the proposed locations of the FSRU, YMS, and pipeline, and in the vicinity of the planned routes of the LNG carriers.

Commercial fishing vessels are used for all types of fishing that occur in the Sound. Lobster fishing occurs throughout the Sound, including in the vicinity of the proposed locations of Project facilities. Lobster fishermen enter the Sound from many different ports and launching areas, and are almost constantly moving their boats as they set or haul in pots.

In the early 1980s, as part of a cooperative effort between lobstermen and commercial trawlers, an agreement was reached between these fishing communities on Long Island Sound to establish two areas specifically reserved for commercial trawling. As such, no lobster traps are set in these trawl lanes. The southern edge of the southernmost trawl lane is located approximately 50 yards north of the center of the YMS. The trawl lane is approximately 0.5 mile wide and extends for approximately 15 miles in an east-west direction; a second trawl lane is present north of this lane (see Figure 3.5-2). From 2 to 12 fishermen use the trawl lane, depending on the season, with the primary use during August (Crismale 2006).

Navy, Coast Guard, and Other Government Vessel Traffic

Seventeen fast-attack submarines are based in Groton, Connecticut. The submarines transit the Race and Block Island Sound under a standard naval vessel safety and security zone that allows no entry within 100 yards (in any direction) for any vessel and entry within 500 yards only by permission. Submarine transits of the Race generally occur during daylight hours, and the Navy provides public notice 24 hours in advance of its transits through the Race.

The Coast Guard operates vessels for routine patrols and for maintenance of navigational aids. Routine patrols include inspections of ports and vessels and occur daily. They generally involve transport of Coast Guard personnel by small Coast Guard vessels. In addition, the Coast Guard conducts maintenance of aids to navigation on a periodic basis, using buoy tenders. Most buoy tenders are based in Newport, Rhode Island.

NOAA periodically operates vessels within Long Island Sound as a part of its hydrographic survey program.

TABLE 3.7.1-5 Ferry Services Potentially Affected by the Proposed Project[a, b]				
Provider	Route	LNG Carrier Route Crossed	Maximum Transits/Day	Year Round?
Ferry Routes Crossing Proposed Transit Route for LNG Carriers				
Cross Sound Ferry Services, Inc.				
Cross Sound Ferry	New London/Orient Point	N & S[b]	46	Yes
Sea Jet	New London/Orient Point	N & S	12	Yes
Block Island Express	New London/Block Island (via Race)	N & S	10	No
Plum Island Ferry/Department of Homeland Security				
	Old Saybrook/Plum Island	N & S	Unknown	Yes
Block Island Ferry/Interstate Navigation				
	Newport/Block Island	N	20	No
	Point Judith/Block Island	N	20	No
Viking Fleet Ferry/Montauk Ferry				
	Montauk/New London	N & S	Unknown	No
	Montauk/Block Island	S	4	No
	Montauk/Martha's Vineyard	N & S	1 round trip in all 2006[c]	No
	Montauk/New Bedford (1 stop at Block Island)	N & S	2 – Sunday only	No
	New Bedford/Block island	N	2 – weekends only	No
	Block Island/Martha's Vineyard	N	2 – weekends only	No
Island Hi-Speed Ferry				
	Galilee (Point Judith) to Block Island	N	12	No
Ferry Routes Crossing Proposed Pipeline Route				
Bridgeport & Port Jefferson Steamboat Company				
Existing ferry	Bridgeport/Port Jefferson	NA	32	yes
Proposed ferry	New Haven/Port Jefferson	NA	Unknown	unknown
North Ferry Company, Inc.				
	Greenport/Shelter Island	NA	130	yes

N = Block Island Route.

NA = Not applicable.

S = Montauk Channel Route.

[a] Sources: Cross Sound Ferry 2005, Bridgeport & Port Jefferson Steamship Company 2005, Block Island Express 2005, Block Island Ferry 2005, Fishers Island Ferry 2005, Island Hi-Speed Ferry 2005, Viking Fleet 2005, Viking Montauk to Martha's Vineyard Ferry 2005, North Island Ferry 2006.

[b] Excludes conceptual Bridgeport to LaGuardia/Manhattan ferry due to a lack of information on the possible service.

[c] Not included on Figure 3.5-2 since there is only one transit per year.

Long Island Sound Waterborne Traffic Plan

The Long Island Sound Waterborne Transportation Plan (LISWTP) is being developed as a long-term plan for including waterborne transportation as part of the infrastructure for improving regional mobility and reducing automobile dependence. The LISWTP focus on regional mobility and vehicular traffic congestion indirectly addresses tank truck versus barge transportation of bulk fuels, such as gasoline and diesel. Because LNG is not a current part of highway traffic and is not considered in the LISWTP as a future part of highway traffic, it is beyond the scope of the LISWTP. However, the Broadwater Project is consistent with the public concerns expressed in LISWTP Section 2.4. Specifically, the Broadwater Project would provide local and regional economic development while avoiding or minimizing dredging and major public costs and subsidies.

3.7.1.4 Potential Impacts and Mitigation Measures

Potential impacts to marine transportation during construction could result from an increase in vessel movements in Long Island Sound and from establishment of a construction zone that would limit use of the waters of the area to vessels associated with the Project. During operation, potential impacts to marine transportation could result from establishment of the fixed safety and security zone around the FSRU, increased vessel traffic (support and service vessels, and LNG carriers), and establishment of a moving safety and security zone around each LNG carrier. These issues are addressed below.

Environmental Impacts Associated with Coast Guard Actions

Based on Coast Guard policy guidance contained in NVIC 5-05, the Captain of the Port can make one of three conclusions regarding the suitability of a waterway to support LNG marine traffic. The first is to issue a Letter of Recommendation finding that the waterway is suitable without the implementation of additional measures. The second is to issue a Letter of Recommendation finding that the waterway is unsuitable. The third is to issue a Letter of Recommendation finding that to make the waterway suitable, additional measures are necessary to responsibly manage risks to navigation safety or maritime security associated with LNG marine traffic.

As a cooperating federal agency, and under the Interagency Agreement[2], the Coast Guard will adopt all or pertinent parts of this EIS to satisfy its own NEPA responsibilities. Some of the potential environmental impacts resulting from LNG vessel activities and transit would not be unique to LNG carriers and may also be addressed by previous Coast Guard NEPA analyses for existing regulations. In accordance with the Coast Guard's NVIC 05-05, all required Coast Guard NEPA analysis and documentation must be complete prior to the issuance of the final Letter of Recommendation.

The Coast Guard has determined that, because an applicant is not able to construct or operate an LNG facility without a Letter of Recommendation, a Letter of Recommendation should be considered a federal permit for the purposes of the CZMA regulations. The environmental effects associated with the Project, including marine vessel transit, are addressed in the appropriate sections of this EIS. The potential impacts associated with a release of LNG are discussed in Section 3.10.

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[2] Interagency Agreement among the Federal Energy Regulatory Commission, U.S. Coast Guard, and Research and Special Programs Administration for the Safety and Security Review of Waterfront Import/Export Liquefied Natural Gas Facilities.

Based on the results of the assessment of potential risks to navigation safety and maritime security associated with Broadwater Energy's proposal, the Coast Guard stated in the WSR that to make the waters of Block Island Sound and Long Island Sound suitable for LNG vessel traffic and the operation of the proposed FSRU, additional measures are necessary to responsibly manage the safety and security risks associated with the proposed project. The necessary measures are listed in Section 8.4 of the WSR.

We have addressed the potential impacts of establishment of safety and security zones on commercial and recreational use of the waterway in this section. However, these zones are not expected to affect environmental resources.

The Coast Guard would undertake several actions and activities if the Project is authorized and implemented, including establishment of a safety and security zone around the FSRU and a moving safety and security zone around each LNG carrier; providing some level of escort, in addition to the escort tug or tugs; conducting safety and security inspections of LNG carriers to ensure compliance with U.S. and international standards; and reviewing Broadwater's facility security plan. In the WSR, the Coast Guard assessed impacts of the Project to marine transportation within Long Island Sound. Portions of that report are incorporated into the following impact analysis. Information included in the WSR regarding safety and security issues is presented in Section 3.10.

Construction

FSRU and YMS

The FSRU and mooring tower would be towed into Long Island Sound to the proposed Project site. During delivery, the FSRU would not contain either LNG or natural gas. The towing from Block Island to the mooring location would be subject to the same Coast Guard regulatory oversight and monitoring as the transit of any large commercial vessel. Thus, the delivery of the FSRU and the mooring tower would be comparable to other similar vessel movements and marine transportation events, and would not significantly affect marine transportation. Additional components of the YMS would be delivered by barge and supply ships.

During installation of the FSRU and YMS, Broadwater and the Coast Guard would provide navigational warnings and enact precautionary procedures to make mariners aware of the construction activities and the need to avoid the area. Notifications would be made by navigational safety messages broadcast by the Coast Guard via VHF radio, telephone calls to vessel operating offices, and daily e-mail broadcasts to interested parties. Each district of the Coast Guard publishes a weekly Local Notice to Mariners. For Long Island Sound and surrounding waters, the Coast Guard's First District would collect and publish Project-specific information in its weekly Local Notice to Mariners. The National Geospatial-Intelligence Agency also issues a weekly U.S. Notice to Mariners on a national basis. This U.S. Notice to Mariners, published weekly since 1869, contains time-sensitive update information for all U.S. Government charts and publications that are produced by the National Geospatial-Intelligence Agency, the National Ocean Service, and the Coast Guard. Each U.S. Notice to Mariners publication also contains other pertinent maritime safety information that affects the safety of life at sea and safe navigation around the globe. One purpose fulfilled by the notices is providing the information needed for specified navigation charts and navigational publications to be manually revised with notes.

NOAA also formally revises U.S. territorial waters' National Ocean Service navigation charts on a periodic basis. These revisions include changes made through Notices to Mariners.

Navigational aids would be permanently installed on the facility to provide adequate warning to passing vessels. Because of its location and the precautionary navigational aids that would be installed by Broadwater, construction of the mooring tower would not significantly affect marine transportation.

When the FSRU and mooring tower are being towed to the site, some commercial shipping vessels and fishing vessels may be required to briefly alter their movements to avoid the tug-and-tow operations. The Cross Sound ferries and the ferries serving Block Island also may be similarly affected by the tug-and-tow operations. Therefore **we recommend that:**

- • **Prior to towing the FSRU and mooring tower into U.S. territorial waters, Broadwater file with the Secretary written documentation that it has coordinated the timing of delivery with the Coast Guard and each of the ferry companies that could be affected by the towing activities.**

Once the FSRU and mooring tower are at the proposed installation site, all vessels not related to the Project would be restricted from the construction area. This would result in the same minor vessel movement alterations as described for pipeline construction below, but for a shorter period of time (about 2 months). Overall, delivery and installation of the FSRU and YMS would result in a minor, temporary impact on the ferry systems and on vessels involved in commercial shipping and commercial fishing.

Pipeline

Installation of the pipeline would result in limited access to the construction area by vessels not involved in the Project from October 2009 through April 2010. Establishment of the pipeline construction corridor would temporarily affect a portion of the generally used shipping route approaching Bridgeport (see Figure 3.7-2). However, there is sufficient safe navigable area adjacent to and near the construction zone for vessels to make minor alterations to their normal routes and expediently reach their destinations.

The Bridgeport-Port Jefferson ferry also would be able to avoid the area of construction activity; however, this may cause a slight increase in ferry transit time. To mitigate this impact, Broadwater would coordinate schedules with the ferry operator to provide for minimal disruption to the ferry schedule. Broadwater also would coordinate with the Coast Guard to assist in developing Local Notices to Mariners that would be communicated to the ferry operator. Daily communication of information related to construction and potential disruption of normal vessel traffic patterns would be made in navigational safety messages broadcast by the Coast Guard via VHF radio, telephone calls by Broadwater to vessel operating offices, and daily e-mail notification broadcasts from Broadwater to interested parties. Broadwater would use radio broadcasts for on-water communication with the ferries and other commercial traffic.

When the pipeline is under construction, some commercial shipping vessels and fishing vessels may be required to briefly alter their movements to avoid construction operations, and the Bridgeport-Port Jefferson ferries also may be affected. However, Broadwater would communicate with the ferry company to provide advanced notice of activities that may prevent use of the established ferry route.

If the Broadwater Project is authorized by FERC and the facility is constructed, any potential risks to navigation safety would be identified and addressed by the Coast Guard before these operations would be allowed to be conducted. Once the FSRU and mooring tower are at the proposed installation site, all vessels not related to the Project would be restricted from the construction area. This would result in the same minor vessel movement alterations as described for operation of the FSRU. Overall, construction of the pipeline would result in a minor, temporary impact on commercial shipping, commercial fishing, and the Bridgeport-Port Jefferson ferry system.

Operation

FSRU and YMS

The FSRU would remain attached to the YMS for the life of the Project. As addressed in Section 8.4.1 of the WSR, Broadwater would be required to install navigational aids, including lights and foghorns, on the FSRU and YMS to provide warning to vessels in the surrounding area, in accordance with Coast Guard regulations. In addition, navigation charts would be updated to incorporate the location of the FSRU and YMS.

If the Project is authorized and constructed, the Coast Guard would establish a safety and security zone that would be a circle with a radius of 1,210 yards (0.7 mile) centered on the YMS. All vessels not related to the Project would be excluded from that 950-acre (1.5-square-mile) area without special permission from the Coast Guard. This exclusion would not affect ferry traffic in the Sound because there are no established ferry routes through or near the safety and security zone around the YMS and FSRU.

As depicted in Figure 3.5-2, the FSRU and its safety and security zone would not be located directly between the larger ports in the area and would not be along established direct routes of travel between those ports. Vessel track lines that were plotted using a sampling of AIS data from 2005 (presented in Figure 3.7-2) indicate that commonly used routes are present along the length of the Sound and across the Sound between major ports. The proposed location of the YMS is approximately 1.2 miles (2,110 yards) north of the major east-west shipping route along the Sound, and the safety and security zone would extend approximately about 1,210 yards (0.7 mile) from that point. Consequently, some vessels that use this major shipping route likely would need to modify their courses slightly to the south. Approximately 18 percent of the vessels within the AIS data reporting system transited within 2.3 miles of the proposed FSRU location.

Commercial vessel traffic in Long Island Sound could increase in the future. For example, the Port of New York/New Jersey is working on a plan to decrease truck traffic in the area by increasing use of barge and rail transport of cargo, including barging cargo to ports at Bridgeport, Connecticut, Providence, Rhode Island, and Boston, Massachusetts. If implemented, that project (Port Inland Distribution Network) would increase vessel traffic to Bridgeport and through traffic in Long Island Sound. In addition, it is possible that commercial shipping in Long Island Sound would increase for other reasons. Because the FSRU and its safety and security zone would be in an area outside of the generally used transit lanes for commercial shipping and would be in the widest portion of the Sound (about 20 miles wide in that area), there would be sufficient room to accommodate future increases in commercial vessel traffic without conflict with the FSRU and its safety and security zone.

One commentor asked if commercial vessel traffic would be consolidated into a narrower zone along the perimeter of the safety and security zone. As discussed in this section, there are currentlyno formal shipping lanes within the Sound. Commercial vessel traffic would shift to the south to avoid the safety and security zone but would not be limited to a specific boundary to the south. As discussed below, if the project is approved by FERC, the Coast Guard would evaluate the need to establish routing measures.

In its WSR, the Coast Guard has identified procedures and measures that it would require Broadwater to incorporate into the Project to mitigate the potential impacts to marine transportation caused by the presence of the YMS and FSRU. Several of these are listed below; the complete list is included in the WSR presented in Appendix D.

- Equip the FSRU with navigation equipment appropriate to assess the risk of allision and to communicate with vessels transiting in the vicinity, and equip the FSRU with appropriate lights and sound signals.
- Include three Vessel Traffic Supervisors on the marine crew for the FSRU in addition to the Port Superintendent, Mooring Master, Cargo Supervisor, and Cargo Transfer Assistant.
- Ensure that the design of the YMS is based on wind and wave conditions equivalent to a Category 5 hurricane and that it includes all practicable redundancies.
- Mark the outer limits of the safety and security zone around the FSRU with lighted buoys at the cardinal points and with unlighted buoys at the inter-cardinal points.
- Prepare and submit an Operations Manual as required by 33 CFR Section 127.305 and an Emergency Manual as required by 33 CFR Section 127.307 to the Captain of the Port, Long Island Sound for review and approval at least 6 months, but no more than 12 months, before the FSRU would receive LNG.
- Within 6 months from the date when FERC issues an authorization for the Project, submit to FERC and the Coast Guard a process for developing the Emergency Response Plan required by the EPAct that incorporates the recommendations in Section 6.2 of the WSR.

To further mitigate potential impacts on marine transportation, the Coast Guard would continue to systematically analyze the waters of Block Island Sound and Long Island Sound to effectively manage the potential risks to navigation safety and maritime security associated with the Project. For these waterways to be suitable for LNG marine traffic and operation of the Broadwater FSRU, the Coast Guard has stated in its WSR that it would accomplish the following:

- Continue to cooperate with FERC on review and approval of the design and construction of the YMS and the FSRU. The Coast Guard also would work with FERC to implement appropriate recommendations related to design and construction of the YMS outlined in Sections 4.6.2.1 and 4.6.2.2 of the WSR and in Section 5.5.1 of the Sensitive Security Information (SSI) Supplement to the WSR.
- Continue to work with FERC to establish an inspection regime that is consistent with the recommendations in Sections 4.6.2.1, 4.6.2.2, and 4.6.2.3 of the WSR.
- Coordinate with FERC to provide appropriate oversight of and to participate in development and approval of the Emergency Response Plan required by Section 311 of the EPAct of 2005.

Commercial fishing vessels that currently travel through the proposed location of the safety and security zone also would need to permanently alter their movements. As described in Section 3.6.8.1, commercial lobster fishermen who have historically set their pots within that zone would be financially compensated for the loss of the fishing area. It is possible that the compensated fishermen also would set pots in other areas, resulting in a minor increase in vessel traffic in other portions of the Sound.

Commercial trawling would not be allowed in the fixed safety and security zone, which extends into one of the established trawling lanes of the Sound. As described in Sections 3.5.5.2 and 3.6.8.1, only about six commercial trawl fishermen use this area and Broadwater would financially compensate them for the lost income. This would decrease vessel traffic in the vicinity of the safety and security zone but could result in increased use of the second trawling zone located to the north. The increase would be minor, however, and would occur only during the times of year when trawling occurs. Based on interviews with fishermen, Broadwater reported that trawl fishing generally occurs from April to June, August to October, and December to January.

Other commercial fishing vessels traveling between ports and fishing locations in the Sound may need to make minor alterations to their routes to avoid the fixed safety and security zone. Overall, the impact of the safety and security zone established around the FSRU and YMS to marine transportation would be minor but would last for the life of the Project.

Connecticut's Long Island Sound LNG Task Force commented regarding potential impacts to the Long Island Sound Trawl Survey. CTDEP, through its Marine Fisheries Division, monitors trends of finfish and invertebrates through the Long Island Sound Trawl Survey, which began in 1984. From 1995 through 2004, 2,000 trawls were conducted as a part of the program. The Task Force suggested that a significant amount of survey trawls have occurred in the proposed location of the safety and security zone around the YMS and FSRU and that the trawl survey should be exempted from the restrictions of the FSRU safety and security zone. The Coast Guard would be responsible for deciding whether or not the trawl survey could conduct sampling within the safety and security zone, with its decision based on weather, security conditions, and other variables within and near the safety and security zone at the time of the requested exemption. As noted in Section 3.2, if the trawl survey is excluded from the safety and security zone, the impact on the program's analyses would be minor but would occur for the life of the Project.

NYSDOS commented that (1) there could be an increase in fishing and lobstering around the perimeter of the FSRU safety and security zone since the safety and security zone would serve as a protected area for fish and invertebrates, and (2) this increased presence of fishing vessels could conflict with commercial shipping. Our evaluation of marine biological resources found that, due to the open sandy bottom in the proposed FSRU area, the mobility of fished species, and the relatively small size of the safety and security zone, no significant increase in the populations of targeted species is anticipated. Consequently, no increase in fishing or lobstering is expected around the perimeter of the safety and security zone.

Pipeline

Operation of the pipeline would not affect marine transportation under normal operating conditions. Periodic maintenance would include periodic internal inspection of the pipeline. This would require the use of support vessels above the end of the pipeline at the tie-in to the IGTS pipeline. During maintenance activities, the presence of support vessels could require minor route alterations for some vessels. However, few vessels would be involved, and the temporary impact would be minor.

LNG Carriers

The Coast Guard's WSR (Appendix D) considered existing conditions and provides the basis for requirements related to LNG carrier transit that will be presented in the Letter of Recommendation. Operation of LNG carriers associated with the Project raises two primary areas of concern: the inherent safety of the LNG carriers, and the impact of LNG carrier traffic on existing vessel traffic. This section addresses the potential impact of LNG carrier traffic on commercial marine transportation; potential impacts of LNG carriers on recreational vessels are addressed in Section 3.5. The review of LNG carrier reliability and safety is presented in Section 3.10.

In the WSR, the Coast Guard determined that the size of the moving safety zone should be 2 nautical miles (2.3 miles) ahead, 1 nautical mile (1.2 miles) astern, and 750 yards (0.4 mile) on each side of each LNG carrier, including both inbound and departing carriers traveling between the pilot stations and the FSRU.

The presence of LNG carriers and their surrounding safety and security zones in transit to and from the FSRU could require that commercial shipping vessels, commercial fishing vessels, and ferries alter their routes or slow or stop their forward progress to avoid vessel conflicts. When transiting the Race and the waters of Long Island Sound, vessels of all types would be made aware of the oncoming LNG carrier via the presence of escort craft (tugs, Coast Guard vessels, or both). Vessels in the path of the oncoming LNG carrier and its safety and security zone would need to move to avoid entering the safety and security zone.

The amount of time that marine traffic crossing the LNG carrier path would be excluded from a specific area would depend on the LNG carrier's transit speed and the size of the safety and security zone. Assuming a speed of about 12 knots, the entire safety and security zone for an LNG carrier would pass a specific point in approximately 15 minutes. The Coast Guard has estimated that carriers would travel through the Race at about 12 to 15 knots. When traveling in Block Island Sound, and when in Long Island Sound between the Race and the FSRU, carriers likely would be traveling at a maximum speed of 12 knots, based on current navigation practices in those areas. (In areas of the Atlantic Ocean outside of the entrance to Block island Sound and Montauk Channel, LNG carrier speed would be limited to 10 knots by NOAA restrictions that apply on a seasonal basis, as discussed in Section 3.4.1.1.)

One of the reasons for establishing a 2.0-nautical mile (2.3-mile) safety and security zone in front of each carrier is to provide sufficient time for vessels to move out of the carrier route, adjust their routes to avoid the carrier and its associated safety and security zone, or stop their progress to avoid the carrier route. The distance the safety zone extends ahead of the LNG carrier should be sufficient to provide small vessels, including kayaks, adequate time to safely clear the channel between Valliant Rock and Race Rock Light. It should also be sufficiently large to reduce the risk of collision with other vessels crossing ahead of an LNG carrier. As analyzed in the WSR, a vessel moving at 2 knots would require approximately 12 minutes to transit from the center of the channel to the outer edge of the safety zone. During this same period, an LNG carrier moving at 12 to 15 knots would travel approximately 2.3 to 3.5 miles. If a small vessel traveling at 2 knots began moving from the center of the channel approximately 12 to 15 minutes before the LNG carrier entered the Race, it would reach the outer edge of the safety and security zone concurrent with the passage of the LNG carrier. Therefore, with a safety and security zone extending 2 nautical miles (2.3 miles) ahead of the LNG carrier, a small vessel moving at 2 knots would have adequate time to move from the center of the channel well in advance of the LNG carrier's transit through the Race. This distance also provides adequate separation from vessels (for example, ferries) that might cross ahead of an LNG carrier.

We received comments expressing concern that the LNG carrier transits effectively would shut down the Race. The State of Connecticut also has commented with specific concern regarding impacts on commercial vessel traffic at the Port of New Haven. The *Interim Report* of the Long Island Sound LNG Task Force (March 2006) and a letter from the Connecticut Attorney General (March 2006) express concern over potential disruption to existing energy supply vessels in the event of an incident at the FSRU or an incident with an LNG carrier in the Race. The Task Force report also suggests that if long-term delays are experienced by commercial shipping due to LNG carrier transits of the Race, some of the marine commerce of Long Island sound could be displaced from Connecticut to Delaware. As described in this section, some commercial traffic would have sufficient space to use the Race even when LNG carriers are in transit through the Race, nearby alternative routes are available for many commercial vessels, and if vessels are delayed, the wait could be approximately 30 minutes. As a result, delays to commercial traffic in the Race are not expected to be significant.

In addition to potential impacts for vessels crossing the LNG carrier route, we evaluated potential impacts to vessels moving along a path similar to that of the LNG carrier, or in the opposite direction. These vessels have the option of transiting outside the limits of the LNG carrier safety and security zone. Including the width (beam) of the widest LNG carrier, the maximum width of the safety and security zone would be about 1,560 yards (0.9 mile). The distance across the channel between Race Rock and Valiant Rock, the most constricted area of the Race, is 1.4 miles (about 2,464 yards). As a result, even within the most constricted portion of the Race, there would be room available for use by other vessels when LNG carriers are passing through. The total distance between the edges of safety and security zone and the edges of the channel at its narrowest point would range from about 840 yards (0.5 mile) to 530 yards (0.3 mile), dependent on the angle of approach taken by the LNG carrier (see Figure 3.7-4).

There are also alternative routes to enter Long Island Sound from the east for many commercial vessels (see Figure 3.7-4). The area between Race Rock Light and Valiant Rock is the preferred route for deep-draft vessel traffic; however, the route between Valiant Rock and Little Gull Island (an area approximately 2.4 miles wide) is frequently used for smaller tankers and tug-barge combinations as an alternate to the Race. The shallowest portion of that route is about 48 feet. The recommended transit area between Valiant Rock and Little Gull Island is approximately 1.2 miles northeastward of Little Gull Island Light. This route is also used by recreational vessels and is heavily used by recreational fishing vessels as well as charter fishing vessels. Occasionally, the ferries running between Orient Point, New York and New London, Connecticut also use this route, if conditions in Plum Gut prohibit safe transit.

The waters located between Plum Island and Little Gull Island, known as the Sluiceway, are not considered a possible alternate route for commercial traffic. This waterway has several known dangers and a very irregular bottom. The area is generally regarded as hazardous for transit without local knowledge.

Plum Gut, located between Orient Point and Plum Island, is an alternate passage for smaller vessels and recreational boaters to Gardiner's Bay and Block Island Sound from Long Island Sound, but caution is recommended when using this passage. The overall width of the Gut is approximately 0.8 mile (1,410 yards), with a deep water central area that is about 0.4 mile (615 yards) wide. However, the Gut has several rock areas with depths of 17 to 19 feet; there are strong tidal currents, with velocities on flood tide of 3.5 knots and 4.3 knots on the ebb tide; and heavy tide rips also occur. In addition, a countercurrent normally develops along the north shore of Plum Island during the flood tide.

For smaller vessels and some shallow-draft or tug and barge combinations, Fishers Island Sound can serve as an alternate route to the Race. Watch Hill Passage is the principal entrance to Fishers Island Sound from the east. As noted in the WSR, the minimum depth in this passage is 13 feet, and rocky areas occur throughout Fishers Island Sound, reducing depths in some locations to as little as 6 feet in the center of the Sound. Vessels transiting to Stonington, Mystic, and Noank, Connecticut must transit through Fishers Island Sound.

The Coast Guard would alert marine vessels of the planned schedule of arrival of the LNG carriers, using navigational safety messages broadcast via VHF radio. This information would allow vessel captains and pilots to plan and time their transits in order to avoid conflicts with the carriers.

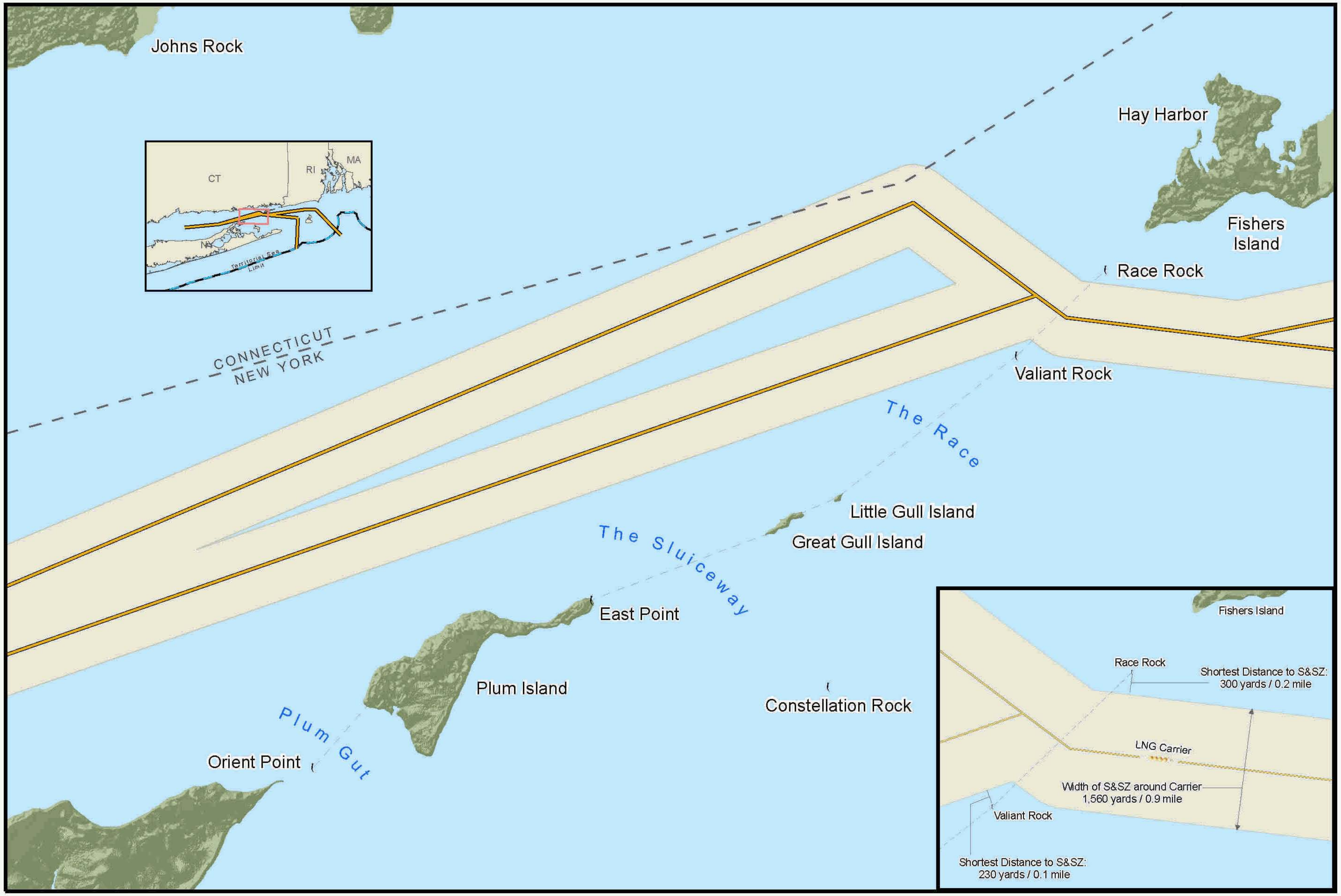

Figure 3.7-4
Broadwater LNG Project
Anticipated LNG Carrier Route
in the Race

- Anticipated LNG Carrier Routes
- State Line
- LNG Carrier Safety and Security Zone (S&SZ): maximum width 1,560 yards (0.9 mile)

Approximate Distances: yards (miles)		
Race Rock to Valiant Rock	2,400	(1.4)
Valiant Rock to Little Gull Island	4,200	(2.4)
Little Gull Island to Great Gull Island	700	(0.4)
Great Gull Island to East Point, The Sluiceway	3,700	(2.1)
Plum Island to Orient Point, Plum Gut	1,600	(0.9)

In its WSR, the Coast Guard has identified procedures and measures that it would require Broadwater to incorporate into the Project to mitigate the potential impacts to marine transportation caused by the transit of LNG carriers. Several of these are listed below; the complete list is included in the WSR presented in Appendix D.

- Conduct the simulations described in Section 4.6.1.3 of the WSR to determine the number and capabilities of the assist tugs required to support LNG carrier berthing and unberthing.
- Provide a contract or suitable documentation to FERC and the Coast Guard, indicating that the required number of assist tugs would be available at all times that the FSRU is in operation.
- Conduct the modeling necessary to establish the performance requirements for escort tugs as addressed in Section 6.3.1 of the WSR.
- Provide a contract or suitable documentation, indicating that the required number of escort tugs would be available at all times to escort LNG carriers through the Race and eastern Block Island Sound.
- Schedule LNG carrier arrivals and departures to minimize conflicts with other waterway users, including the Navy, as addressed in Section 4.6.1.2 of the WSR.
- In coordination with the Connecticut Department of Transportation, the New York Board of Pilot Commissioners, and the Coast Guard, conduct full mission bridge simulator training for all pilots who may be responsible for serving as a pilot on LNG carriers calling at the FSRU.
- Arrange for a pilot licensed by either the State of New York or the State of Connecticut to remain onboard LNG carriers while they are moored at the FSRU.

To further mitigate the potential impacts on marine transportation caused by transit of the LNG carriers, the Coast Guard would continue to systematically analyze the waters of Block Island Sound and Long Island Sound to effectively manage the potential risks to navigation safety and maritime security. For these waterways to be suitable for LNG marine traffic and operation of the Project, as stated in the WSR, the Coast Guard would need to undertake the following if the Project is approved by FERC:

- Initiate the development of regulations promulgating the safety and security zone around LNG carriers.
- Conduct a Port Access Route Study (PARS) as required by 33 USC Section 1223(c) to evaluate the recommendation in Section 4.6.1.6 of the WSR to establish vessel traffic routing measures on Block Island Sound and Long Island Sound. The PARS could result in alternative recommendations to those included in the WSR.
- Conduct an evaluation with waterway users of potential options, including the recommendation in Section 4.6.1.7 of the WSR to establish a Vessel Traffic Service, for real-time monitoring and, when necessary, directing vessel traffic on Block Island Sound and Long Island Sound. This evaluation could result in alternative recommendations to those in the WSR.

Impacts on Commercial Shipping and Fishing Vessels. Commercial shipping and fishing vessels occasionally would need to make minor adjustments in their routes or travel speeds to avoid LNG carriers and their associated safety and security zones. This would result in minor navigational route or vessel course impacts to some commercial vessels that would occur periodically for the life of the Project. However, we anticipate that, during most of the time each commercial vessel is in operation, conflicts with the routes of LNG carriers would not occur and there would be no impact to the navigational routes or courses of such vessels.

As noted in the WSR, operation of the Project would increase commercial shipping traffic in Long Island Sound by about 1 percent. If other commercial shipping in the Sound increases in the future as described above, it is not likely that there would be conflicts since there would be a low number of LNG carriers transiting the Sound, there would not be more than one carrier allowed into the Sound at any one time, and the only constriction point along the carrier transit route is at the Race.

Commercial fishing in the Race primarily is timed to coincide with slack tides, although striper and bluefish fishermen fish the running tides – primarily during daylight hours. Party boats and commercial charters fish during both the daylight and the night-time tides.

Impacts on Ferry Systems. As noted in the WSR (Appendix D), the Coast Guard could allow regularly scheduled ferries inside the LNG carriers' safety and security zones, assuming that the specific safety and security conditions at the time of passage are acceptable to the Coast Guard. In addition, once the pilot is onboard a carrier, the Coast Guard and Broadwater would provide information to mariners about the planned transit schedule for the carrier. Nevertheless, it is possible that the transit of LNG carriers may result in a minor delay of ferries. Due to frequent ferry transits on some routes, a delay during one crossing could result in subsequent delays in other crossings.

The time required for an LNG carrier and its associated safety and security zone to pass a single point is approximately 15 minutes. This is the worst-case time loss for a ferry crossing the path of an LNG carrier. The probability of a schedule conflict between a ferry and an LNG carrier was determined using the ferry schedules and the estimated LNG carrier frequency of six transits per week (incoming and outgoing). Calculations were performed for ferry routes that cross the LNG carrier route and for ferry routes that transit the Race. The latter typically would not cross the path of a carrier but would run parallel to it. The assumptions used in the supporting calculations are listed below. They were conservative by overstating the potential for schedule route conflict between ferries and LNG carriers.

- Estimates are based on the highest reported daily transit frequency for each ferry route;
- For ferry routes to and from Block Island, the potential conflict was estimated assuming that all LNG carriers would cross the ferry route;
- It was assumed that ferries would cross the LNG carrier path and would not change course to minimize delay time;
- It was assumed that ferries using the Race would be parallel with the LNG carrier route for a distance of 3 miles;
- Actual ferry cruising speeds were used when available. When not available, speeds for comparable vessels were used. When multiple vessels serve a route, the slowest vessel cruising speed was used; and
- Dimensions for a proposed 250,000 m^3 LNG carrier were used; this is the largest vessel proposed for use in the Broadwater Project (Oil & Gas Journal undated).

The probability of conflict was calculated as the probability of a ferry being present in an LNG carrier's safety and security zone (referred to as the "common area"). The probability of a ferry occupying the common area was determined using the ferry speed and frequency. The probability is expressed as the amount of time spent in the common area as a percent of total ferry operating time. Similarly, the probability of an LNG carrier being in the common area was determined based on six carrier transits per week (incoming and outgoing). The probability of conflict was calculated as the product of the probability of the ferry being in the common area and the probability of the LNG carrier being in the common area.

The probability for delays due to ferry and LNG carrier schedule conflict was found to be greatest for Cross Sound's Orient Point-New London route because that route has significantly more ferry transits and most of them are made by larger, slower ferries. Even on that route, however, the probability of conflict is less than 0.2 percent. Based on the busiest schedule for that route, with 46 crossings per day, up to one conflict would occur every 11 days. The probability for conflict on all other ferry routes (see Table 3.7.1-5) that cross the LNG carrier was less than 0.06 percent for any route; due to the lower ferry frequency, the calculated frequency of conflict is less than one per year per route.

Two ferry routes normally transit the Race: the Montauk-New London route and the New London-Block Island high-speed ferry route. The Race is a relatively narrow passage, with less flexibility for route variation than the relatively open waters elsewhere in Block Island Sound and Long Island Sound. The potential for a ferry/LNG carrier schedule conflict in the Race was calculated using a shared path that is 3 miles long.

The Montauk-New London ferry is relatively slow but has few transits per day (estimated at four). The New London-Block Island ferry is high speed, with up to 10 transits per day. The calculated probability of conflict for each ferry route is approximately 0.05 percent. The associated frequency of conflict for the Montauk-New London ferry is less than one conflict per year. For the high-speed ferry, the associated frequency of conflict is one in 224 days. For these potential conflicts in the Race, the worst-case delay of 15 minutes applies.

The ferry operators may use an alternate route through the Race to avoid an LNG carrier delay. LNG carriers would use the channel between Race Rock Light and Valiant Rock. There is also a navigable channel southwest of Valiant Rock, between Little Gull Island and Valiant Rock, that the ferries may use.

The Montauk-New London route is operated by Viking Fleet Ferry. The schedule disclaimer on Viking Fleet's web page states that "Crossing time is approx. 60 min. However seasonal harbor traffic may add 10–15 min to your arrival time." Thus, the worst-case delay due to a conflict with an LNG carrier is comparable to the normal schedule variation noted on the Viking Fleet web site.

To alleviate potential ferry and LNG carrier schedule conflicts in the Race and elsewhere along the LNG carrier routes, the Coast Guard generally would allow ferry operation within the LNG carrier safety and security zone.

The potential impacts of LNG carrier traffic to ferry operations would range from no effect to periodic minor impacts that would occur over the life of the Project. By allowing conditional ferry transit of LNG carrier safety and security zones, the Coast Guard would reduce the potential impact to the ferry systems to the lowest level possible.

Impacts on Navy, Coast Guard, and Other Government Vessel Traffic. In its *Interim Report*, the Long Island Sound LNG Task Force (2006) expressed concern that LNG tankers associated with the Project would interfere with operations at the Naval Submarine Base in Groton, Connecticut. The Coast Guard's Captain of the Port for Long Island Sound responded to this concern by stating that directing both submarine and LNG carrier traffic is a manageable task. Because the movement of the LNG carriers would be conducted under the direction of the Coast Guard and the Coast Guard also is kept informed of submarine movement by the U.S. Navy, the Coast Guard could order an LNG carrier to remain out of the

Race or the Sound if a submarine needs to pass through the Race in transit to or from Groton. Consequently, the transits of the LNG carriers would not affect submarine traffic.

Vessels operated by the Coast Guard and other government agencies may occasionally be in the vicinity of LNG carriers, although there are no regularly scheduled transits that potentially would be affected. The operators of these vessels would be aware of the presence of the LNG carriers as a result of communications issued by the Coast Guard and could make minor adjustments to their routes to avoid conflicts with the carriers.

Onshore Support Facilities

As proposed, Broadwater has indicated that both temporary and permanent onshore facilities would be required during construction and operation of the Broadwater LNG facility. During construction of the pipeline from the FSRU to its connection with the IGTS pipeline, the Broadwater contractor would require temporary space on the shore and dock space. This area would be used primarily for shuttling personnel and supplies to the project site. Barges would be used for transporting the pipe; the vessel type for personnel transport has not been specified. Broadwater has indicated that existing dockage space in Port Jefferson or Greenport would be used for this purpose.

Permanent onshore facilities would include office space, warehousing, and a facility with waterfront access. These facilities would be located within existing marine facilities that are operated by others. Waterfront facilities primarily would be used for tug mooring, personnel transfer, and materials transfer. Voice and data communication capability would link the onshore support facilities to the FSRU. Broadwater's operations would require both a facility for transfer of equipment, consumables, and personnel between the shore and boats for transport to and from the FSRU. The shore-side facility would require mooring locations for the tugs required for escorting LNG vessels; a supply boat or barge, if the tugs cannot be used; and crew boats for personnel transfers, which likely would occur on a weekly basis. The waterfront facility would require berthing for up to four tugs, measuring about 100 feet (30 meters) long by about 33 feet (10 meter) beam, with about a 14-foot (4-meter) draft. According to Broadwater, support craft designated for the Broadwater FSRU would be for the sole use of the facility; although, at Broadwater's management's discretion, support craft may be allowed to perform other activities when appropriate.

In correspondence with the Coast Guard, Broadwater indicated that, if only a shared facility is available, Broadwater would establish dedicated security measures for its activities. The waterfront facility would be equipped to provide secure storage of all materials being transferred offshore. A security system also would be implemented to ensure that only authorized personnel and equipment are transferred from shore to the FSRU. Broadwater has indicated that security measures would include inspection of credentials and goods, secure waiting areas and storage, secure moorings for supply craft/tugs, and physical security monitoring during onshore facility personnel and equipment transfer operations.

Office accommodations also would be located onshore to provide support for normal FSRU operations. This office would function as the emergency response and communications center for the FSRU. An onshore warehouse also would be necessary for a supply of spares, special tools, and equipment. The warehouse could be located on the waterfront or inland.

Broadwater has identified Port Jefferson and Greenport, New York as potential locations with the necessary infrastructure to provide marine access necessary for the shore-side support facilities. As proposed, the marine support function would be contracted for by Broadwater. Broadwater has indicated that the marine services contractor likely would perform the waterfront functions associated with the marine support facilities, including tug services, supply boat or barge services for normal supplies and equipment, a crew boat for personnel transfers, and moorings for the marine support craft.

Traffic in this area of the Sound between Port Jefferson or Greenport and the FSRU would increase; tug traffic to support LNG vessel operations would transit to and from the facility at least twice per week.

For Port Jefferson, New York (a proposed location for shore-based Project support), over 27,000 vessel trips were reported in 2003 (Table 3.7.1-1), a daily average of 76.3 trips. The Project would add four tugs based at the port. Assuming three LNG carrier arrivals per week and four tugs assisting per arrival, the Project-related tugs could add up to 24 trips per week (counting both tug departures and tug arrivals), or 1,248 trips per year. However, that estimate is likely high because only the largest LNG carriers would require the support of four tugs. Crew rotation would occur weekly; a round trip of the crew vessel would add 2 trips per week, or 104 trips in a year. Additional supply vessel trips, crew vessel trips, and other support trips would be involved with routine operations and maintenance. Those additional vessel trips were assumed to average 1 round trip per day, or 730 departures and arrivals per year. The net increase in vessel traffic would be 2,082 trips per year, or a daily average of an additional 5.7 vessel trips per day, an increase of daily traffic at the port of 7.5 percent. The majority of the increase is due to the tugs, which would depart within a short period of time when an LNG carrier is arriving and return after the carrier departs.

For Greenport, New York (the other proposed location for shore-based Project support), over 56,000 vessel trips were reported in 2003 (Table 3.7.1-2), a daily average of 154 trips. The large number of vessel transits includes the Greenport-Shelter Island ferry, which departs "every 15 to 20 minutes" on weekdays (North Ferry Company 2006). The Project would add the same trips identified above for Port Jefferson. The net increase in vessel traffic at Greenport would be 2,082 trips per year, or a daily average of an additional 5.7 vessel trips per day, an increase of daily traffic at the port of 3.7 percent. The majority of the increase is due to the tugs, which would depart within a short period of time when an LNG carrier arrives and return after the carrier departs.

The magnitude of impacts to marine traffic in Port Jefferson or Greenport would depend on the ability of the port to accommodate additional marine traffic capacity. The ferry associated with each port holds to a published schedule, and delays in a single ferry transit could affect on-time performance of subsequent ferry transits. Because of the incidental nature of the tug and other support vessel departures and returns, and because the types of vessels involved would be consistent with existing vessel traffic, the impact to marine transportation is considered minor but would last for the duration of the Project. To mitigate the impact, vessels would follow Inland Rules of the Road (Collision Regulations), which are established standards and protocols for vessel maneuvering and marine traffic movement.

3.7.2 Onshore Traffic

3.7.2.1 Project Summary

The Project would not require construction of onshore facilities. Fabrication of the FSRU and mooring tower would not involve commitment of land within the United States. These components of the Project would be constructed at existing overseas shipyards. The FSRU and YMS would be transported to the proposed offshore site by ship. Four tugs would be constructed specifically for the Broadwater Project at an existing shipbuilding facility within the United States. Broadwater proposes to use an existing concrete coating facility outside of the New York-Connecticut area for concrete coating of the pipe. The concrete-coated pipeline segments would arrive by rail and would be stored at an approximately 10-acre pipe laydown and storage yard that likely would be located within an existing developed area at the Port of New York/New Jersey. From the storage yard, pipe segments would be loaded onto barges for transport to the pipe lay barge.

During construction, all offshore workers would be housed on barges used for pipe laying and installation of the YMS and FSRU. Some workers would need to travel periodically between an existing waterfront support facility (either Port Jefferson or Greenport) and the offshore work area for emergency or routine purposes. As such, a limited number of offshore workers periodically may require onshore transportation. In addition, Approximately 20 onshore support workers would be commuting during construction.

During operation, 60 workers would be employed. The offshore workforce would be composed of two groups of 25 workers, who rotated on a weekly or bi-weekly basis. These workers would be ferried to and from the FSRU from the selected port. Ten additional workers would provide onshore support. Onshore workers would divide their time between rented office space, a warehouse, and the waterfront support facility. Because the office space and warehouse do not need to be on the waterfront, they may be located in areas distinct from the waterfront support facility.

3.7.2.2 Existing Conditions

The waterfront village of Greenport is approximately 1 square mile and has a population of 2,048 (U.S. Census Bureau 2005). The potential onshore support facility in Greenport is an existing marine facility surrounded by open water, commercial and marine commercial development, and village residences. The potential waterfront support site is accessed overland by several two-lane roads that are surrounded by the residences and commercial establishments of the village.

The waterfront village of Port Jefferson is approximately 3 square miles and has a population of 7,837 (U.S. Census Bureau 2005). The potential onshore support facility in Port Jefferson is an existing marine facility surrounded by open water, industrial applications including an electric generating station, and medium- to high-density residences. The potential waterfront support site is accessed overland by a two-lane road that is surrounded by existing marinas and residences.

At both locations, traffic currently is associated with employees of the area's businesses, truck deliveries, and services.

3.7.2.3 Potential Impacts and Mitigation

Potential impacts to onshore traffic could be associated with worker or material transport. During construction, onshore traffic would be limited primarily to the daily commuting of the 20 onshore support workers and shuttling of some supplies from vendors or the warehouse to the waterfront support site for their eventual delivery offshore. Because the vast majority of offshore construction workers would be housed offshore, they would not be associated with onshore transportation, except for occasional trips to the onshore support facility for transport to and from the construction barges. During operation, onshore transportation impacts would include approximately two truck deliveries per day, the daily commute of 10 onshore support workers, and the periodic (weekly or bi-weekly) rotation of the 25-member offshore crews.

The effects on onshore traffic, at either the Greenport or the Port Jefferson waterfront sites, would be minor and would persist for the life of the Project.

3.8 CULTURAL RESOURCES

Section 106 of the National Historic Preservation Act (NHPA, as amended), requires FERC to take into account the effects of its undertakings (including authorizations under Sections 3 and 7 of the NGA) on properties listed in, or eligible for listing in, the National Register of Historic Places (NRHP). Section 106 also requires FERC to afford the Advisory Council on Historic Preservation (ACHP) with an opportunity to comment on the undertakings. Broadwater, as a non-federal party, is assisting FERC in meeting its obligations under Section 106 and the ACHP's implementing regulations at 36 CFR 800.

3.8.1 Project Summary

The FSRU would be moored to a YMS that includes a mooring tower secured to the seafloor located approximately 9 miles north of the nearest Long Island shoreline and about 10 miles from the nearest shoreline in Connecticut. Vaporized LNG (natural gas) would be transported from the FSRU to the existing IGTS pipeline through a 21.7-mile-long, 30-inch-diameter subsea pipeline that would extend southwest from the base of the mooring tower to the IGTS pipeline. At its closest approach, the pipeline would be approximately 4 miles from the nearest shoreline.

Broadwater has identified two potential locations on Long Island (Greenport and Port Jefferson) for the Project's onshore support facilities. Both locations have existing marine facilities, warehouses, office space, and parking lots to accommodate the Project's needs. Broadwater would lease facilities at one or both of these locations for the life of the Project. New construction at either location would be limited to security fencing and a security guardhouse at the entrance gate.

The FSRU, YMS, and the Project's purpose-built tugs would be fabricated at shipyards located overseas. As a part of construction, concrete coating of the pipe segments would take place at an existing facility and would be shipped by rail to the Port of New York/New Jersey for temporary storage on a developed site at one of the Port's facilities.

3.8.2 Existing Environment

3.8.2.1 Surveys and Reviews

Broadwater initiated consultation with the State Historic Preservation Officer (SHPO) at the New York State Office of Parks, Recreation and Historic Preservation (OPRHP) in January 2005. On February 21, 2005, Broadwater submitted to the SHPO a letter summarizing the results of a February 10, 2005 meeting between Broadwater and the SHPO, at which Broadwater presented the results of background research and a proposed protocol for a Phase I cultural resources survey of offshore portions of the Project area. Broadwater also requested written approval of the survey protocol.

During April and May 2005, Broadwater conducted a geophysical survey of the Project's area of potential effect (APE) for archaeological resources. The APE for the pipeline, determined in consultation with the SHPO, consists of a 300-foot-wide corridor within which the pipeline would be installed, and an approximately 2,000-foot-wide area on each side of the proposed pipeline route within which the effects of any anchoring could occur (a total width of 4,000 feet). The 300-foot-wide portion of the APE would accommodate the pipeline trench (approximately 8 feet deep), the spoil area, and additional work spaces required for the IGTS and FSRU tie-ins and cable crossings. The APE for the YMS mooring system encompasses approximately 13,180 square feet under the mooring tower as well as the location of the four corner pilings of the tower that would be installed to a depth of approximately 230 feet.

In-field archaeological investigations were conducted concurrently with Broadwater's geophysical surveys and made use of the same data. Geophysical survey data were acquired along track lines spaced 75 feet apart within the pipeline corridor and 200 feet apart within the 4,000-foot-wide temporary anchor construction ROW. Survey equipment used to complete field investigations included, in addition to the navigation system, a digital precision dual-frequency (24- and 200-kilohertz) fathometer, a digital dual-frequency (100- and 500-kilohertz) side-scan sonar, a digital full-spectrum CHIRP sub-bottom profiler (operated at frequencies between 2 and 10 kilohertz), and a marine magnetometer operated at a 0.5-second sampling rate with a full scale range set at 100/1,000-gamma scales and 1-gamma resolution. Survey equipment and methodology used for Broadwater's survey are generally consistent with those called out in NTL 2005-G07 ("Notice to Lessees and Operators of Federal Oil, Gas and Sulphur Leases and Pipeline Right-of-way Holders in the Outer Continental Shelf, Gulf of Mexico OCS Region") (MMS 2005a).

3.8.2.2 Existing Conditions

Offshore Facilities

No NRHP-listed or NRHP-eligible properties are located within the offshore portions of the Project area.

Although a review of OPRHP's files found that no pre-European contact (Native American) deposits have been recorded offshore within the Project area, it is possible that submerged prehistoric archaeological deposits exist within the Project area as a result of marine transgression (sea-level changes). Approximately 75 percent of the Project area would have been dry land available for aboriginal occupation during the Paleo-Indian period prior to 10,000 years Before Present (B.P.); by approximately 9,000 B.P., however, only about 5 percent of the Project area would have remained uninundated. At some point during the period from 8,000 to 5,000 B.P., rising sea levels would have inundated all offshore portions of the Project area. In addition, much of the Project vicinity's pre-inundation land surface likely was destroyed, disturbed, or buried as a result of marine transgression, modern wave and tidal current activity, or human activities.

Broadwater reviewed existing geomorphological data, post-processed sub-bottom profiler data collected for the Project, and related vibratory coring data. No stratified paleosols, suggestive of the presence of intact pre-contact landforms suitable for habitation, were identified within the Project area. Broadwater did not directly examine original core samples as has been done in prior studies but instead relied on coring logs and core photographs. Based on that review, Broadwater concluded that the archaeological sensitivity of the Project area for pre-contact period archaeological resources is generally low.

A review of OPRHP files, NOAA's Automated Wreck and Obstruction Information System (AWOIS), and Northern Maritime Research's Northern Shipwreck Database (Version 2002), in addition to queries of local informants, revealed that the general area encompassing the Project contains 105 reported wrecks/obstructions. However, only 18 of those are associated with specific locations.

An inventory was prepared of magnetic and acoustic anomalies/targets identified during the geophysical survey. Of 750 anomalies identified, 88 were determined to have characteristics warranting further investigation. The remainder were dismissed as spurious or modern in origin (for example, they were associated with adjustments in survey instruments, passing vessels, navigation aids, or lobster traps). Broadwater identified nine targets (composed of 13 anomalies out of the 88 subjected to detailed analysis) as potential archaeological deposits. All nine targets are located within the temporary anchoring area of the construction ROW; none of the targets are within the 300-foot-wide corridor.

Onshore Support Facilities

Although no NRHP-listed or NRHP-eligible properties or known archaeological sites are recorded at either potential onshore location, two NRHP-listed properties (the Greenport Railroad Station and the Greenport Historic District) are adjacent to the Greenport location. Two NRHP-listed properties (the Bayles Shipyard and the Port Jefferson Village Historic District) are in close proximity to the Port Jefferson location.

The potential onshore locations are both in areas classified by the U.S. Department of Agriculture (USDA) on soil maps as urban land. The USDA defines "urban land" as areas where soil identification is impractical because more than 80 percent of the land is covered with buildings and pavements (Warner et al. 1975). However, both potential onshore support locations are identified in the SHPO's GIS system as archaeologically sensitive areas.

3.8.3 Native American Consultation

Broadwater contacted the Wampanoag Tribe of Gay Head (Aquinnah), the Narragansett Indian Tribe, the Delaware Indian Tribe, the Mashantucket Pequot Tribal Nation, the Mohegan Tribal Nation, the Shinnecock Indian Nation Tribal Council, and the Poospatuck Indian Nation to elicit any concerns about the proposed Project with regard to possible effects on properties of traditional religious or cultural importance. Each group was contacted twice (letters dated July 27, 2005, and November 8, 2005). Only the Mashantucket Pequot Tribe has responded. The tribe has no knowledge of properties of religious or cultural concern that might be affected by the Project.

3.8.4 Unanticipated Discoveries Plan

On August 25, 2005, Broadwater's consultants submitted to the SHPO a draft document entitled *Procedures Guiding the Discovery of Unanticipated Cultural Resources and Human Remains,* with a request for SHPO review and comment.

Broadwater's plan provides that, in the event that a suspected shipwreck is uncovered during a construction activity, the activity would be immediately halted and the suspected shipwreck site evaluated. If Broadwater concludes that a shipwreck may be present, a visual inspection would be conducted using a remotely operated vehicle (ROV) and the results would be forwarded to the SHPO and FERC. Construction would not resume until Broadwater received written comments from the SHPO and FERC. If the SHPO and FERC conclude that an NRHP-eligible resource may be present, Broadwater would develop measures to avoid the site.

Broadwater's plan provides that, in the event that human remains are encountered during construction, construction in the general area of the discovery would stop; the location would be secured and protected; and the Suffolk County Medical Examiner, local law enforcement, FERC, SHPO, and if appropriate, Native American groups would be notified. Remains would be left in place until a plan for their avoidance or removal could be developed. FERC staff finds Broadwater's plan acceptable.

3.8.5 Potential Impacts and Mitigation

Broadwater has identified nine remote-sensing targets representing possible historic properties within the Project's APE, all of which are in the temporary anchoring construction ROW portion of the APE. All of these targets are susceptible to disturbance from construction-related anchoring and/or "sweep" from anchor cables. Based on consultation with the SHPO, Broadwater has proposed avoiding impacts on the nine targets by establishing and maintaining a minimum 100-foot-wide buffer zone in all directions around the detectable limits of each target. This would be accomplished by the use of mid-line buoys on anchor cables during construction. FERC staff concurs with this approach.

There would be no expected impacts to cultural resources during operation of the FSRU, pipeline, or LNG carriers.

The SHPO recommended, and FERC concurs, that the offshore portions of the proposed Project would have no effect on historic or cultural resources (Peckham 2006).

All historic properties in the vicinity of the proposed locations for onshore support facilities are located outside of the boundaries of the proposed facilities. Proposed onshore activities, such as berthing of tugs, storage of materials, equipment loading and unloading, and transfer of crews, are consistent with the historic use of the immediate areas at both proposed locations. The SHPO commented on Broadwater's survey on October 13 and December 22, 2005 and requested additional information, which Broadwater subsequently provided.

Broadwater has indicated that, due to the severe land alterations that previously occurred and the absence of natural surfaces at the Greenport and Port Jefferson locations, neither site is likely to contain significant archaeological resources. On February 9, 2006, the SHPO responded that no archaeology concerns are associated with the Port Jefferson location. If the Greenport location were selected, the SHPO requested additional information from Broadwater on the historic setting and site plans because the site is adjacent to two NRHP-listed historic districts.

Broadwater recommended that Project-related activities at either of the proposed onshore support facility sites would not adversely affect historic properties. However, the potential effects of the onshore support facilities cannot yet be determined since the design of the onshore facilities has not been finalized.

Temporary onshore facilities (a concrete coating yard and a pipe storage yard) would make use of existing facilities but the location of these facilities has not been identified.

To ensure that the Commission's responsibilities under Section 106 of the NHPA and its implementing regulations are met, **we recommend that:**

- **Broadwater defer implementation of any treatment plans/measures (including archaeological data recovery), construction of facilities, and use of all staging, storage, or temporary work areas and new or to-be-improved access roads until:**

  a. **Broadwater files with the Secretary cultural resources survey and evaluation reports, any necessary treatment plans, and the New York State Historic Preservation Officer's comments on the reports and plans; and**
  b. **the Director of OEP reviews and approves all cultural resources survey reports and plans, and notifies Broadwater in writing that treatment plans/mitigation measures may be implemented or that construction may proceed.**

  All material filed with the Commission containing location, character, and ownership information about cultural resources must have the cover and any relevant pages therein clearly labeled in bold lettering: "CONTAINS PRIVILEGED INFORMATION-DO NOT RELEASE."

3.9 AIR QUALITY AND NOISE

3.9.1 Air Quality

3.9.1.1 Existing Environment

The climate of Long Island Sound and Suffolk County in New York is typical of the coastal northeastern United States. Long Island Sound is considered to have a mixed maritime-continental type climate. Air masses of continental origin frequently affect weather conditions over Long Island Sound, although the ocean also has a strong influence on the area's climatic conditions. This influence includes moderating winter temperatures such that minimum temperatures below 0°F are uncommon.

Severe weather events are not uncommon and in many winters one or more intense storms called Nor'easters produce blizzard conditions with snowfalls of 1 to 2 feet and near-hurricane force winds. Fair weather conditions can occur during summer when the region is dominated by a stagnant high-pressure system called a "Bermuda high." Under such conditions, the presence of air pollutants in this densely populated region, results in poor air quality such as elevated ground level ozone that can cause respiratory problems to the area's inhabitants.

Long Island averages a rainfall of approximately 45 inches per year and 26.6 inches of snowfall. Average January temperature on land (Northport, NY) is 29.2°F and average July temperature is 71.6°F.

Existing Air Quality

The proposed Project would be located within Suffolk County, New York, which is encompassed by the New Jersey-New York-Connecticut (NJ-NY-CT) Interstate air quality control region (AQCR; No. 043). Ambient air quality monitoring stations are located throughout the AQCR. The ambient air quality monitoring stations closest to the proposed Project are located onshore in both New York and Connecticut. A summary of ambient air quality monitoring data for these stations is provided in Tables 3.9.1-1 through 3.9.1-6. Figure 3.9-1 depicts the location of the monitoring stations for which data are provided within the Project area.

As shown in the preceding tables, the Project area is in attainment for carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and particulate matter of 10 micron diameter or less (PM_{10}). Particulate matter of 2.5 micron diameter or less ($PM_{2.5}$) data presented for the particular stations listed in Table 3.9.1-5 satisfy the standards. It is recognized that data from other local areas in the region but relatively distant from the Project area have resulted in the EPA nonattainment designation for $PM_{2.5}$. As shown in Table 3.9.1-1, the Project area is in nonattainment for ozone. Overall 5-year trends for CO, NO_2, and PM_{10} are generally downward while SO_2 is flat, which is consistent with attainment status. For the nonattainment pollutants ozone and $PM_{2.5}$, trends are indeterminate, which is consistent with the nonattainment designation.

Ozone is a regional problem in the Project area; much of the northeastern United States is classified as nonattainment for the federal air quality standards. Ozone is not emitted directly into the air but rather develops as inversion-layer ozone formed through photochemical reactions between atmospheric oxygen, nitrogen oxides (NO_x) and volatile organic compounds (VOCs) in the presence of sunlight (ultraviolet light). The major sources of NO_x and VOC precursor emissions include motor vehicles, industrial facilities, electric utilities, gasoline storage facilities, chemical solvents, and biogenic sources. Ozone control programs are in place to regulate NO_x and VOC emissions from these sources.

TABLE 3.9.1-1
Ambient Air Measurement of Ozone (in ppm)[a]
NAAQS – 1-Hour: 0.12 ppm 8-Hour: 0.08 ppm

Averaging Time	State	Station Location	2000	2001	2002	2003	2004	2005
1-Hour (1st highest)	NY	Babylon	0.134	0.128	0.143	0.151	0.103	0.130
		Riverhead (seasonal)[b]	0.145	0.122	0.129	0.118	0.104	0.126
	CT	Stratford Coast Guard Lighthouse	0.140	0.148	0.153	0.155	0.135	0.136
1-Hour (2nd highest)	NY	Babylon	0.112	0.126	0.141	0.130	0.101	0.124
		Riverhead (seasonal)[b]	0.116	0.111	0.127	0.114	0.085	0.113
	CT	Stratford Coast Guard Lighthouse	0.122	0.144	0.145	0.144	0.105	0.111
8-Hour (1st highest)	NY[c]	Babylon	0.086	0.084	0.108	0.094	0.081	0.098
		Riverhead (seasonal)[b]	0.085	0.082	0.090	0.082	0.069	0.086
	CT	Stratford Coast Guard Lighthouse	0.124	0.131	0.129	0.125	0.110	0.096

a Sources: NYSDEC 2000b, 2001a, 2002, 2003; CTDEP 2006c.

b The Riverhead station operates seasonally, generally March/April through October. The site has an EPA waiver from percent annual availability based on an operational year of less than 12 months.

c The 8-hour values NY stations are reported as the 4th highest daily maximum 8-hour average.

TABLE 3.9.1-2
Ambient Air Measurements of Carbon Monoxide (in ppm)[a]
NAAQS 1-Hour: 35 ppm 8-Hour: 8.7 ppm

Averaging Time	State	Station Name/ Location	1999	2000	2001	2002	2003	2004
1-Hour (1st highest)	NY	Holtsville	N/A	3.7	3.9	3.7	3.1	2.9
	CT	New Haven Courthouse	4.4	4.4	3.9	3.7	3.0	3.1
1-Hour (2nd highest)	NY	Holtsville	N/A	3.4	3.4	3.7	2.8	2.9
	CT	New Haven Courthouse	4.2	4.3	3.5	3.4	2.7	2.8
8-Hour (1st highest)	NY	Holtsville	N/A	2.8	2.3	2.2	2.0	2.2
	CT	New Haven Courthouse	3.3	3.3	2.7	2.6	2.1	2.0
8-Hour (2nd highest)	NY	Holtsville	N/A	2.8	2.2	1.9	1.6	1.6
	CT	New Haven Courthouse	3.1	2.6	2.5	2.3	1.9	2.0

N/A = The station did not operate or data recovery did not meet minimum requirements.
ppm = Parts per million.
[a] Sources: NYSDEC 2000b, 2001a, 2002, 2003; EPA 2005e.

TABLE 3.9.1-3
Ambient Air Measurements of Nitrogen Dioxide (in ppm)[a]
NAAQS Annual: 0.053 ppm

Averaging Time	State	Station Location	1999	2000	2001	2002	2003	2004
Annual	NY	Holtsville	N/A	0.017	0.017	0.017	0.014	0.012
	CT	Sherwood Island SP	0.017	0.018	0.021	0.019	0.016	0.014

N/A = The station did not operate or data recovery did not meet minimum requirements.
ppm = Parts per million.
SP = State Park.
[a] Sources: NYSDEC 2000b, 2001a, 2002, 2003; EPA 2005e.

TABLE 3.9.1-4
Ambient Air Measurement of Sulfur Dioxide (in ppm)[a]
NAAQS 3-Hour: 0.50 ppm 24-Hour: 0.14 ppm Annual: 0.03 ppm

Averaging Time	State	Station Location	1999	2000	2001	2002	2003	2004
3-Hour (1st highest)	NY	Holtsville	N/A	0.040	0.035	0.039	0.045	0.065
	CT	Sherwood Island SP	N/A	0.041	0.034	0.035	0.042	0.034
3-Hour (2nd highest)	NY	Holtsville	N/A	0.040	0.033	0.037	0.045	0.065
	CT	Sherwood Island SP	N/A	0.039	0.034	0.032	0.036	0.031
24-Hour (1st highest)	NY	Holtsville	N/A	0.023	0.024	0.030	0.030	0.034
	CT	Sherwood Island SP	N/A	0.023	0.025	0.028	0.030	0.021
24-Hour (2nd highest)	NY	Holtsville	N/A	0.022	0.023	0.021	0.030	0.033
	CT	Sherwood Island SP	N/A	0.022	0.024	0.026	0.028	0.021
Annual	NY	Holtsville	N/A	0.007	0.006	0.006	0.006	0.007
	CT	Sherwood Island SP	N/A	0.004	0.004	0.004	0.004	0.004

ppm = Parts per million.
N/A = The station did not operate or data recovery did not meet minimum requirements.
SP = State Park.

[a] Sources: NYSDEC 2000b, 2001a, 2002, 2003; EPA 2005e.

TABLE 3.9.1-5
Ambient Air Measurements of $PM_{2.5}$ (in • g/m^3)[a]
NAAQS 24-Hour: 65 ug/m^3 Annual: 15 ug/m^3

Averaging Time	State	Station Location	1999[b]	2000	2001	2002	2003	2004
24-Hour (1st highest)	NY	Babylon	N/A	42.1	45.3	40.0	47.1	37.0
	CT	Sherwood Island SP	N/A	43.6[b]	38.7	81.5	44.8	41.0
24-Hour (98th %)	NY	Babylon	31.9	31.8	34.1	30.9	38.8	34.0
	CT	Sherwood Island SP	N/A	33.4[c]	34.5	34.3	44.8	41.0
Annual	NY	Babylon	13.0	12.6	13.0	11.4	11.9	11.2
	CT	Sherwood Island SP	N/A	13.5	12.1	12.1	11.7	12.0

• g/m^3 = Micrograms per cubic meter.
N/A = The station did not operate or data recovery did not meet minimum requirements.
$PM_{2.5}$ = Particulate matter with an aerodynamic diameter less than or equal to 2.5 microns.
SP = State Park.
[a] Sources: NYSDEC 2000b, 2001a, 2002, 2003; EPA 2005e.
[b] The following annual data did not satisfy summary criteria:
1999: all New York and Connecticut sites.
2000: Sherwood Island SP.
[c] 2000 24-hour 98-percent data for CT sites based on reported 2nd highest 24-hour reading.

TABLE 3.9.1-6
Ambient Air Measurements of PM_{10} (in • g/m^3)[a]
NAAQS 24-Hour: 150 ug/m^3 Annual: 50 ug/m^3

Averaging Time	State	Station Location	1999	2000	2001	2002	2003	2004
24-Hour (1st highest)	NY	Eisenhower Park	N/A	45	61	85	58	46
	CT	Sherwood Island SP	N/A	46[b]	42	75	54	27
24-Hour (2nd highest)	NY	Eisenhower Park	N/A	38	41	47	37	30
	CT	Sherwood Island SP	N/A	39[b]	40	31	33	26
Annual	NY	Eisenhower Park	16	17	17	18	18	15
	CT	Sherwood Island SP	N/A	16[b]	15	14	21	13

• g/m^3 = Micrograms per cubic meter.
N/A = The station did not operate or data recovery did not meet minimum requirements.
SP = State Park.

[a] Sources: NYSDEC 2000b, 2001a, 2002, 2003; EPA 2005e.

[b] The following annual data did not satisfy summary criteria:
2000: all Connecticut sites.

$PM_{2.5}$ is also a regional problem in the northeastern United States. Its sources include direct emission from a wide variety of source types in the region, including both mobile and stationary combustion sources. $PM_{2.5}$ also results from atmospheric particle formation from the reaction of gaseous air pollutants, including SO_2 and ammonia (NH_3).

Ambient Air Quality Standards and Attainment Status

In 1970, the CAA was passed to establish federal standards for emission of various air pollutants, to provide for the regulation of emissions through state implementation plans, to prevent significant deterioration in areas where air quality exceeds national standards, and to provide for improved air quality in areas that do not meet federal standards (nonattainment areas). AQCRs are geographical units with boundaries that are not necessarily coincidental to political or state boundaries and that share common air pollution issues.

EPA established the federal standards (NAAQS) for criteria pollutants to protect human health (primary standards) and public welfare (secondary standards, such as damage to vegetation). NYSDEC has adopted the NAAQS as the ambient air quality standards within the State of New York. Table 3.9.1-7 presents a summary of the NAAQS for each criteria pollutant.

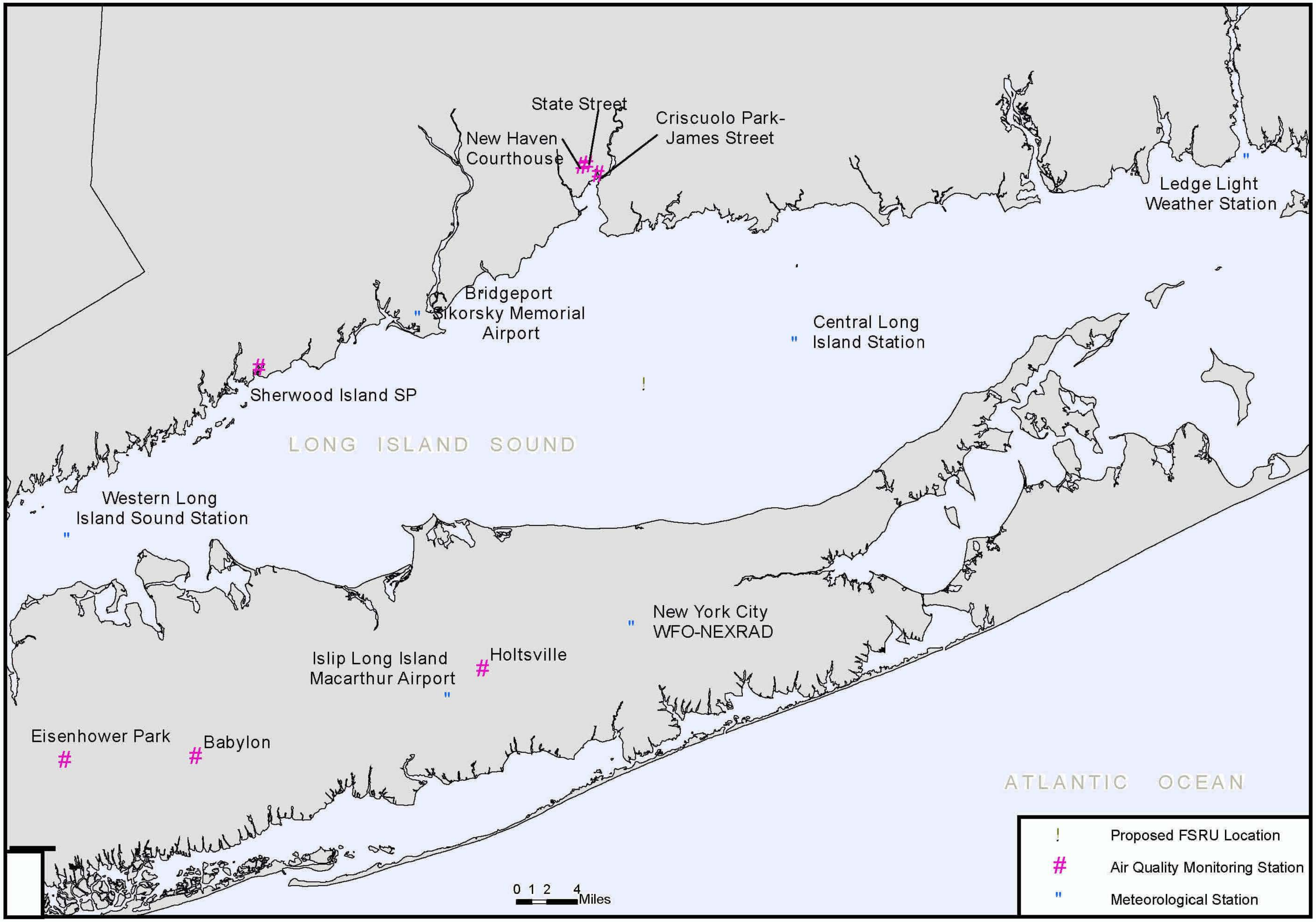

Figure 3.9-1
Broadwater LNG Project
Air Monitoring and Meteorological Stations in the Vicinity of the Proposed Project

TABLE 3.9.1-7 National Ambient Air Quality Standards (40 CFR Part 50)			
Pollutant	**Averaging Time**	**Primary Standard**	**Secondary Standard**
Ozone	1-Hour[a]	235 μg/m^3 (0.12 ppm)	235 μg/m^3 (0.12 ppm)
	8-Hour[b]	156 μg/m^3 (0.08 ppm)	156 μg/m^3 (0.08 ppm)
Carbon monoxide	1-Hour[c]	40,000 μg/m^3	----
	8-Hour[c]	10,000 μg/m^3	----
Nitrogen dioxide	Annual[d]	100 μg/m^3	100 μg/m^3
Lead	Quarter[d]	1.5 μg/m^3	----
Sulfur dioxide	3-Hour[c]	----	1,300 μg/m^3
	24-Hour[c]	365 μg/m^3	----
	Annual[d]	80 μg/m^3	----
$PM_{2.5}$	24-Hour[e]	65 μg/m^3	65 μg/m^3
	Annual[f]	15 μg/m^3	15 μg/m^3
PM_{10}	24-Hour[a]	150 μg/m^3	150 μg/m^3
	Annual[g]	50 μg/m^3	50 μg/m^3

μg/m^3 = Micrograms per cubic meter.
ppm = Parts per million.

[a] Standard is attained when the expected number of exceedances is less than or equal to one per year.
[b] Standard is compared to the average of the annual 4^{th}-highest 8-hour concentrations over a 3-year period.
[c] Standard not to be exceeded more than once per year.
[d] Standard never to be exceeded.
[e] Standard is compared to the average of the annual 98th percentile 24-hour concentrations over a 3-year period.
[f] Standard is compared to the average of the annual concentrations over a 3-year period.
[g] Standard (as expected annual arithmetic mean of 24-hour concentrations) never to be exceeded.

Because the proposed Project would be located within Suffolk County, New York, it would be located within the NJ-NY-CT Interstate AQCR (No. 043). Suffolk County currently has the following designations for the federal/state air quality standards (EPA 2006d):

- Attainment or nonclassified for the CO, lead, NO_2, PM_{10}, and SO_2 standards;
- Moderate nonattainment of the 8-hour ozone standard; and
- Nonattainment of the $PM_{2.5}$ standards.

Implementation of 8-hour Ozone Standard

On April 15, 2004, EPA designated as "nonattainment" areas throughout the country that exceeded the health-based standards for 8-hour ozone. On June 15, 2004, EPA issued the Final Rule to implement the 8-hour national ambient air quality ozone standard – Phase I. The Phase I Final Rule sets forth the classification scheme for nonattainment areas and requires states' continued obligations with respect to existing 1-hour ozone requirements. On May 20, 2005, EPA took final action on reconsideration of certain aspects of its Final Rule to implement Phase I of the 8-hour national ambient air quality ozone standard. On June 15, 2005, the 1-hour ozone standard was revoked for all areas except the 8-hour ozone nonattainment Early Action Compact (EAC) areas by virtue of 40 CFR 50.9(b). Communities that enter into these EACs work to reduce ground-level ozone pollution at least 2 years earlier than required by the CAA. As of June 15, 2005 (70 FR 44470), the 1-hour designations and classifications for all areas except EAC areas with deferred effective dates for their designations under the 8-hour ozone standard were removed from 40 CFR Part 81.

The Phase I Final Rule that implements the 8-hour ozone standard provides generally that only the portion of the designated area for the 8-hour NAAQS that was designated as nonattainment for the 1-hour NAAQS is required to comply with 40 CFR 51.905(a). The maintenance plans required under Section 51.905(a)(3)(iii) and (4)(ii) must demonstrate maintenance only for the area designated as nonattainment (or attainment with a Section 175a maintenance plan) for the 1-hour NAAQS at the time of designation of the 8-hour NAAQS.

Notwithstanding NO_2 attainment status, NO_x and VOCs are ozone precursors and are considered nonattainment pollutants in ozone nonattainment areas. Therefore, they are subject to New Source Review (NSR), which is described further below.

Regulatory Requirements

The proposed Project is potentially subject to a variety of federal and state regulations pertaining to construction or operation of air emission sources. Air emissions are governed federally by the CAA and at the state level by the Environmental Conservation Law (ECL) Article 19 and the New York Codes, Rules, and Regulations (NYCRR).

Federal Regulations

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

- New Source Performance Standards (NSPS);
- NSR/Prevention of Significant Deterioration (PSD);
- National Emission Standards for Hazardous Air Pollutants (NESHAPs);
- Chemical accident prevention provisions (Risk Management Plans);
- Title V operating permits; and
- The General Conformity Rule (for emissions not subject to NSR).

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

Subpart Db of 40 CFR 60, "Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units," applies to fuel-fired steam-generating units with a heat input capacity of greater than 100 million British thermal units per hour (million BTU/hr). The definition of an applicable unit includes sources that produce steam or heat water, or any other heat transfer medium. The process heaters proposed for the FSRU are considered steam-generating units under the regulation. The combined capacity of 227 million BTU/hr makes them subject to Subpart Db. Because current best available control technology (BACT) standards are more stringent than Subpart Db, however, implementing BACT would ensure compliance with Subpart Db.

Subpart Kb of 40 CFR 60 lists affected emission sources as storage vessels containing volatile organic liquids. Regulatory applicability depends on the construction date, size, and vapor pressure of the storage vessel and its contents. Subpart Kb applies to new tanks, unless otherwise exempted, with a storage capacity between approximately 20,000 and 39,000 gallons that contain VOCs with a maximum true vapor pressure greater than or equal to 15.0 kilopascals (kPa). Subpart Kb also applies to tanks with a storage capacity greater than about 39,000 gallons that contain VOCs with a maximum true vapor pressure greater than or equal to 3.5 kPa. LNG is mainly comprised of methane and some ethane, in addition to trace propane and butanes. Methane and ethane are considered non-VOCs by the EPA. Propane has a relatively low photochemical reactivity, and butane is considered exempt from the subpart regulations. Because the LNG stored on the FSRU would not be emitted, except potentially during emergencies, the LNG storage vessels would not be subject to Subpart Kb.

The proposed Project also would include three diesel fuel storage tanks. Although the capacity of the largest diesel storage tank would be slightly more than one-half million gallons (528,344 gallons), the vapor pressure of diesel fuel is significantly less than the regulatory threshold of 15.0 kPa, as mentioned above. Consequently, these tanks would not be subject to NSPS Subpart Kb.

Subpart GG of 40 CFR 60, "Standards of Performance for Stationary Gas Turbines," applies to all stationary gas (combustion) turbines with a heat input at peak load equal to or greater than 10.1 million BTU/hr that were modified, constructed, or reconstructed after October 3, 1977. Regarding the production of electrical power, simple-cycle gas turbines governed by this standard are capable of powering generators producing greater than 1 MW (3.4 million BTU) of electricity (assuming a heat rate of 10,000 BTU/KW-hr, or 34.1% efficiency). Each of the natural gas turbines proposed for the FSRU would be required to supply 22 MW (220 million BTU/hr); therefore, it is expected that the selected turbines would be subject to Subpart GG.

EPA published proposed standards of performance for new stationary combustion turbines in 40 CFR Part 60, Subpart KKKK to apply to units with a peak power output of 1 MW or higher that commence construction, modification, or reconstruction after February 18, 2005. The proposed standards include new NO_x and SO_2 emission limits that reflect the changes in turbine design and NO_x emission control technology that have taken place since the initial standards were promulgated in 1979 (in 40 CFR Part 60, Subpart GG). If these proposed standards are promulgated, the selected turbines proposed for the FSRU would be subject to Subpart KKKK.

New Source Review/Prevention of Significant Deterioration. The NSR permitting program was established as part of the 1977 Clean Air Act Amendments (CAAA). NSR is a preconstruction permitting program that ensures that air quality is not significantly degraded from the addition of new or modified major emissions sources.[3] In poor air quality areas, NSR ensures that new emissions do not inhibit progress toward cleaner air. In addition, the NSR program ensures that any large new or modified industrial source will be as clean as possible, and that the best available pollution control is utilized. The

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[3] A major stationary pollutant source in a nonattainment area has the potential to emit more than 100 tons per year (tpy) of any criteria pollutant. In PSD areas, the threshold level may be either 100 or 250 tpy, depending on the source.

NSR permit establishes what construction is allowed, how the emission source is operated, and which emission limits must be met.

If construction or modification of a major stationary source located in an attainment area would result in emissions greater than the significance thresholds, the project must be reviewed in accordance with PSD regulations. The construction or modification of a major or, in some jurisdictions, non-major stationary source in a nonattainment or PSD maintenance (Section 175A) area requires that the project be reviewed in accordance with nonattainment NSR regulations. Broadwater would assess the applicability of the NSR and PSD regulations to the Project and, based on the assessment, would submit pertinent permit applications to the federal and state agencies. Nonattainment NSR for sources in the State of New York is under the jurisdiction of NYSDEC, and EPA Region 2 reviews PSD applicability for sources in the State of New York.

The proposed Project would be located in an area currently designated as in attainment with NAAQS for criteria pollutants CO, NO_2, lead, SO_2, and PM_{10}, – even though NO_x are an ozone precursor. Therefore, the PSD regulations would apply to the Project for these pollutants if the proposed facility was classified as a major stationary source; otherwise, the PSD regulations would not apply. Twenty-eight source categories are listed in 40 CFR 52.21(b)(1)(i)(a) as major sources where the threshold is a "potential to emit" (PTE) greater than or equal to 100 tons per year (tpy) for any criteria pollutant. For source types other than the 28 listed in 40 CFR 52.21(b)(1)(i)(a), the major source threshold is a PTE greater than or equal to 250 tpy for any criteria pollutant. If multiple pieces of similar emissive equipment are used in operations at a source type that is not included as one of the 28 source categories, but one or more individual pieces of equipment is listed as a source category, the 100-tpy threshold applies exclusively to those emission units listed.

EPA has not made an agency-wide determination concerning which PSD threshold would apply to an FSRU as proposed in the Project. A review of available applications for other proposed LNG regasification facilities similar to the Project revealed that both 100- and 250-tpy thresholds have been implemented in the PSD review process, with a number of facilities designated in the 250-tpy category. An additional factor in determining the appropriate threshold is how the Project would be classified by the Standard Industrial Classification[4] (SIC) or North American Industry Classification System (NAICS), because it does not fit with any of the 100-tpy major source categories listed in 40 CFR Part 52 (power plants, petroleum refineries, sulfur recovery plants, storage tanks, or fuel conversion plants). Other LNG terminals in the United States are classified similarly: Cove Point and Hackberry are classified as "natural gas storage and transmission" (SIC 4922, NAICS 486210), while Port Pelican and Cabrillo Port are classified as "marine cargo handling" (SIC 4491, NAICS 488310 and 488320). The former code, "natural gas storage and transmission" (SIC 4922) for the FSRU was determined by Broadwater to be the most applicable. This code has been used for similar projects in the Gulf of Mexico, for which EPA Region 6 has determined that "fuel conversion plant" source category does not apply (EPA 2003b). Historically, fuel conversion plants have been listed in the PSD regulations as coal gasification and oil shale conversion – clearly not the function of an LNG regasification terminal. Therefore, it was assumed that the FSRU process proposed for the Project is not one of the 28 listed source categories under PSD and that the 250-tpy PTE threshold would apply to each criteria pollutant.

The FSRU would operate two gas turbines (with an additional turbine as a backup unit), along with waste heat recovery, which would have a combined heat input capacity greater than 250 million

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[4] SIC is a system that classifies establishments (individual business locations) by type of economic activity. The NAICS codes replaced the SIC codes and were first used in the 2002 Economic Census.

BTU/hr. The turbines would be used to generate electric power exclusively for use onboard the FSRU. The combined heat input capacity of the four process heaters (with an additional unit serving as a backup unit) would be slightly less than 250 million BTU/hr. Even if the process heaters would be considered individual or collective emission sources, they would not be included in the source category "Fossil Fuel Boilers [over 250 million BTU/hr]," as listed under 40 CFR 52.21(b)(1)(i)(a). Because the primary purpose of the FSRU is storage and regasification of natural gas, the 250-tpy threshold likely would apply to the FSRU process, but this would be determined by EPA and NYSDEC following Broadwater's analysis of the applicability of the regulations to the Project.

The air pollutants that are in attainment and therefore are reviewed under PSD include CO, NO_2, SO_2, and PM_{10}. Although NO_2 is in attainment with NAAQS, NO_x (including NO_2) are precursors to the creation of ozone, which is in moderate nonattainment for the new 8-hour standard. Lead emissions are not included because they would be emitted from the proposed facility in minute amounts. An estimate of annual emissions is presented in Table 3.9.1-8. EPA Region 2's position is that LNG carrier emissions related to off-loading and on-board processing of the LNG should be included in the cumulative PTE for the FSRU, and that LNG carrier emissions related to propulsion and hotelling should not. It is Broadwater's position that LNG carriers and their resultant emissions would not be under the control of Broadwater because the proposed Project does not include a fleet of dedicated, company-owned LNG carriers to deliver LNG to the FSRU, and Broadwater therefore would be unable to accept and implement any permit conditions on vessels not under its control. Broadwater maintains that its' lack of control over the LNG carrier emissions precludes them from being considered in the PSD applicability determination for the proposed Project. Broadwater also maintains that the FSRU is categorized under a different SIC code than the LNG carriers, which is one of the criteria in EPA's Draft New Source Review Workshop Manual (EPA 1990). The PTE for the FSRU and the emissions estimated to occur while the LNG carrier is berthed at the FSRU and while off-loading and on-board processing LNG are both presented in Table 3.9.1-8.

If it is formally determined that LNG carrier emissions that occur while berthed at the FSRU are not included in the estimation of PTE, then the estimated emissions from those carriers (limited to operation of auxiliary engines and pumps, and excluding propulsion engine emissions) would be considered by Broadwater as part of the General Conformity (Section 176) analysis for CO, PM_{10}, and SO_2 that would be conducted for the Project. Emissions from mobile sources are addressed in the General Conformity determination.

Emission thresholds under NSR and potentially applicable PSD maintenance regulations are presented in Table 3.9.1-9. The pollutants shown in Table 3.9.1-9 are limited to those for which the region is considered nonattainment. The values below do not include emissions from LNG carrier operations. Based on the estimated annual potential emissions after applying control equipment or methodology as shown in Table 3.9.1-9, the proposed FSRU would be considered an NO_x major stationary source under NSR regulations and a non-major source of VOC and $PM_{2.5}$. Thus, BACT would be required for NO_x, VOC, and $PM_{2.5}$ under NSR due to the nonattainment or, potentially, PSD maintenance status of Suffolk County in the AQCR.

National Emissions Standards for Hazardous Air Pollutants. NESHAPs, codified in 40 CFR Parts 61 and 63, regulate hazardous air pollutant (HAP) emissions. Part 61 was promulgated prior to the 1990 CAAA and regulates eight types of hazardous substances (asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionucleides, and vinyl chloride). LNG storage and processing facilities do not fall under one of the source categories regulated by Part 61; therefore, the requirements of Part 61 are not applicable to the proposed Project.

TABLE 3.9.1-8 Annual Potential to Emit for the Proposed FSRU Stationary Sources Compared to PSD Major Source Size Thresholds				
Air Pollutant	**Estimated FSRU Annual Potential Emissions[a] (tpy)**	**Estimated Annual Potential Emissions from LNG Carrier[b] (tpy)**	**Total Estimated Annual PTE (FSRU + LNG carrier)**	**PSD Major Source Size (tpy)**
Carbon monoxide	88	0.6	89	250
Nitrogen oxides	71	11	82	250
Sulfur dioxide	4	84	88	250
Particulate matter less than 10 microns	48	4	52	250

PSD = Prevention of significant deterioration.

PTE = Potential to emit.

tpy = Tons per year.

[a] Accounts for use of selective catalytic reduction and oxidation catalyst for control of nitrogen oxides and carbon monoxide/volatile organic compounds, respectively.

[b] The emissions presented for the current LNG carriers include only those estimated for off-loading and on-board processing of LNG while berthed at the FSRU.

TABLE 3.9.1-9 Annual Potential to Emit for the Proposed FSRU Stationary Sources Compared to NSR Major Source Size Thresholds		
Air Pollutant	**Estimated Annual Potential Emissions[a] (tpy)**	**NSR Major Source Size Threshold (tpy)**
Nitrogen oxides (as NO_2)	71	100/25[b]
Volatile organic compounds	18	50/25[b]
Particulate matter less than 2.5 microns	48	100

tpy = Tons per year.

[a] Accounts for use of selective catalytic reduction and oxidation catalyst for control of nitrogen oxides and carbon monoxide/volatile organic compounds, respectively.

[b] First value is threshold for 8-hour moderate ozone nonattainment designation; second value is threshold for 1- hour severe ozone nonattainment designation.

The 1990 CAAA established a list of 189 additional HAPs, resulting in the promulgation of Part 63. Also known as the maximum achievable control technology (MACT) standards, Part 63 regulates HAP emissions from major sources of HAP emissions and specific source categories that emit HAPs. Part 63 considers any source with the potential to emit 10 tpy of any single HAP or 25 tpy of HAPs in aggregate as a major source of HAPs. In addition, Part 63 establishes HAP emission standards for marine vessel loading operations; oil and gas production facilities; natural gas transmission and storage facilities; industrial, commercial, and institutional boilers and process heaters; and reciprocating internal combustion engines. The Project does not have the potential to emit HAP emissions greater than 10 tpy for a single HAP, nor does it have the potential to emit 25 tpy of multiple HAPs. Thus, the proposed FSRU would not be considered a major source of HAP emissions and would not be subject to NESHAPs.

Chemical Accident Prevention Provisions. The chemical accident prevention provisions, codified in 40 CFR 68, are federal regulations designed to prevent the release of hazardous materials in the event of an accident and to minimize potential impacts if a release did occur. The regulations contain a list of substances and threshold quantities for determining applicability to stationary sources. If a stationary source stores, handles, or processes one or more substances on this list in a quantity equal to or greater than specified in the regulation, the facility must prepare and submit a Risk Management Plan (RMP). If a facility does not have a listed substance onsite, or if the quantity of a listed substance is below the applicability threshold, the facility does not need to prepare an RMP. In the latter case, the facility is no longer required to comply with requirements of the general duty provisions in Section 112(r)(1) of the 12 1990 CAAA, if any regulated substance or other extremely hazardous substance is onsite, based on a March 12, 2006 memorandum from EPA indicating that LNG import terminals are no longer subject to these provisions (EPA 2006e).

Title V Operating Permits. Title V of the federal CAA requires individual states to establish an air operating permit program. The requirements of Title V are outlined in 40 CFR 70, and the permits required by these regulations are often referred to as Part 70 permits. NYSDEC regulates compliance with the permitting program under Title V in the State of New York. Title V applicability is discussed under "State Regulations."

General Conformity Rule. The General Conformity Rule was designed to require federal agencies, such as FERC, to ensure that proposed projects conform to the applicable State Implementation Plan (SIP). General Conformity regulations apply to project-wide emissions of pollutants for which the project areas are designated as nonattainment (or, for ozone, its precursors NO_x and VOC) that are not subject to NSR and that are greater than the significance thresholds. Federal agencies are able to make a positive conformity determination for a proposed project if any of several criteria in the General Conformity Rule are met. These criteria include:

- Emissions from the project are specifically identified and accounted for in the SIP attainment or maintenance demonstration; or
- Emissions from the action are fully offset within the same area through a revision to the SIP or a similarly enforceable measure that creates emissions reductions so that there is no net increase in emissions of that pollutant.

A General Conformity analysis is required for pollutant emissions that would occur in nonattainment areas not subject to NSR. The AQCR's ozone nonattainment designation would not require an analysis of FSRU emissions of NO_x and VOC under the General Conformity regulation because these emissions already would be subject to NSR. Likewise, Suffolk County's designation as a nonattainment area for $PM_{2.5}$ would not require a General Conformity analysis for $PM_{2.5}$ emissions because NSR would be applicable. However, emissions of $PM_{2.5}$, NO_x, and VOCs from Project-related sources such as vessels, motor vehicles, and construction equipment that are not governed by stationary source permits would be considered under the General Conformity Rule. The required evaluation of the proposed Project under General Conformity includes an applicability analysis via a comparison of potential emissions to applicability threshold levels, as well as a conformity determination if the emissions are greater than applicability thresholds.

At this time we do not have the necessary information to make a Conformity determination. Each federal agency is required to make a Conformity determination before the action is taken. To allow the FERC staff to complete the analysis and issue a Final General Conformity determination, **we recommend that:**

- **Broadwater provide a full air quality analysis identifying all mitigation requirements required to demonstrate conformity and file detailed information documenting how the Project would demonstrate conformance with the applicable State Implementation Plan in accordance with Title 40 CFR Part 51.858. The documentation address each regulatory criterion listed in Part 51.858; provide a detailed explanation as to whether or not the Project would meet each requirement; and, for each criterion satisfied, provide all supporting information on how the Project would comply. Broadwater file documentation supporting conformity with the Secretary before the end of the draft EIS comment period.**

FERC will evaluate the magnitude and potential impact of the emissions to make a General Conformity determination in consultation with EPA and NYSDEC prior to the start of the activity. Annual vessel operation emissions also would be evaluated in the General Conformity determination made by FERC. These emissions would be subject to mitigation if they could not be accommodated in the current AQCR emissions budget. The General Conformity determination is discussed further in Section 3.9.1.2 Potential Impacts and Mitigation.

State Regulations

Title V operating permit requirements, as well as nonattainment NSR, have been delegated to the jurisdiction of NYSDEC for this type of project. The NYCRR has many of the same requirements as the federal regulations but may opt to include stricter BACT emission standards and toxic air pollutant regulations.

Title V Operating Permits. Title V of the CAA (40 CFR 70) requires that all states establish air operating permit programs. The New York State Title V permitting program is included in 6 NYCRR 201, which contains a provision for operating permits for State Facility (non-major source) permits (6 NYCRR 201-5) and Title V (major source) permits (6 NYCRR 201-6). As listed in 6 NYCRR 201-6.1, Title V permits are required for the following:

- Any major stationary source (see definition below);
- Any major stationary source subject to NSPS requirements (non-major stationary sources subject to an NSPS are currently exempt from Title V);
- Any stationary or area source subject to regulations for HAPs under Section 112 of the CAA, except sources solely subject to the control of accidental release provisions of Section 112;
- Any affected source (combustion sources subject to the federal acid rain program under Title IV of the CAA); and
- Any stationary source in a category designated by EPA and added by NYSDEC pursuant to rulemaking.

The definition of a "major stationary source" is different for Title V applicability and for PSD applicability. In Suffolk County, New York, a Title V major stationary source is defined as a facility with the PTE that meets the criteria listed below. If a facility's emissions are less than any of the criteria listed, the source is considered non-major or minor and is issued a State Facility permit. The following thresholds define a major stationary source in New York:

- 100 tpy or more of any air pollutant;

- 100 tpy or more of NO_x or 50 tpy or more of VOCs (in an 8-hour moderate ozone nonattainment designation);
- 25 tpy or more of NO_x or VOC (in a 1-hour severe ozone nonattainment designation);
- 25 tpy or more of any combination of HAPs; or
- 10 tpy or more of any individual HAP.

NYSDEC is in the process of revising the required SIP for ozone to address these changes. NYSDEC plans to revise the SIP by the year 2008, which would result in application of moderate ozone nonattainment thresholds. The proposed Project's emissions would be below the major stationary source threshold under Title V (see Table 3.9.1-10) because of the emission estimates of NO_x, VOCs, and HAPs; implementation of permit restrictions and control equipment; and location of the Project within an 8-hour moderate ozone nonattainment area. Therefore, a State Facility (non-major source) permit from New York State would be obtained for the Project, authorizing both construction and operation in accordance with all applicable state air regulations.

Pipeline installation from the FSRU to the IGTS interconnect would occur between November 2009 and January 2010, and would be preceded by installation of the FSRU and YMS. Construction activities are expected to be complete by December 2010. Provided that the SIP is revised according to schedule (by 2008), the Project would not require a Title V operating permit.

Construction of the YMS is estimated to begin in September 2009 prior to initiation of pipeline construction activities. The determination of major or non-major source would be based on the SIP in place at the time of construction. If the SIP has not yet been revised, the FSRU would be considered a major source. If the SIP has been revised, the FSRU would be considered a non-major source.

Nonattainment NSR/PSD Maintenance. Nonattainment and maintenance involves various requirements, including required application of BACT to emission sources. Based on the estimated annual potential emissions presented in Table 3.9.1-10 and assuming that the New York State SIP would be revised for the 8-hour moderate ozone nonattainment designation, the Project would not be subject to nonattainment requirements in the NSR regulations for NO_x and VOC under the 8-hour ozone standard.

However, if PSD maintenance status would be in effect per Section 175A, the Project would remain subject to nonattainment NSR requirements for NO_x and VOC. As required by the New York State SIP, federal NSR regulations are administered by NYSDEC under NYCRR Title 6, Part 231 (6 NYCRR 231). NSR for $PM_{2.5}$ also would be applicable if there is no change in the $PM_{2.5}$ nonattainment status for Suffolk County. If an 8-hour SIP is not approved by the EPA prior to construction, the 1-hour provisions would remain in effect.

The Project would be able to achieve an annual emission level for NO_x and VOC that is below the major source threshold, subject to federally enforceable permit conditions, by applying control equipment to source emissions that would reduce emission levels to the current BACT requirements. This would occur for either nonattainment or maintenance status. Use of the control equipment (selective catalytic reduction [SCR] and oxidation catalyst) would be an applicable condition in the air permit. This control technology, along with additional potential operating restrictions, would limit emissions to a level that is below major source thresholds for an 8-hour ozone moderate nonattainment designation. Low-NO_x burners would be used, and both the process heaters and the gas turbines would be equipped with SCR and oxidation catalyst units.

TABLE 3.9.1-10 Annual Potential to Emit for the Proposed FSRU Stationary Sources and Title V Major Source Size Thresholds		
Air Pollutant	**Estimated Annual Emissions (tpy)**	**Title V Major Source Size (tpy)**
Carbon monoxide	89	100
Nitrogen oxides (as NO_2)	71	100
Volatile organic compounds	18	50
Sulfur dioxide	4	100
Particulate matter less than 2.5 microns	48	100
Particulate matter less than 10 microns	48	100
Ammonia	66	----
Total hazardous air pollutants	9.4	25

tpy = Tons per year.

State of New York Regulations. Air emission sources in the State of New York are required to meet state air emission standards and to comply with requirements codified in 6 NYCRR Parts 201 to 257. Part 204 (NO_x Budget Trading Program) would apply to this Project, as the combined heat input ratings of the gas turbines exceed the applicability threshold of 250 million BTU/hr, as listed in Part 204 1.4. However, the process heaters would not qualify as NO_x budget units because the combined heat input would be slightly below the unit applicability threshold of 250 million BTU/hr, as listed in Part 204 1.4. The emission standards and requirements from 6 NYCRR Parts 201 to 257 that may apply to the proposed FSRU are described below.

- Part 200: General Provisions;
- Part 201: Construction and Operating Permits;
- Part 202: Emissions Verification;
- Part 211: General Prohibitions;
- Part 212: General Process Emission Sources;
- Part 226: Solvent Metal Cleaning Processes;
- Part 227: Stationary Combustion Installations;
- Part 231: New Source Review; and
- Part 257: Ambient Air Quality Standards.

Part 200 includes definitions, the list of HAPs, and general provisions.

Part 201 includes the permitting requirements for construction/operation of sources of air emissions, State Facility and Title V permitting requirements, exemptions, general permits, and minor and State Facility restrictions and permits. The application process for construction and operation permits consists of a combined single application in the State of New York. For the proposed FSRU, it is anticipated that NYSDEC would generate a draft Part 201 (State Facility) permit from Broadwater's application, followed by subsequent public notice.

Part 202 includes guidelines for emissions testing and annual emissions reporting. Annual emissions statements for the proposed Project would be required for submittal to NYSDEC.

Part 211 includes general prohibitions on injurious air pollution releases and excessive visible emissions.

Part 212 includes emission standards for all process emission sources. The emission standards outlined in Part 212 apply to all nonexempt emission sources at proposed facilities with certain exceptions, such as combustion units. The proposed STVs, gas turbines, and auxiliary equipment that would operate on the FSRU are considered combustion installations, not process emission sources. Thus, Part 212 is not applicable to the Project.

Part 226 includes provisions for operation of degreasers and other solvent-based metal cleaning devices.

Part 227 includes emissions standards and testing, monitoring, and reporting requirements for stationary source combustion installations, as well as reasonably available control technology (RACT) for sources of NO_x such as turbines and boilers. Because the proposed FSRU would be considered a non-major stationary source of NO_x (assuming that the SIP is revised and approved on schedule), a compliance plan outlining the methods and measures of compliance for combustion installations at the FSRU would not be required. However, it is anticipated that federally enforceable record keeping and reporting requirements to monitor compliance with the emission limits would be imposed on the Project. The Part 227 NO_x emission limit for each process heater is 0.2 pound per million BTU for a heat input range of 100 million BTU/hr to less than 250 million BTU/hr. This rate should be reasonably available using low-NO_x burners and SCR as control measures. If the Project is unable to achieve this rate because low-NO_x burners and SCR are technically infeasible or economically impractical for implementation, a comprehensive technical demonstration on those constraints – as well as proposed alternate control mechanisms – must be included as part of a compliance plan or BACT analysis. For the gas turbines, a case-by-case determination would be made based on the BACT proposal submitted (such as SCR plus oxidation catalyst). Historically, the NO_x BACT limit for simple-cycle gas turbines in the New York City metropolitan area (including Suffolk County) has been less than the limit for simple-cycle BACT for CO and VOC. Small boilers and emergency equipment are not subject to specific emission limits.

Part 231 includes the NSR requirements for emissions sources in any nonattainment areas, emission reduction credits, and the lowest achievable emission rate (LAER).

Part 257 includes the ambient air quality standards for the State of New York. As mentioned previously, NYSDEC has adopted the federal NAAQS for criteria air pollutants. NYSDEC has adopted additional ambient air quality standards for the following pollutants: SO_2, settled particulates, total suspended particulates (TSP), non-methane hydrocarbons, fluorides, beryllium, and hydrogen sulfide.

Class I Prevention of Significant Deterioration Areas

As discussed previously, the 1977 CAAA established the PSD program to protect air quality in areas where the existing air quality was already better than the federal standards. The PSD program allows for larger air emission increments relative to an established emissions baseline; the volume of these increments depends on the classification of the area. EPA recognizes three types of area classifications for existing air quality (Classes I, II, and III). The classifications vary in terms of the amount of increase in emissions permitted before significant deterioration would be expected to occur. EPA-designated Class I areas, promulgated in August 1977 under Title I Air Pollution Prevention and Control Section 162 of the CAA, allow for the smallest increments and minimal degree of deterioration. Classes II and III allow for moderate and even greater increases over the baseline, respectively.

Class I areas are specified by EPA and include locations of special air quality concern due to national or regional natural, scenic, recreational, or historical value, such as international parks, national wilderness areas, and national parks. PSD regulations provide special protection for these areas to maintain the existing high quality of air. To clarify, an emissions source within 62 miles (100 kilometers) of a Class I area is required to evaluate air quality impacts in that Class I area, and only a small increase over baseline is permitted. In addition to restrictive Class I increments for SO2, particulate matter, and NO2, visibility protection requirements were adopted for specific Class I areas to ensure that visibility is preserved in those areas. The proposed Project is not located within 62 miles (100 kilometers) of any Class I area.

3.9.1.2 Potential Impacts and Mitigation

Construction

Offshore construction activities would consist of installation of the FSRU, the YMS, and the pipeline. Because the FSRU would be constructed in a shipyard outside of the United States and then towed to the site, no emissions associated with the physical construction of the FSRU would occur in Long Island Sound. The primary sources of emissions during construction activities would be the marine construction vessels used to install the FSRU, YMS, and pipeline.

Construction activities, including FSRU towing, YMS installation, and pipeline installation, would take place during fall and winter months over a 15-month period. Emission estimates from construction activities were developed based on the anticipated duration of use of each vessel type during the construction period, the vessels' engine characteristics and duty cycles, and appropriate emission factors using an emissions estimate tool provided by MMS (MMS 2005b). A summary of emission estimates for construction activity is presented in Table 3.9.1-11.

Construction-related emissions are not covered by an existing air permit program and therefore are evaluated under the General Conformity Rule. Construction-related emissions would cease prior to commencement of FSRU operations. Because the Project region is considered nonattainment for the ozone standard, emissions of ozone precursor compounds NO_x and VOCs are evaluated against General Conformity applicability thresholds.

As presented in Table 3.9.1-11, the estimated NO_x emissions that would be generated due to construction activities would exceed the General Conformity applicability threshold of 100 tpy for each year of construction (conservatively assuming applicability of the 8-hour moderate ozone nonattainment threshold). Under the General Conformity regulations, the total amount of the NO_x emissions during the 15-month construction period would be required to be accounted for in the New York SIP through offsets, allowances, or another method under 40 CFR 93.158. Because construction would be scheduled to occur outside of the typical ozone season (May 15 through September 15), construction emissions are not expected to contribute to the typical summer ozone season. If construction were to occur during the ozone season, Broadwater would be required to obtain NO_x emission offsets. Any offsets obtained would need to be available in the same timeframe as the proposed construction. However, the timeframe in which emissions would be produced may be considered for mitigation purposes. To avoid contributing to emissions during the typical ozone season, Broadwater would limit construction to fall and winter months.

TABLE 3.9.1-11 Estimated Emissions from Construction Activities[a]						
Year	**Carbon Monoxide (tpy)**	**Nitrogen Oxides (tpy)**	**Volatile Organic Compounds (tpy)**	**Sulfur Dioxide (tpy)**	**Particulate Matter ($PM_{2.5}$) (tpy)**	**PM_{10} (tpy)**
1	46	213	11	3.2	10	10
2	117	538	24	8.4	22	22
Annual General Conformity *applicability threshold*[b]	Not applicable	100[c]	50	100[c]	100	100[c]

tpy = Tons per year.

[a] With the exception of sulfur dioxide, values presented in this table were taken from the Air Emissions Calculations table in Appendix A, Construction Emissions, provided in the Broadwater application. If mid-line buoys are used on all anchor lines, construction emissions are expected to increase by 6 percent. If it is determined that mid-line buoys would indeed be used on all anchor lines, emission calculations would be updated.

[b] Thresholds for a moderate ozone nonattainment area..

[c] The EPA-Proposed Rule of November 1, 2005 (EPA 2005f), does not set applicability thresholds for $PM_{2.5}$ precursor compounds, such as sulfur dioxide and nitrogen oxide. However, the Proposed Rule does suggest that the thresholds will be set equal to nonattainment area major source levels for the NSR program. As a result, 100 tpy would be the applicable threshold level for all $PM_{2.5}$ precursor pollutants.

Because the bulk of Project-related activities would occur at least 9 miles offshore, air pollutant emissions would not interfere with, or create a nuisance for, the general public. The only potential receptors of "nuisance emissions," such as a visible water vapor plume or odors from kitchen, sanitary, or ventilation systems, would be recreational boaters or commercial fishermen. Broadwater has conducted a model and concluded that a water vapor plume would not be visible under any weather circumstances. In addition, the distance between potential receptors and nuisance emissions would be mandated by the Coast Guard-established safety and security zone around the FSRU, which would allow odors to dissipate.

During construction, onshore facilities would be utilized merely as temporary dock, office, and warehouse space for construction contractors. Because the onshore facility would be pre-existing, the only air emissions associated with the Project would be an increase in truck traffic (estimated at two to three trips per day) and delivery of fuel by tankers for the tugs (estimated at one trip per day). Four tugs would be docked at the facility; emissions would be generated during engine warmup, departure from the facility, and return docking. Emissions associated with these onshore activities are expected to be minor.

Operation

Potential impacts during operation could be associated with emissions from stationary sources, such as the FSRU, and mobile sources, such as LNG carriers and supply vessels.

Facility Stationary Source Operation

All emission sources identified for operation of the FSRU are associated with combustion of natural gas and diesel fuel that would generate air emissions throughout the long-term operation of the facility. The air pollutants typically generated by combustion of these fuel types are CO, HAPs, NO_x, PM_{10}, $PM_{2.5}$, SO_2, and VOCs. Emission estimates for these sources were generated by:

- Examining the projected LNG peak throughput data for the proposed FSRU (1.25 bcfd);
- Examining the annual limit of LNG delivered to the FSRU on an annual basis (7.7 million metric tons of natural gas delivered to the pipeline);
- Identifying the BACT emission factors from process heaters and gas turbine manufacturers;
- Incorporating other EPA emission factors where applicable; and
- Evaluating emission data for other similar LNG projects.

Emission estimates were calculated for all criteria pollutants, except for lead and ozone, as well as for HAPs and ozone precursors NO_x and VOCs. Lead and ozone emissions were not estimated because these compounds either would be emitted from the facility in minute amounts (lead) or would not be directly emitted (ozone).

Operation-related emission estimates for the stationary and mobile sources from the proposed Project are presented in Tables 3.9.1-12 and 3.9.1-13, respectively. The emission estimates reflect the use of SCR for NO_x reduction and CO oxidation catalysts on the gas turbines and process heaters as BACT. Ammonia also would be emitted due to emission of unreacted ammonia through the SCRs used on the gas turbines and process heaters.

TABLE 3.9.1-12
Annual Emission Summary for Stationary FSRU during Operation

Ammonia[2] (tpy)	Carbon Monoxide (tpy)	Nitrogen Oxides[2] (tpy)	Volatile Organic Compounds[2] (tpy)	Sulfur Dioxide[2] (tpy)	PM_{10}/ $PM_{2.5}$ (tpy)	Hazardous Air Pollutants (tpy)
66	88	71	18	4	48	9.4

(1) Emission estimates do not include any mobile source emissions or LNG carrier emissions occurring during LNG unloading.
2) NO_X, VOCs, SO_2, and ammonia are also candidate $PM_{2.5}$ precursors as defined in the EPA proposed $PM_{2.5}$ implementation rule.

Emission levels generated during operation of the FSRU would be less than ozone nonattainment NSR thresholds applicable to the Project area (assuming that future PSD maintenance requirements would not be implemented and that moderate ozone nonattainment thresholds would be applicable). However, FSRU operations would result in annual PM_{10} emissions that are greater than 15 tpy, which triggers an analysis of the secondary formation of $PM_{2.5}$, according to the NYSDEC policy CP-33. According to the EPA-Proposed Rule for implementation of the $PM_{2.5}$ NAAQS, $PM_{2.5}$ is formed through various atmospheric chemical reactions between NO_x and SO_2, and can result in nitrate and sulfate $PM_{2.5}$ particles. The main components of ambient PM are elemental and organic carbon, inorganic ions (ammonium sulfate and ammonium nitrate), and trace elements (HEI 2004).

In addition, ammonia can combine with nitrate, sulfate, or VOCs to form particles. The Proposed Rule for $PM_{2.5}$ indicates that more research is needed before considering programs for ammonia emission reduction. It cannot be concluded at this time whether the ammonia emissions from the FSRU would contribute significantly to secondary particle formation, but reduction of SO_2 and NO_x would aid in controlling the secondary formation of $PM_{2.5}$. Ammonia emissions would occur from use of SCR to minimize NO_x emissions; therefore, proper operation of the SCR units and compliance with air permit limits are important.

TABLE 3.9.1-13 Annual Emission Summary for Vessel Activity during Operation					
	Carbon Monoxide (tpy)	**Nitrogen Oxides (tpy)**	**Volatile Organic Compounds (tpy)**	**Sulfur Dioxide (tpy)**	**PM_{10}/ $PM_{2.5}$ (tpy)**
LNG carrier unloading	1.6	29	0.4	222	10
Carrier transit and support tugs	54	427	18	341	25
Total	**56**	**456**	**19**	**563**	**35**
Annual General Conformity applicability thresholds	Not applicable	100	50	Not applicable	100[a]

$PM_{2.5}$ = Particulate matter with an aerodynamic diameter less than or equal to 2.5 microns.

PM_{10} = Particulate matter with an aerodynamic diameter less than or equal to 10 microns.

tpy = Tons per year.

[a] EPA (2005f) describes an interim surrogate $PM_{2.5}$ program for nonattainment areas to be used while states develop $PM_{2.5}$ control programs. The threshold for $PM_{2.5}$ in this guidance is recommended to be equal to the 100-tpy threshold for PM_{10} nonattainment areas.

In summary, emission offsets may be required. The emission levels also would be less than the applicable PSD major source thresholds; therefore, a review of the Project under PSD requirements would not be required. Finally, because the annual emissions would be below Title V operating permit major source thresholds, the FSRU would be operated under a State Facility Permit issued by NYSDEC, subject to federally enforceable conditions required to support the Title V exemption.

Facility Mobile Source Operation

Emissions would be produced by LNG carriers during transit to and from the FSRU, and by support vessel activity during routine operation of the FSRU. Vessels used for routine operation of the FSRU include the LNG carriers; tugs that would escort and assist the LNG carriers while approaching, positioning, docking, and leaving the FSRU; and smaller vessels delivering supplies for use on the FSRU.

Emissions calculated for the LNG carrier encompass the complete delivery cycle, beginning with the vessel entering U.S. waters, as it travels inbound to the FSRU, unloads LNG at the FSRU[5], and travels outbound to the boundary of U.S. waters.

Tugs would maneuver LNG carriers while in the vicinity of the FSRU and also would meet inbound LNG carriers east of Long Island Sound (outside the Race), escort them to the FSRU, and then escort the outbound LNG carrier to the Race after delivery of cargo. The number of tugs required for these operations would vary, based on the size of the LNG carrier and Coast Guard requirements. Emissions were estimated based on two tugs escorting the LNG carrier and three tugs assisting the LNG carrier while berthing at the FSRU. If it is formally determined that the number of tugs would be greater

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[5] The position of EPA Region 2 is that emissions associated with off-loading LNG from the LNG carrier while it is berthed at the FSRU are to be included in the evaluation as part of stationary sources.

than two and three tugs, respectively, Broadwater would update the emission calculations to reflect the actual number proposed. One supply vessel typically would visit the FSRU for each LNG delivery. Based on an estimated 118 LNG carrier visits per year, 118 supply vessel trips to the FSRU are predicted annually. EPA has suggested that Broadwater consider the use of tug engines specifically designed to reduce emissions of NO_x. Criteria such as feasibility, performance, and availability would be included in the consideration. If a determination can be made prior to the issuance of the Final EIS, emission estimates would be updated to reflect any reductions from the use of such engines.

The LNG carrier would operate its primary power generator while docked alongside the FSRU. Approximately 10 MW of electrical power would be needed to operate pumps aboard the carrier during the LNG transfer. EPA has suggested that Broadwater assess the feasibility of alternative methods for reducing emissions from the LNG carriers while berthed at the FSRU including the use of boil-off gas or 1 percent sulfur fuel oil for generating electricity, or using electrical power from the FSRU (generated from natural gas). Broadwater has stated that the LNG carriers could not use boil-off gas while docked, and residual oil would be used in the power generation equipment onboard the carrier during the actual LNG transfer period (active transfer would last approximately 15 hours for an LNG carrier with a cargo capacity of 140,000 m^3). Broadwater also determined that it is infeasible to transfer 1 percent sulfur fuel oil from the FSRU to the LNG carriers for use during off-loading and onboard processing based on a review of the regulations governing the use of 1 percent sulfur fuel oil, the availability and storage mechanisms, the compatibility of systems onboard the vessels, and potential risks. Lastly, Broadwater determined that it was infeasible for the FSRU's gas turbines to provide electricity to the LNG carriers as they were docked alongside the FSRU (cold-ironing) based on safety, design, operational, and commercial considerations associated with this type of power transfer. Additional discussion is provided in Section 4.9.

A summary of emissions from vessel activities during normal FSRU operations is presented in Table 3.9.1-13. Because these emissions would not be covered by any current air permit program, they could be evaluated under the General Conformity Rule by comparison to applicability thresholds, assuming that the thresholds for an 8-hour moderate ozone nonattainment area would apply. Associated mobile sources could be deemed a component of the stationary source and subject to mitigation, such as BACT or offsets. Mobile source emissions (tug, crew, and supply boats) exclusively associated with the stationary source (FSRU) could be included in the stationary source inventory under the regulation and could be subject to NSR or PSD as applicable. However, the applicability of mobile sources to the Project inventory is a detailed permitting issue beyond the scope of this evaluation.

Direct emissions of PM_{10} would be less than the applicability threshold; therefore, $PM_{2.5}$ emissions would be less than the applicability threshold (following EPA's April 2005 interim guidance on using PM_{10} as a surrogate for $PM_{2.5}$). While EPA has not yet determined whether it will regulate NO_x as a $PM_{2.5}$ precursor compound, NO_x emissions exceed the applicability threshold. It is possible that offsetting these emissions may not be required. If required, offsets in place for construction-related NO_x emissions during the ozone control period may also serve as a $PM_{2.5}$ precursor offset if EPA decides to regulate NO_x as a $PM_{2.5}$ precursor in the future.

Air Quality Modeling and Analysis

Air Quality Modeling

Atmospheric dispersion models were used to determine impacts to air quality. Studies were conducted according to the modeling protocol reviewed by NYSDEC and EPA. Dispersion modeling was performed using the offshore coastal dispersion (OCD) model to estimate concentration levels beyond an assumed safety and security zone. When this modeling was conducted, the Coast Guard had not determined the preliminary extent of the safety and security zone; therefore, the safety and security zone for this analysis was assumed to have a 500-meter (1,640 feet) radius around the FSRU. It should be noted that the safety and security zone for the FSRU has since been determined to have a radius of 0.7 mile (approximately 3,700 feet) originating at the YMS, which is equivalent to 15 square miles centered around the YMS. In addition, the Coast Guard would establish a safety and security zone around each LNG carrier that would extend 2 nautical miles (2.3 miles) in front of the bow, 1 nautical mile (about 1.2 miles) behind the stern, and 750 yards (0.4 mile) to each side of the vessel based on the preliminary determination. The established safety and security zone would reduce the actual impacts to these receptors relative to those discussed in the following assessment since the modeling was conducted assuming a smaller safety and security than established by the Coast Guard.

AERMOD-PRIME is an EPA-approved model for evaluating the impact of land-based stationary sources. The AERMOD-PRIME model was used to evaluate air quality impacts over water in the immediate vicinity of the FSRU related to the aerodynamic effects of air flow over the structure. Because the model was formulated for over-land use, use of the model was limited to evaluating impacts at and just beyond the 500-meter radius (1,640 feet) around the YMS. The OCD model was used to evaluate dispersion well beyond 1,640 feet (the assumed radius of the safety and security zone at the time of the modeling).

The OCD model has been deemed appropriate by EPA for this Project and has been considered appropriate for evaluating the potential transport and dispersion of emissions from other offshore sources over water to a shoreline (MMS 1997). The OCD model contains calculations designed to evaluate dispersion beyond the safety and security zone, and onshore in New York and Connecticut.

Extensive meteorological data sets for offshore and onshore sites were used for OCD modeling. Background (existing) air pollutant concentration levels also were obtained from onshore stations located on Long Island, New York and in Connecticut just inland from the south shore of the Sound. These data were used to compare estimated air quality impacts from FSRU operations to existing conditions and thus provide an indication of the relative effect on current air quality conditions. At the request of NYSDEC, Broadwater is currently reassessing the extent and availability of other sources of meteorological data. As discussed later in this section, modeled air quality emission concentrations associated with the FSRU based on the current meteorological data would be below Significant Impact Levels (SILs) as defined in the NSR regulations under 6 NYCRR Part 231 and listed in Table 3.9.1-14.

Emissions and subsequent ambient air quality impacts would be affected by the quantity of emission sources operating at any given time, the operating load, and the fuel type. Appropriate operating scenarios were developed and evaluated in the modeling study in order to characterize annual impacts to air quality and shorter-term (1-, 3-, 8-, or 24-hour) impacts. These time periods correspond to the time periods used for criteria pollutants in the NAAQS.

The objective of the modeling analysis was to assess potential impacts to ambient air quality, using design parameters identified for the Project (see Section 2.0), which would then be compared to the current regulatory levels in order to identify potential issues with predicted air pollutant emission rates. Air quality impacts were assessed only for emissions resulting from operation of the FSRU. The model will be updated to include specific off-loading activities of the LNG carriers.

All emission sources onboard the FSRU were categorized as point sources of emissions. Model input parameters included stack height, stack gas temperature, stack exit inside diameter, stack gas exit velocity, stack angle from vertical, and elevation of stack base above water surface.

TABLE 3.9.1-14 OCD Model Results				
Pollutant[a]	Averaging Period	Significant Impact Levels(μg/m^3)	OCD Maximum Predicted (μg/m^3)	Exceeds Significant Concentration Level?
Carbon monoxide	8-Hour	500	111	No
	1-Hour	2,000	258	No
Nitrogen dioxide	Annual	1	0.26	No
Sulfur dioxide	Annual	1	0.00	No
	24-Hour	25	0.15	No
	3-Hour	5	0.65	No
$PM_{2.5}$	Annual	1	0.05	No
	24-Hour	5	2.75	No
PM_{10}	Annual	1	0.05	No
	24-Hour	5	2.82	No
Ammonia	Annual	100[b]	0.06	Below AGC
	1-hour	2,400[b]	17.05	Below SGC

• g/m^3 = Micrograms per cubic meter.

$PM_{2.5}$ = Particulate matter with an aerodynamic diameter less than or equal to 2.5 microns.

PM_{10} = Particulate matter with an aerodynamic diameter less than or equal to 10 microns.

[a] Lead was not modeled because insignificant levels would be emitted.

[b] Significant concentrations for ammonia were taken from New York State Department of Environmental Conservation Department's Air Guide (DAR-1) guidance, Short-term Guideline Concentrations (SGC)/ Annual Guidelines Concentrations (AGC) table. The 1-hour maximum impact was compared to SGC, and the annual maximum impact was compared to AGC.

For pollutants with shorter-term averaging periods (from 1- to 24-hour), model runs were conducted using the greatest potential hourly emission rate. The maximum emission rate used as a model input was developed through an examination of the equipment emissions under normal operations and was based on a peak sendout rate of 1.25 bcfd, as proposed for the Project. Startup and shutdown conditions also were incorporated into these emission rates.

For pollutants where annual averaging periods were used, modeling runs were conducted using the highest permissible hourly emission rate that would occur during typical delivery of natural gas into the Project's pipeline, up to an annual maximum limit of 7.7 million metric tons. In this case, the modeled hourly emission rate was calculated by dividing annual emissions by 8,760 hours per year. Startup and shutdown conditions were incorporated into these emission rates.

NO_x emissions from these sources would be in the form of nitric oxide (NO) and NO_2. Following release to the atmosphere, a significant portion of NO is oxidized to NO_2. Because NSR significance levels (as well as NAAQS) are expressed in terms of NO_2, the model result expressed in terms of NO_x must be converted to an NO_2 value. For the purposes of this modeling analysis, complete conversion of NO_x to NO_2 was assumed.

Building and nearby structure data were included as inputs to the AERMOD-PRIME model to account for potential building wake effects (downwash) on emissions.

Meteorological Data

The OCD model requires meteorological data from the surface and upper air collected from representative measurement sites over land and over water. The over-land meteorological station that provided surface data was Islip MacArthur Airport, New York, and the upper air over-land data were obtained from Upton (Brookhaven), New York. The central Long Island Sound data buoy (Buoy 44039) is the closest monitoring location available to the proposed FSRU location and provided the over-water surface data. Another remote buoy called the Western Long Island Sound Station (Buoy 44040) is located approximately 35 miles southwest of the FSRU. Data were obtained from this buoy for the period during which the central Long Island Sound data buoy was taken out of the water for repair and maintenance. No over-water stations collect upper air data along the immediate coastline of Long Island Sound or within the Sound itself. The closest site collecting upper air data is Upton (Brookhaven), New York, which is approximately 15 miles south of the proposed FSRU location and is also the station that provided the over-land upper air data. The Brookhaven station is located approximately midway between the north and south coast of Long Island, which is approximately 15 miles wide at this point. Although the land surface would influence the very near surface conditions differently than over water, the long fetch over the ocean to the south of Brookhaven – and the approximately 20-mile fetch over Long Island Sound to the north of Brookhaven – is expected to impart a strong maritime signature on the low-altitude atmospheric conditions.

The data used in the modeling study were from calendar years 2003, 2004, and 2005 (through December 8). The central Long Island Sound buoy did not operate before 2003.

Data missing from the central Long Island Sound buoy data set were filled in using established EPA procedures for short-duration missing periods, as well as procedures described in the OCD model User's Guide (MMS 1997). Data missing for longer periods were filled in using data from the Western Sound station for air and water temperatures, and relative humidity. Wind direction and speed data were obtained from the Bridgeport, Sikorsky Memorial Airport (located on the north coast of Long Island Sound).

Results

The OCD and AERMOD-Prime models were used to estimate ambient air quality impacts to receptors within 500-meter (1,640-foot) radius of YMS, and in the near-water area beyond this assumed safety and security zone. The receptor locations and densities were designed to thoroughly cover the Project study area in order to determine the maximum ambient air concentrations (annual and short-term periods) for each regulated pollutant, and for each pollutant's appropriate averaging time. Predicted concentrations at all other receptor locations would be less than these maximum values, which are shown in Table 3.9.1-14.

For pollutants with short-term averaging periods, the modeled air quality concentrations were based on the maximum operation of FSRU-proposed turbines, process heaters, and auxiliary equipment. Annual impacts were based on emissions generated during (1) continuous operation of FSRU turbines and process heaters, operating at the full load required to deliver natural gas into the Project pipeline annually; and (2) operation of emergency fire pumps and emergency generators for 100 hours per year.

Ambient impacts were compared with SILs defined in the NSR regulations. The OCD results and the comparison are presented in Table 3.9.1-14.

As shown in Table 3.9.1-14, all predicted maximum concentrations (the highest concentration found throughout the entire receptor grid) are below the significance levels applicable to Class II areas.

Therefore, the Project is expected to result in minimal air quality impacts and does not require further analysis based on the current modeling parameters and results.

Building Downwash Wake Effects and Cavity Analysis – AERMOD-PRIME

The purpose of this modeling was to determine concentrations in air near the FSRU due to downwash of stack emissions caused by the aerodynamic disruption of the FSRU and LNG carrier structures. If concentration estimates produced by AERMOD-PRIME were greater than the maximum concentrations produced by the OCD model, they would be compared to SILs for criteria pollutants with averaging periods of 24 hours or less, or against the NYSDEC Department's Air Guide (DAR-1) (SGC for ammonia). The AERMOD-PRIME results and the comparison are presented in Table 3.9.1-15.

TABLE 3.9.1-15
AERMOD-PRIME Model Results

Pollutant	Averaging Period	Significant Impact Concentration (μg/m³)	AERMOD-PRIME Maximum Predicted (μg/m³)	Exceeds Significant Concentration Level?	NAAQS (μg/m³)	AERMOD-PRIME Maximum Including Background[a]	Exceeds NAAQS?
Carbon monoxide	8-Hour	500	517	Yes	10,000	3,831	No
	1-Hour	2,000	971	No	40,000	-	No
Nitrogen dioxide	Annual	1	2.02	Yes	100	24.7	No
Sulfur dioxide	Annual	1	0.1	No	80	-	-
	24-Hour	25	1.5	No	365	-	-
	3-Hour	5	2.2	No	1,300	-	-
$PM_{2.5}$	Annual	1	1.32	Yes	15	12.5	No
	24-Hour	5	22	Yes	65	59	No
PM_{10}	Annual	1	1.32	Yes	50	16.3	No
	24-Hour	5	17.8	Yes	150	63.5	No
Ammonia	Annual	100[b]	1.5	Below AGC	-	-	-
	1-hour	2,400[b]	32.6	Below SGC	-	-	-

• g/m³ = Micrograms per cubic meter.

$PM_{2.5}$ = Particulate matter with an aerodynamic diameter less than or equal to 2.5 microns.

PM_{10} = Particulate matter with an aerodynamic diameter less than or equal to 10 microns.

a Background concentrations are shown in Table 3-8 of the Modeling Protocol, Appendix C.

b Significant concentrations for ammonia were taken from New York State Department of Environmental Conservation Department's Air Guide (DAR-1) guidance, Short-term Guideline Concentrations (SGC)/ Annual Guidelines Concentrations (AGC) table. The 1-hour maximum impact was compared to SGC, and the annual maximum impact was compared to AGC.

As presented in the table, estimated maximum concentrations of CO (8-hour), NO_2, PM_{10} (annual and 24-hour), and $PM_{2.5}$ (annual and 24-hour) exceed the applicable SIL at points located on the 500-meter (1,640 feet) radius around the FSRU. For pollutant and averaging period combinations for which an SIL is exceeded, it is required to add the background ambient air concentrations (for the New York stations listed in Tables 3.9.1-1 through 3.9.1-6) must be added to the maximum concentration and compared to the NAAQS. No NAAQS are exceeded.

Based on the modeling results described in the table, ambient air quality impacts from stationary operations are predicted to be below NAAQS. The FSRU would operate under a stationary source permit granted by NYSDEC. This state permit would require enforceable record keeping and reporting requirements used to demonstrate compliance with applicable permit conditions and to support a Title V exemption.

3.9.2 Noise

Sound is mechanical energy transmitted by pressure waves in a compressible medium such as air. Noise is unwanted sound. Sound is characterized by various parameters that describe the rate of oscillation of sound waves, the distance between successive troughs or crests, the speed of propagation, and the pressure level or energy content of a given sound. In particular, the sound pressure level has become the most common descriptor used to characterize the loudness of an ambient sound level. The noise level perceived by a receptor depends on the following parameters:

- The distance between the noise source and the receptor;
- The presence or absence of absorptive noise barriers;
- The amount of mitigative noise features between the receptor and noise source, including intervening terrain, structures, foliage, and ground cover;
- Cumulative noise impacts from reflective surfaces such as building facades, concrete and asphalt, and waterbodies; and
- Current weather conditions (snow, wind, and rain) and weather-related ground cover (snow, mud, and wet or dry ground).

Noise level (or volume) is generally measured in decibels using the A-weighted sound pressure level (dBA). The A-weighting scale is an adjustment to the actual sound power levels to be consistent with that of human hearing response, which is most sensitive to frequencies around 4,000 Hertz (about the highest note on a piano) and less sensitive to low frequencies (below 100 Hertz). In addition to the instantaneous measurement of sound levels, the duration of sound is important because sounds that occur over a long period are more likely to be a nuisance or cause direct physical damage or environmental stress. One of the most frequently used noise metrics that considers duration as well as sound power level is the equivalent noise level (Leq). The Leq is defined as the steady A-weighted level that is equivalent to the same amount of energy as that contained in the actual time-varying levels over a period of time. Typically, Leq is summed over a 1-hour period.

The sound pressure level is measured on a logarithmic scale, with the zero dB level based on the lowest detectable sound pressure level that people can perceive (an audible sound that is not zero sound pressure level). Decibels cannot be added arithmetically, but rather are added on a logarithmic basis. A doubling of sound energy is equivalent to an increase of 3 dB and a sound that is 10 dB less than another does not increase the overall sound level. Because of the nature of the human ear, a sound must be about 10 dB greater than the reference sound to be judged as twice as loud. In general, a 3-dB change in community noise levels is noticeable, while 1- to 2-dB changes generally are not perceived.

Human activities cause community noise levels to be widely variable over time. The time period in which noise occurs is important because noise that occurs at night tends to be more disturbing than that which occurs during the daytime. The noise equivalent level recognizes this characteristic by weighting the hourly Leq over a 24-hour period ($Leq_{[24]}$). The weighting involves the addition of 5 dB in the evening hours (7 p.m. to 10 p.m.) and 10 dB to noise occurring at night (10 p.m. to 7 a.m.) to account for the greater amount of disturbance associated with noise during these periods. Federal agencies use both the $Leq_{(24)}$ and the day-night equivalent sound level (L_{dn}) to relate the time-varying quality of environmental noise to its known effect on people. The L_{dn} is calculated by adding 10 dBA to the nighttime sound levels between the hours of 10 p.m. and 7 a.m., to account for the greater sensitivity of people to sound during the nighttime hours.

Community noise levels depend on the intensity of nearby human activity. Noise levels are generally considered low when ambient levels are below 45 dBA, moderate in the 45- to 60-dBA range, and high above 60 dBA. In rural and undeveloped areas, the ambient noise levels can be below 35 dBA. Levels above 75 dBA are more common near major freeways and airports. Typical noise levels associated with pyrotechnical displays average 153 decibels at approximately 3 feet from the source (League) for the Hard of Hearing 2006). Although people often accept the higher levels associated with very noisy urban areas, they nevertheless are considered to be adverse to public health.

Noise would be generated during installation of the proposed FSRU, YMS, and pipeline, and during operation of the FSRU. At any location, both the magnitude and frequency of environmental noise could vary considerably over the course of the day and throughout the week. This variation is caused in part by changing weather conditions and the effects of obstructions and absorbers. Potential noise impacts to marine resources are discussed in Sections 3.3 and 3.4.1.

3.9.2.1 Existing Environment

The proposed facility would be located approximately 9 miles from the New York shore and 11 miles from the Connecticut shore. The ambient sound level of a region is defined by the total noise generated, including sounds from both natural and artificial sources. Typically, ambient airborne noise levels over ocean areas are in the range of 46 to 51 dBA (COE 2004). The magnitude and frequency of environmental noise may vary considerably over the course of the day and throughout the week, due in part to changing weather conditions affecting wind and wave activity. Other contributors to short-term noise levels in the Project area include commercial shipping traffic, planes, and helicopters.

Noise Regulations

EPA (1974) evaluated the effects of environmental noise with respect to health and safety. The document provides information for state and local governments to use in developing ambient noise standards. EPA has determined that to protect the public from interference with activities and nuisance conditions outdoors in residential areas, noise levels should not exceed an L_{dn} of 55 dB. An L_{dn} of 55 dB is equivalent to a continuous noise level of 48.6 dB for facilities that operate at a constant level of noise. FERC has adopted this criterion for new compression and associated facilities, and it is used here to assess the potential noise impact from construction and operation of the LNG terminal.

No promulgated state-wide noise regulations are applicable within New York. However, NYSDEC has issued a noise guidance document that is used as part of a State Environmental Quality Review Act (SEQRA) process to evaluate potential noise impacts from projects (NYSDEC 2001b). The guidance serves to identify at what point noise levels may cause a significant environmental impact and provides methods for noise impact assessment, avoidance, and reduction measures. Under this policy, sound pressure increases of greater than 6 dBA over baseline conditions could require a more detailed analysis of noise impact potential, depending on existing sound pressure levels and the character of the surrounding land use or receptors. Appropriate human receptor locations may be either at the parcel's property line or at the location of use or inhabitance on an adjacent property.

Existing Noise Levels

As stated earlier, the ambient sound level of a region is defined by the total noise generated, including sounds from both natural and artificial sources. Typically, ambient airborne noise levels over ocean areas are in the range of 46 to 51 dBA (COE 2004).

3.9.2.2 Potential Impacts and Mitigation

Construction

Construction equipment used to install the FSRU and associated pipeline would include typical offshore vessels, such as crane barges, tugs, supply vessels, ROVs, and surveying equipment. In addition, commercial, fishing, and recreational vessels could frequent the construction area; and the crews of these vessels could encounter construction vessels or be passed by a supply vessel. Boaters on motorized vessels would not be particularly susceptible to additional noise because engine noise from their own vessels would dominate, but recreational boaters in non-motorized vessels such as sailboats could be affected by the increased noise associated with construction. In either case, recreational boaters could easily avoid and would tend to avoid the larger ships in the construction area, and all boaters would be transient. This impact is not considered significant as the increased noise levels would be temporary and highly localized based on the nature of the construction (taking place during fall and winter months for two seasons). Construction workers would be subject to increased noise levels; however, appropriate safety equipment such as ear protection would be used when operating machinery and equipment capable of producing elevated noise levels. Typical noise levels generated by construction equipment are presented in Table 3.9.2-1.

Construction equipment would be operated only when needed, with minimum idling, and would be maintained in accordance with the manufacturers' specifications to reduce or minimize noise impacts. Construction-related noise during pipeline installation would result in a minor and temporary adverse impact on sound levels in the vicinity of the construction activities; due to the distance from the nearest land (9 miles from Long Island), noise would not affect human receptors onshore. Also, recreational boating is at a minimum during the winter months, when construction activities would occur.

During YMS installation, conventional pile-driving would be conducted to install the four legs of the tower. Because only one leg would be installed at a time and each leg would take approximately 1 week to install, noise associated with this phase would occur for 4 weeks over a period of 2 months for no more than 12 hours per day (not to take place at night). A typical uncontrolled impact-type pile-driver produces a peak impact level of about 101 dBA at 50 feet above the water surface (EPA 1971). Because the Project would not be located near noise-sensitive areas, sensitive receptors would not be affected by pile-driving activities (noise from pile-driving activities are not expected to be perceptible onshore). However, recreational boaters in sailboats or other non-motorized vessels could be affected by the noise from pile-driving. Due to the rhythmic low-frequency characteristics of pile-driver noise, there is heightened potential to create a nuisance condition during the pile-driving period. As mentioned previously, relatively few recreational boaters are in the middle of Long Island Sound in fall and winter, when the construction activities would occur, and all boaters would be transient. This impact is not considered significant, as the increased noise levels would be minor and temporary, based on the location and timing of the construction (taking place during the fall and winter months for two seasons). Construction workers would be subject to increased noise levels; however, appropriate safety equipment such as ear protection would be used when operating machinery and equipment capable of elevated noise levels. See Section 3.3.4 for a detailed discussion of potential impacts of underwater noise to marine life, including potential impacts from pile-driving.

Table 3.9.2-1 Typical Ranges of Construction Equipment Noise Levels[a]	
Equipment	**Noise Levels (dBA at 49 feet)**
Mobile Equipment	
Front loader	75–80
Backhoe	75–85
Bulldozer, tractors	75–85
Scraper	80–90
Grader	75–85
Truck	75–90
Paver	80–90
Materials Handling Equipment	
Concrete mixer	75–85
Concrete pump	75–80
Crane	75–85
Derrick	75–90
Stationary Equipment	
Pumps	70–75
Generators	75–80
Compressors	75–80
Saws	75–80
Impact Equipment	
Pile-drivers	95–100
Jackhammers	75–90
Rock drills	80–100
Pneumatic tools	80–85

[a] Source: EPA 1971.

Due to the distance between onshore communities and the YMS location, sensitive onshore receptors such as schools, churches, and hospitals would not be affected by Project-related noise.

Operation

Several components of the FSRU would generate noise, including generation equipment, pumps, compressors, and other rotating equipment. Much of the equipment on the FSRU would be located below deck, and enclosures would be used on certain equipment to further reduce noise emissions. Sound pressure levels at a distance of 3.3 feet are listed in Table 3.9.2-2 for the major noise-producing equipment installed onboard the FSRU during operation.

Although a helicopter deck would be located on the stern of the FSRU, helicopters would be used only in the event of emergencies. Therefore, a noise impact analysis for helicopters is not included in this EIS.

Noise Modeling and Noise Analysis

Atmospheric noise modeling was conducted to reflect the reduction of sound levels over distance. The modeling was conducted using the following commonly used equation for noise reduction over distance:

$$L_2 = L_1 - 20\log\left(\frac{d_2}{d_1}\right)$$

Where d_1 is starting distance, d_2 is ending distance, L_1 is noise level at distance d_1, and L_2 is noise level at distance d_2. Table 3.9.2-3 presents the projected noise levels at various distances from the FSRU.

TABLE 3.9.2-2
Summary of Noise Sources Associated with the FSRU Equipment[a]

Noise Source	Location	Initial SPL[b] (dBA)	TL (dB)	Reduced SPL (dBA)	All Units Combined (dBA)
Shell-and-tube vaporizers (three)	Below deck	85	10	75	80
Boil-off gas compressors (three), housed	Above deck	95	20	75	80
High-pressure LNG pumps (eight)	Above deck	94	10	84	93
Ballast water pumps (four)	Below deck	87	30	57	62
Cooling water circulation pumps (four)	Below deck	78	30	48	54
Nitrogen system air compressors (two)	Above deck	110	-	110	113
20-MW gas turbines (two) air intake/exhaust	Above deck	95	-	95	98
LNG transport vessel (one)	-	90	-	90	90
Combined sound pressure level					**113**

dBA = Decibels, A scale.
SPL = Sound pressure level.
TL = Transmission loss through deck or enclosure.
[a] Source: Coast Guard 2004.
[b] At a distance of 3.3 feet.

Combined sound pressure levels associated with operation of the FSRU would be in the range of typical ambient noise levels (46 to 51 dBA) at approximately 0.9 mile (1,500 meters), and noise associated with operations would typically not be noticeable from this distance or greater distances from the FSRU. However, based on the equipment noise levels presented in Table 3.9.2-3, the operating noise may become noticeable (that is, it may produce a 3-dBA increase above background noise levels) at distances of less than 0.9 mile. At the boundary of the safety and security zone (0.7 mile from the FSRU) established by the Coast Guard, the combined noise level would be less than 53 dBA, which is less than the noise level that would interfere with normal conversation.

TABLE 3.9.2-3 Projected Sound Levels at Various Distances from the FSRU					
	Sound Pressure Level (dBA)				
Noise Source	1 Meter	250 Meters	500 Meters	1,000 Meters	1,500 Meters
Shell-and-tube vaporizers (three)	80	32	26	20	16
Boil-off gas compressors (three), housed	80	32	26	20	16
Submersible LNG high-pressure pumps (eight)	93	45	39	33	30
Ballast water pumps (four)	60	12	6	0	0
Cooling water circulation pumps (four)	54	6	0	0	0
Nitrogen system air compressors (two)	113	65	59	53	49
20-MW gas turbines (two) air intake/exhaust	98	50	44	38	34
LNG transport vessel (one)	90	42	36	30	26
Combined sound pressure level	**113**	**65**	**59**	**53**	**50**

Foghorns installed on each end of the FSRU would produce warning signals at 146 dBA (100 hertz) at 3.3 feet, as required by Coast Guard regulation 33 CFR 67.10 for the foghorn to be audible at 2 miles. In addition, the foghorn must sound a 2-second blast every 20 seconds when visibility is less than 2 miles. Because the additional noise generated by the foghorn would be barely perceptible onshore (3 dBA) above typical background onshore noise or existing foghorns around the Sound, it would not result in a significant impact to onshore noise receptors. An additional standby foghorn would be installed on each end of the FSRU that would be audible at 0.5 mile from the FSRU and therefore would not be audible from shore. The Project-related foghorns are not expected to result in a substantial impact to recreational boaters because the purpose of the foghorns would be to assist boaters, and they would become part of the existing maritime environment, blending in with foghorns from other vessels.

Vessels

The noise associated with LNG carriers under transit would be comparable to other large ships; therefore, the contribution of LNG carriers to existing shipping noise would not be significant. LNG carriers underway are designed to operate at decibel levels specified to be 90 dBA or less at 3.3 feet above the deck. LNG carriers moored at the proposed FSRU would emit similar noise levels during off-loading operations. Noise levels from the berthed LNG carriers would be less than 30 dBA at the edge of the safety and security zone, a level that would not interfere with normal conversation. There would be no perceptible noise from the berthed LNG carriers to onshore receptors. Delivery of crews and materials during construction and operation would follow typical vessel routes that avoid sensitive receptors, and the number of trips to deliver crews to the site would be limited by maximizing the full capacity of shuttles to the extent possible. In addition, shuttle vessels during operations would be operated during daytime hours in order to limit adverse impacts near shore.

3.10 RELIABILITY AND SAFETY

Operation of the proposed Broadwater Project poses a potential hazard that could affect the public safety unless strict design and operational measures are implemented to control potential accidents. The primary concerns are those events that could lead to an LNG spill of sufficient magnitude to create an offsite hazard including events occurring during the course of, but not limited to, LNG carrier transits. However, it is also important to recognize the stringent requirements for the design, construction, operation, and maintenance of the facility, as well as the extensive safety systems that would be in place to detect and control potential hazards.

With the exception of the October 20, 1944 fire at the LNG facility in Cleveland, Ohio, the operating history of U.S. LNG facilities has been free of LNG safety-related incidents resulting in adverse effects to the public or the environment. The 1944 Cleveland incident was attributed to the use of materials inadequately suited for cryogenic temperatures and the lack of spill impoundments at the site.[6] More recently, an operational accident occurred in 1979 at the Cove Point LNG facility in Lusby, Maryland, when a pump seal failed, resulting in gas vapors entering an electrical conduit and settling in a confined space. When a worker switched off a circuit breaker, the gas ignited, resulting in heavy damage to the building and a worker fatality. Lessons learned from this accident resulted in changing the national fire codes, with the participation of the FERC, to ensure that the situation would not occur again.

On January 19, 2004, a blast occurred at Sonatrach's Skikda, Algeria LNG liquefaction facility that killed 27 and injured 56 workers. No members of the public were injured. Preliminary findings of the accident investigation suggest that a cold hydrocarbon leak occurred at Liquefaction Train 40 and was introduced to the high-pressure steam boiler by the combustion air fan. An explosion developed inside the boiler firebox which subsequently triggered a larger explosion of the hydrocarbon vapors in the immediate vicinity. The resulting fire damaged the adjacent liquefaction process and liquid petroleum gas (LPG) separation equipment of Train 40, and spread to Trains 20 and 30. Although Trains 10, 20, and 30 had been modernized in 1998–1999, Train 40 had been operating with its original equipment since start-up in 1981.

Although there are major differences between the equipment involved in the accident at Skikda and that proposed by Broadwater (that is high-pressure steam boilers that power refrigerant compressors would not be used here nor are they used at any LNG facility under FERC jurisdiction), the sequence of cascading events identifies potential failure modes that warrant further evaluation. To ensure that all potential hazards are addressed, we have provided a recommendation in Section 3.10.2.2 to address this issue.

A discussion of the principal properties and hazards associated with LNG is presented in Section 3.10.1. A summary of our preliminary design and technical review of the cryogenic aspects of the LNG terminal is presented in Section 3.10.2. An analysis of the thermal radiation and flammable vapor cloud hazards resulting from an LNG spill is presented in Section 3.10.3. The safety aspects of LNG transportation by ship is discussed and summarized in Section 3.10.4. Environmental impacts associated with Coast Guard actions are discussed in Section 3.10.5. Emergency response and evacuation planning is discussed in Section 3.10.6. Our conclusions regarding marine safety are presented in Section 3.10.7. A discussion on security awareness related to terrorism is presented in Section 3.10.8, and a discussion on pipeline reliability and safety is provided in Section 3.10.9

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[6] For a description of the incident and the findings of the investigation, see U.S. Bureau of Mines, *Report on the Investigation of the Fire at the Liquefaction, Storage, and Regasification Plant of the East Ohio Gas Co., Cleveland, Ohio, October 20, 1944*, February 1946.

3.10.1 LNG Hazards

LNG's principal hazards result from its cryogenic temperature (-260°F), flammability, and vapor dispersion characteristics. As a liquid, LNG will neither burn nor explode. Although it can cause freeze burns and, depending on the length of exposure, more serious injury, its extremely cold state does not present a significant hazard to the public, which rarely, if ever, comes in contact with LNG. As a cryogenic liquid, LNG will quickly cool materials it contacts, causing extreme thermal stress in materials not specifically designed for ultra-cold conditions. Such thermal stresses could subsequently subject the material to brittleness, fracture, or other loss of tensile strength. These hazards, however, are not substantially different from the hazards associated with the storage and transportation of liquid oxygen (-296°F) or several other cryogenic gases that have been routinely produced and transported in the United States.

Methane, the primary component of LNG, is colorless, odorless, and tasteless, and is classified as a simple asphyxiant. Methane could, however, cause extreme health hazards, including death, if inhaled in significant quantities within a limited time. At very cold temperatures, methane vapors could cause freeze burns. Asphyxiation, like freezing, normally represents a negligible risk to the public from LNG facilities.

When released from its containment vessel and/or transfer system, LNG will first produce a vapor or gas. This vapor, if ignited, represents the primary hazard to the public. LNG vaporizes rapidly when exposed to ambient heat sources such as water or soil, producing 620 to 630 standard cubic feet of natural gas for each cubic foot of liquid. LNG vapors in a 5- to 15-percent mixture with air are highly flammable. The amount of flammable vapor produced per unit of time depends on factors such as wind conditions, the amount of LNG spilled, and whether it is spilled on water or land.

Once a flammable vapor-air mixture from an LNG spill has been ignited, the flame front will propagate back to the spill site if the vapor concentration along this path is sufficiently high to support the combustion process. An unconfined methane-air mixture will burn slowly, tending to ignite combustible materials within the vapor cloud. LNG is not explosive as it is normally transported and stored. However, LNG vapors (primarily methane) can explode if contained within a confined space, such as a building or structure, and ignited. There is no evidence, however, suggesting that LNG is explosive in unconfined open areas. Experiments conducted to date to determine if unconfined methane-air mixtures will explode have all been negative.

Over the years, various parties have occasionally expressed the energy content of an LNG storage tank or LNG carrier in equivalent tons of trinitrotoluene (TNT), as an implied measure of its explosive potential. However, such a simplistic analogy fails to consider that explosive forces are not just a function of the total energy content but also of the rate of energy release. For an explosion to occur, the rate of energy release must be nearly instantaneous, such as with a TNT charge initiated by a blasting cap. Unlike TNT or other explosives that inherently contain an oxidizer, an unconfined vapor cloud must be mixed with oxygen within the flammability range of the fuel for combustion to occur. For a large unconfined vapor cloud, the flammability range tends to exist at the mixing zone at the edges of the cloud. When ignited, flame speeds of about 66 to 82 feet per second (20 to 25 meters per second) and local over pressures up to 0.2 psig have been estimated for methane-rich fuels, which is well below the flame speeds and over pressures associated with explosion.

A rapid phase transition (RPT) can occur when a portion of LNG spilled onto water changes from liquid to gas virtually instantaneously. Unlike an explosion that releases energy and combustion products from a chemical reaction as described above, an RPT is the result of heat transferred to the liquid inducing a change to the vapor state. The rapid expansion from the liquid to vapor state can cause locally large over pressures. RPTs have been observed during LNG test spills onto water. In some test cases, the over pressures generated were strong enough to damage test equipment in the immediate vicinity of the LNG release point. The sizes of the over pressure events have been generally small and are estimated to be equivalent to several pounds of TNT. Such a small over pressure would not be expected to cause significant damage to an LNG carrier or the FSRU. However, an RPT may increase the rate of LNG pool spreading and the LNG vaporization rate.

3.10.2 Cryogenic Design and Technical Review

Three federal agencies share in the oversight of the safety and security of LNG import terminals: the FERC, the Coast Guard, and the DOT. The FERC authorizes the siting and construction of LNG import terminals and is the lead federal agency under NEPA for the analysis of the environmental, safety, security, and cryogenic design of proposed facilities. The Coast Guard has authority over the safety of LNG carriers and the marine transfer area. The Coast Guard also has authority over security of LNG carriers and the entire LNG facility. In conjunction with this, the Coast Guard determines the suitability of waterways for LNG marine traffic by issuing a Letter of Recommendation (see Section 3.10.4.5 for further discussion). The DOT has exclusive authority to promulgate and enforce safety regulations and standards over onshore LNG facilities beginning at the last valve immediately before the LNG storage tank(s).

In February 2004, the three participating agencies entered into an Interagency Agreement to ensure that they work in a coordinated manner to address the full range of issues regarding safety and security at LNG import terminals, including the terminal facilities and tanker operations, and to maximize the exchange of information related to the safety and security aspects of the LNG facilities and related marine operations. The FERC closely coordinates its pre-Certificate review of the proposal with the Coast Guard and the DOT to ensure a seamless safety and security review by the three federal agencies.

The proposed FSRU is an offshore structure and would be regulated as a facility. For the purposes of the cryogenic design and technical review, the FSRU is essentially characterized as an LNG carrier with vaporization equipment onboard that would be moored using a YMS at a fixed location in state waters. In accordance with Section 193.2001(b)(4), the facility would not be under the authority of the DOT as it is located in navigable waters. However, FERC and Coast Guard staff are evaluating the proposed facility on multiple equivalent design standards, including appropriate portions of 49 CFR 193 and NFPA 59A.

The proposed facility would incorporate design and engineering components of an LNG import facility and an offshore marine facility, as well as features similar to an LNG carrier. FERC staff have expertise in the review of some of these areas, while Coast Guard staff have expertise in others. In August 2005, FERC sent a letter to the Coast Guard requesting assistance in the analysis of the Broadwater Project. As stated in that letter, FERC would be the lead agency in conducting a cryogenic design review of the proposed facilities. The Coast Guard would review matters relating to the FSRU engineering and safety standards, as well as navigation safety and waterway suitability assessment for the carriers transporting LNG. Specifically, FERC staff would analyze the front-end engineering design for the LNG pumps and vaporization systems, process piping systems and vessels, process instrumentation and controls, process electrical systems, and other equipment normally reviewed for an onshore terminal. The Coast Guard staff would be responsible for assessing the design basis for the FSRU (including evaluating the standards and codes), oversight of the structural design review, and oversight of the mooring system design assessments by any contracted third-party reviewers. Both FERC and Coast Guard staff would jointly review items such as the general arrangement and equipment layout, storage tank design and construction, pressure relief and venting systems, emergency shutdown systems, spill containment systems, and hazard detection and control systems.

3.10.2.1 Codes and Standards Review

The design, construction, and operation of LNG carriers are covered by the "The International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk" commonly known as the IGC Code. In general, both the U.S. regulations under 46 CFR 154 and International Classification Society Gas Ship Rules use the IGC Code as a baseline. The design and construction of Broadwater's proposed FSRU would be similar to an LNG carrier, making the IGC code a reasonable standard. However, other standard LNG facility codes and regulations such as 49 CFR 193 and NFPA 59A also remain relevant in parts. Like an LNG carrier, detailed design and construction of the proposed FSRU would take place in a shipyard; consequently, it is anticipated that the shipyard would use codes and standards aligned with its suppliers and construction methods. The selection of possibly overlapping and conflicting standards requires a well-defined approach to selecting the particular codes to which the FSRU would be designed and constructed.

Throughout the application review process, FERC and Coast Guard staff requested that Broadwater clearly specify the process it would use to refine the general list of rules and codes into specific standards to be used in the design of the various FSRU systems and components. This process is needed to clearly describe the method for determining applicability and relative stringency for each particular standard when multiple standards are identified. In addition, the method for comparison and adoption of standards would need to be documented and approved by FERC and the Coast Guard.

In a filing dated August 31, 2006, Broadwater delineated a specific process by which it would propose the codes and standards to be applied to the Project. The proposed process would require final approval of the codes and standards by FERC and the Coast Guard and is largely reliant on the procedures established by the Coast Guard for the review of deepwater ports.

The Coast Guard developed Navigation and Inspection Circular (NVIC) 03-05 *Guidance for Oversight of Post-Licensing Activities Associated with Development of Deepwater Ports* in order to provide guidance related to design, plan review, fabrication, installation, inspection, maintenance, and oversight of deepwater ports. NVIC 03-05 lays out a framework for the use of independent, third-party oversight to assist in ensuring regulatory compliance: "Given the resources and levels of expertise needed to address the dynamic range of designs for Deepwater Ports, the Coast Guard is using a new approach for the review, approval and inspection of these projects, but one that is similar to existing Coast Guard programs. The Coast Guard, along with other federal agencies, recognizes the value in utilizing third-parties to assist in fulfilling its regulatory obligations."

Since the proposed FSRU would be considered a deepwater port if it were sited in federal waters, the Coast Guard recommended employing the Certifying Entity (CE) framework provided in NVIC 03-05 for review of the Broadwater Project. Following this model, Broadwater formally nominated the American Bureau of Shipping (ABS) to fulfill the role of a CE, as described in NVIC 03-05. Subsequently, the Coast Guard recommended that FERC accept the nomination of ABS as the CE contingent on the satisfactory outcome of a pre-acceptance meeting between ABS, FERC, and the Coast Guard.

As described in NVIC 03-05, the CE would provide an initial presentation outlining details of its plans for handling the project, as well as interacting with the FERC and the Coast Guard, at the pre-acceptance meeting. The initial meeting, held on October 4, 2006, with ABS, FERC, and Coast Guard staff, concentrated on identifying the various phases of the Project (that is design, fabrication, installation, and testing), designating points of contact, and discussing Project-specific details. Although ABS is developing a Project management plan to cover the various phases of the Project life cycle, this plan has not been completed. Therefore, **we recommend that:**

•• **Broadwater should engage a qualified CE for an independent review of the codes and standards development, detailed design, fabrication, installation, and operation of the proposed FSRU for the life of the facility. Prior to final approval of a CE, a detailed project management plan should be filed with the Secretary for the review and written approval of the Director of OEP. At a minimum, this plan should be in accordance with the Coast Guard Navigation and Inspection Circular 03-05 *Guidance for Oversight of Post-Licensing Activities Associated with Development of Deepwater Ports.***

Once completed, this plan would address ABS's procedures for reviewing and approving the appropriate codes and standards, the detailed design basis that would be used for the project, and the procedures for construction inspections of the FSRU. In addition, this plan would include provisions for ABS to provide its recommendations to FERC and the Coast Guard regarding the proposed standards or design. This process is consistent with Broadwater's proposal on the selection of standards, as described in its filing dated August 31, 2006.

In its application, Broadwater indicates that it would engage a classification society to ensure compliance with all codes and standards during the design and construction of the facility. Futhermore, Broadwater also has indicated that it would select ABS as the classification society for the proposed project. However, Broadwater states that class may not be maintained throughout the operational life of the facility. Rather, a third-party regime, approved by the FERC and the Coast Guard, would be proposed to ensure compliance with the design basis and applicable standards, including in-service structural surveys of the FSRU and YMS, over the life of the facility. However, the third-party regime would not specifically require use of a classification society, which FERC and Coast Guard staff believe would be the most appropriate method for ensuring safety of the facility. Therefore, **we recommend that**:

•• **Broadwater should maintain classification for the life of the proposed facility, using a member of the International Association of Classification Societies. Use of an alternate classification society other than ABS must be reviewed and approved by the Director of OEP.**

3.10.2.2 Front-End-Engineering Design Review

As part of its application and in response to FERC staff's data requests, Broadwater provided a preliminary front-end-engineering design (FEED) for the FSRU and the YMS. The FEED and technical review emphasize the engineering design and safety concepts, as well as the projected operational reliability of the proposed storage and process facilities. The principle areas of coverage include materials in cryogenic environments, insulation systems, cryogenic safety, thermodynamics, heat transfer, instrumentation, cryogenic processes, and other relevant safety systems.

Study and evaluation of information for the proposed design and installation of the storage, process equipment, and YMS for the Broadwater Project has been performed by FERC and Coast Guard staff. The FEED and specifications submitted for the proposed facility to date are considered preliminary but would be the basis for any detailed design to follow. A significant amount of the design involving final selection of equipment manufacturers, process conditions, and resolution of some safety-related issues would be completed in the next phase of Project development, if authorization is granted by the Commission. After review and approval by the CE, this information would be submitted for FERC and Coast Guard staff review and approval as well.

As a result of the technical review of the information provided by Broadwater in the submittal documents, a number of concerns were identified by staff relating to the reliability, operability, and safety of the proposed design. In response to staff's questions, Broadwater provided written responses prior to the technical conference held on June 7 to 8, 2006, and in subsequent submittals dated June 20, 2006, and August 31, 2006, with revised FEED information. After review of that information, FERC staff note several areas of concern that require additional consideration and/or action on behalf of Broadwater. Follow up on those items requiring additional action should be documented in reports to be filed with FERC. As a result, **we recommend that:**

The following measures should apply to the LNG terminal design and construction details. Information pertaining to these specific recommendations should be filed with the Secretary, for review and approval by the Director of OEP either: prior to keel laying or any other Project-related construction activity; prior to construction of final design; prior to commissioning; or prior to commencement of service as indicated by each specific condition. Items relating to Resource Report 13 *Engineering and Design Material* and security should be submitted as critical energy infrastructure information (CEII) pursuant to 18 CFR Parts 388.12 and PL01-1. Information pertaining to items such as: offsite emergency response; procedures for public notification and evacuation; and construction and operating reporting requirements would be subject to public disclosure. Broadwater should file this information a minimum of 30 days before approval to proceed is required.

- **The piping and instrumentation diagrams (P&IDs) and design information for the FSRU process, utility, and safety systems as reviewed by the CE should be filed prior to keel laying or any other Project-related construction activity.**
- **Complete plan drawings and a list of the hazard detection equipment should be filed prior to keel laying or any other Project-related construction activity. The list should include the instrument tag number, type and location, alarm locations, and shutdown functions of the proposed hazard detection equipment. Plan drawings should clearly show the location of all detection equipment.**
- **A technical review, providing the following information for the proposed facility, should be filed prior to keel laying or any other Project-related construction activity:**
    a. **Identification of all combustion/ventilation air intake equipment and the distances to any possible hydrocarbon release (LNG, flammable refrigerants, flammable liquids, and flammable gases); and**
    b. **A demonstration that these areas are adequately covered by hazard detection, including a description of how these devices would isolate or shutdown any combustion equipment whose continued operation could add to or sustain an emergency.**
- **Complete plan drawings and a list of the fixed and wheeled dry-chemical, fire extinguishing, and other hazard control equipment should be filed prior to keel laying or any other Project-related construction activity. The list should include the equipment tag number, type, size, equipment covered, and automatic and manual remote signals initiating discharge of the units. Plan drawings should clearly show the planned location of all fixed and wheeled extinguishers.**
- **Facility plans showing the proposed location of, and area covered by, each monitor, hydrant, deluge system, hose, and sprinkler, as well as piping and instrumentation diagrams, of the fire water system should be filed prior to keel laying or any other Project-related construction activity.**
- **A complete equipment list of the process and utility equipment, with process data sheets and design specifications should be filed prior to keel laying or any other Project-related construction activity.**

- Manufacturer's data submitted in response to process equipment design specifications should be filed prior to keel laying or any other Project-related construction activity.
- A copy of the hazard design review and list of recommendations that are to be incorporated in the final facility design should be filed prior to keel laying or any other Project-related construction activity.
- The final design of the fixed and wheeled dry-chemical, fire extinguishing, and hazard control equipment should identify manufacturer and model.
- The final design should specify that the LNG unloading arm isolation valves SDV-101/3/5 be equipped with bypass valves sized for draining the unloading arms into the unloading line.
- The final design should include thermal relief valves for the unloading arms and piping upstream of the isolation valves.
- The final design should include boil-off gas flow and temperature measurement from the LNG storage tanks.
- The final design should include an LNG flow control element upstream of the vaporizer LNG flow control valve, dedicated to vaporizer flow control.
- The final design should include details of the control system and interlocks that would prevent the LNG flow to the vaporizer from exceeding the heating capacity of the flowing heating medium and prevent the LNG flow control valve from opening without appropriate heating medium flow and temperature conditions being verified.
- The final design should specify that piping specification change should occur downstream of the system isolation valve.
- The final design should specify that, for LNG and natural gas service, branch piping and piping nipples less than 50-millimeters (2 inches) are to be no less than Schedule 160.
- The final design should specify that spiral wound gaskets for LNG and natural gas service are to be equipped with inner and outer stainless steel retaining rings.
- The final design should include a fire protection evaluation carried out in accordance with the requirements of NFPA 59A, Chapter 9.1.2.
- The final design should include details of the shutdown logic, including cause and effect matrices for alarms and shutdowns.
- The final design should include emergency shutdown of equipment and systems activated by hazard detection devices for flammable gas, fire, and cryogenic spills, when applicable.
- The final design should include details of the air gaps to be installed downstream of all seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system. Each air gap should vent to a safe location and be equipped with a leak detection device that should continuously monitor for the presence of a flammable fluid, should alarm the hazardous condition, and should shut down the appropriate systems.
- The final design should include a HAZOP review of the completed design. A copy of the review and a list of the recommendations should be filed.
- The final design should provide up-to-date P&IDs, including a description of the instrumentation and control philosophy, type of instrumentation (pneumatic or electronic), use of computer technology, and control room display and operation. Drawings and all information should be clearly legible on 11-inch x 17-inch paper, and the piping legend and

symbology should be in accordance with accepted practice. All drawings should be filed in black and white. The following information should be included on the P&IDs:

- a. **equipment tag number, name, size, duty, capacity and design conditions;**
- b. **piping with line number, piping class spec, size, and insulation;**
- c. **LNG tank pipe penetration size or nozzle schedule;**
- d. **piping spec breaks and insulation limits;**
- e. **vent, drain, cooldown, and recycle piping;**
- f. **isolation flanges, blinds, and insulating flanges;**
- g. **valve type, in accordance with the piping legend symbol;**
- h. **all control valves numbered;**
- i. **all valve operator types and valve fail position;**
- j. **instrumentation numbered;**
- k. **control loops, including software connections;**
- l. **alarm and shutdown set points;**
- m. **shutdown interlocks;**
- n. **relief valves numbered, with set point;**
- o. **relief valve inlet and outlet piping size;**
- p. **car sealed valves and blinds;**
- q. **equipment insulation;**
- r. **drawing revision number and date;**
- s. **all manual valves numbered, including check, vent, drain, and car sealed valves; and**
- t. **alarm and shutdown set points.**

•• **The final design should specify that all hazard detection equipment should include redundancy, fault detection, and fault alarm monitoring.**

•• **The final design of the FSRU, subject to verification by the Coast Guard, should include provisions for:**

- a. **appropriate navigation equipment to assess the potential of a vessel alliding with the FSRU, as well as to monitor the FSRU's position and movement around the mooring tower;**
- b. **appropriate lights, sound signals, and communications equipment;**
- c. **a qualified navigation watch; and**
- d. **a pre-rigged emergency towing bridle.**

•• **The final design of the FSRU should meet or exceed all applicable design and construction standards for LNG carriers trading in the U.S.**

•• **The final design of the FSRU should include an adequate number of side shell bitts as well as at least two sets of emergency towing equipment.**

•• **All valves including drain, vent, main, and car sealed valves should be tagged in the field during construction and prior to commissioning.**

•• **The design details and procedures to record and to prevent the tank fill rate from exceeding the maximum fill rate specified by the tank designer should be filed prior to commissioning.**

•• **Complete plan drawings and a list of the proposed hand-held fire extinguishers should be filed prior to commissioning. The list should include the equipment number, type, size, number, and location. Plan drawings should include the type, size, and number of all hand-held fire extinguishers.**

•• Operation and Maintenance procedures and manuals, as well as safety procedure manuals, should be filed prior to commissioning.

•• The FERC staff should be notified of any proposed revisions to the security plan and physical security of the facility prior to commencement of service.

•• Progress on the construction of the FSRU should be reported in monthly reports filed with the Secretary. Details should include a summary of activities, projected schedule for completion, problems encountered, and remedial actions taken. Problems of significant magnitude should be reported to FERC within 24 hours.

In addition, we recommend that the following measures should apply throughout the life of the facility:

•• The facility should be subject to regular FERC staff technical reviews and site inspections on at least an annual basis, or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, the Applicant should respond to a specific data request, including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed piping and instrumentation diagrams reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted annual report, should be submitted.

•• The FSRU and YMS should be subject to regular structural surveys for the life of the facility. These surveys should include participation of Coast Guard marine inspectors, and should be conducted in accordance with a plan to be developed by the CE and approved by the Director of OEP. Survey intervals should not be less than those specified in the API RP2A standard and applicable classification rules.

•• Semi-annual operational reports should be filed with the Secretary to identify changes in facility design and operating conditions, abnormal operating experiences; activities (including ship arrivals, quantity and composition of imported LNG, vaporization quantities, boil-off/flash gas, etc.); and plant modifications, including future plans and progress thereof. Abnormalities should include, but not be limited to, unloading/shipping problems, potential hazardous conditions from offsite vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tanks, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, vapor or liquid releases, fires involving natural gas and/or from other sources, negative pressure (vacuum) within a storage tank and higher than predicted boil-off rates. Adverse weather conditions and the effect on the facility also should be reported. Reports should be submitted within 45 days after each period ending June 30 and December 31. In addition to the above items, a section entitled "Significant Plant Modifications Proposed for the Next 12 Months (dates)" should be included in the semi-annual operational reports. Such information would provide the FERC staff with early notice of anticipated future construction/maintenance projects at the LNG facility.

•• In the event the temperature of any region of any secondary containment becomes less than the minimum specified operating temperature for the material, the Commission should be notified within 24 hours, and procedures for corrective action should be specified.

- Significant non-scheduled events, including safety-related incidents (i.e., LNG or natural gas releases, fires, explosions, mechanical failures, unusual over pressurization, and major injuries) and security related incidents (i.e., attempts to enter site, suspicious activities) should be reported to Commission staff within 24 hours. In the event an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification should be made immediately, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification should be made to Commission staff within 24 hours. This notification practice should be incorporated into the LNG facility's emergency plan. Examples of reportable LNG-related incidents include:

  a. fire;
  b. explosion;
  c. estimated property damage of $50,000 or more;
  d. death or personal injury necessitating in-patient hospitalization;
  e. free flow of LNG that results in pooling;
  f. unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes gas or LNG;
  g. any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes gas or LNG;
  h. any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes gas or LNG to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the buildup allowed for operation of pressure limiting or control devices;
  i. a leak in an LNG facility that contains or processes gas or LNG that constitutes an emergency;
  j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;
  k. any condition that could lead to a hazard and cause a 20-percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility;
  l. safety-related incidents to LNG carriers occurring at or en route to and from the LNG facility; or
  m. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, Commission staff would determine the need for an onsite inspection by Commission staff, and the timing of an initial incident report (normally within 10 days) and follow-up reports.

3.10.2.3 Yoke Mooring System Reliability

The FSRU would be permanently moored in place by a YMS that includes a mooring tower secured to the seabed. The YMS, which would allow the FSRU to orient in response to the prevailing wave, wind, and current conditions, would be designed to withstand the forces of the high wave and wind conditions that would occur with storms of greater severity than the 100-year return storm.

The overall reliability and safety of the FSRU and its operation is dependent upon the reliability of the YMS. The risk and safety concerns associated with the YMS include the following:

- Accidental detachment of the FSRU mooring structure from the yoke • •the FSRU could then interfere with other vessels and/or could impact shoreline facilities; detachment would also damage or disconnect the flexible jumpers and could lead to a natural gas release;
- Mechanical failure of FSRU-to-YMS flexible jumpers, the YMS-to-subsea pipeline risers, or failure of the YMS gas swivel and other mooring head equipment • •any of these conditions could result in a gas release and fire that may threaten FSRU personnel and equipment;
- Failure of control system cables from the FSRU to the YMS • •this could impede the ability to shutdown the subsea shutoff valve at the base of the mooring tower; and
- Failure of the mooring tower • •this could result in a navigational hazard due to the release of the FSRU or grounding of the FSRU.

These failure scenarios would result from excessive forces acting on the YMS. Extreme weather conditions, including wind, waves, and ice floes, would induce force directly on the YMS jacket and directly on the FSRU, which would transmit forces through the yoke to the mooring head and YMS jacket.

Also, recent hurricane activity in the Gulf Coast region has increased concerns about the possible effects of natural disasters on existing and proposed LNG facilities. The 2005 Atlantic hurricane season was the most active season on record with Hurricanes Katrina and Rita directly affecting Gulf Coast port areas in which existing, under-construction, and planned terminals are located. The weather criteria upon which Broadwater intends to base the design of the YMS exceed the 100-year storm. Broadwater intends to use a 1-hour average wind speed design factor between 112 and 127 miles per hour (50.2 to 56.8 meters per second). Broadwater determined that a 1-hour average wind speed of 127 miles per hour approximates a 1-minute average wind speed of 198 miles per hour (88.5 meters per second), which is equivalent to a Category 5 hurricane.

As the overall reliability and safety of the proposed Project is primarily dependent upon the reliability of the YMS, **we recommend that**:

- **The following measures should apply to the YMS design and construction details. Information pertaining to these specific recommendations should be filed with the Secretary, for review and approval by the Director of OEP either: prior to keel laying or any other Project-related construction activity; or prior to construction of final design. This information should be submitted a minimum of 30 days before approval to proceed is required.**
- **Prior to keel laying or any other Project-related construction activity, a failure modes and effect analysis should be conducted by a third party to verify that there is not a single point of failure in the design of the YMS.**
- **The final design of the YMS should meet or exceed the design and construction requirements in the American Petroleum Institute RP2A standard for high consequence designs for offshore structures that are accepted by MMS upon completion of their review based on Hurricanes Katrina and Rita.**
- **The final design of the YMS should be capable of withstanding a Category 5 hurricane.**

- **The final design of the FSRU and YMS should include measures to prevent the FSRU from being set adrift following a potential failure of the mooring, regardless of the cause of the failure. Proposed measures should take into account, among other things, adverse wind and sea conditions, potential impacts of mishaps onboard the FSRU (e.g., fire, collision damage, etc.), time of day, proximity to shoal waters, and other vessel traffic in the vicinity. A layered approach for mitigation measures should be used.**
- **The final design should specify, for different weather conditions, how long the mooring tower would be able to accommodate the anticipated range of forces associated with the attached FSRU and an LNG carrier, following an allision with the mooring tower.**
- **The final design of the yoke mooring tower should verify that the results of the detailed geotechnical studies are consistent with the preliminary results upon which the load and survivability analysis was based.**

In addition, we recommend that the following measures should apply throughout the life of the facility:

- **Broadwater should provide the Commission and the Coast Guard with a report on any structural repairs, modifications, or failures of yoke mooring systems owned or operated by Broadwater, Shell, or TransCanada. This report should be filed with the Secretary (or in the semi-annual operational report) and should address the applicability of these repairs, modifications, or failures to the YMS provided for the FSRU.**

3.10.2.4 Hazardous Materials Receipt and Storage

Operation of the FSRU may require use of various substances, such as: odorants, diesel fuel, lube oils, solvents and paints, sodium hypochlorite, and ammonia. Odorants generally include one or more mercaptan compounds, which are used to produce a distinctive, unpleasant smell to provide a warning in the event of a pipeline leak. Mercaptan odorants are flammable and buoyant (lighter than air) gases at ambient conditions. They are generally colorless compounds that are insoluble in water, are non-toxic at the concentrations found in natural gas, and have relatively low toxicity at the concentrations stored in bulk tanks or feed tanks at odorizing stations. Broadwater would use commercially available odorant, transported and stored in 6,600-gallon containers, with up to two containers onboard the FSRU at any time. The containers would be staged within a secondary containment area, and odorant would be handled in accordance with the manufacturer's material safety data sheet.

In the event that natural gas is not available, a total of 528,344 gallons (2,000 m^3) of diesel fuel would be stored on the FSRU for use in the emergency electric power generators. If diesel fuel were spilled into Long Island Sound, it could interfere with recreational and commercial shipping, impact marine life, and potentially present a threat to public safety. Lubricating and hydraulic oils for use in the operating equipment and for maintenance would also be stored on the FSRU. It is expected that the inventory of these oils would be small relative to the inventory of diesel fuel. The risk of a diesel or oil spill would be mitigated by secondary containment systems, isolation valves, and other equipment. As proposed, the final design of the facility would include safety and spill features, such as:

- Secondary containment systems;
- Drip pans or coatings;
- Quick closing, remotely operated isolation valves; and
- Level gauges/alarms.

In addition, Coast Guard regulations may be applicable to the transfer operations for diesel fuel/lube and hydraulic oils. If the material is received from a vessel with a total oil capacity in excess of 10,500 gallons (40 m^3), the FSRU would be required to comply with the pollution prevention regulations specified in 33 CFR 154 and 156 (including requirement for a Facility Response Plan).

Solvents and paints would be stored onboard for maintenance purposes. The inventory of these materials would be limited to retail-sized containers. If released, solvents and paints can dissipate in the water column more so than oils. A release of these materials, due to their small quantity and solubility, would be unlikely to impact marine traffic or public health but may result in a localized impact to water quality. The containers of these materials would be stored in compartments specifically designed and constructed for storage of hazardous materials and paints. Empty containers would be brought to shore for appropriate disposal or recycling.

Sodium hypochlorite (essentially household bleach) would be produced onboard the facility and used to prevent marine growth in the FSRU seawater systems. As Broadwater has not proposed facilities or tanks for accumulation or storage of hypochlorite, there would not be a potential for a large-volume spill. However, if packaged sodium hypochlorite in quantities exceeding 100 pounds were housed on the FSRU, the proposed facility would be subject to sodium hypochlorite handling regulations specified in 33 CFR 126. Additionally, any spills exceeding 100 pounds would be reportable. Potential impacts from routine use of sodium hypochlorite are addressed in Section 3.2.3.2.

The selective catalytic reduction systems of the gas turbine exhausts would use aqueous ammonia to reduce the emission of nitrous oxides in the exhaust. Broadwater states that specific storage and handling procedures for ammonia would be developed during detailed design of the FSRU. However, if packaged in quantities exceeding 100 pounds, storage of this material would be subject to handling regulations specified in 33 CFR 126. If transferred in bulk, such as by hose from a shipping vessel to the FSRU), then the facility would be subject to the requirements specified in 33 CFR 127 Subpart C. Also in accordance with these regulations, any spills exceeding 100 pounds would be reportable.

OSHA regulations, in addition to state agency regulations, governing the handling and storage of hazardous materials may also be applicable to the proposed facility. All over-water transfers of hazardous materials, whether via hose or within containers, present some risk of release of the hazardous material to the environment. As details concerning the storage, handling, and use of these substances have not been sufficiently developed, **we recommend that:**

- **Broadwater should provide, as comments on the draft EIS, the following information for any hazardous substances, including odorants, diesel fuel, lube oils, solvents and paints, sodium hypochlorite, and ammonia, which may be used on the FSRU:**
  - **a. an inventory of the hazardous substances proposed for use;**
  - **b. a detailed list of storage quantities and locations;**
  - **c. a description of the means by which these materials would be replenished during operation;**
  - **d. the schedule and frequency of replenishment;**
  - **e. material safety data sheet information on all hazardous materials present on the FSRU, including potential environmental and health hazards, first aid measures, fire and explosion hazards, and accidental release measures; and**
  - **f. the applicability of any federal or state regulations regarding storage, transfer procedures, or spill response for these substances.**

Additionally, in Section 3.2.2.1, we recommend that Broadwater provide an offshore-specific SPCC Plan. The offshore SPCC Plan would include a worst-case spill scenario, identify potential impacts to water resources and marine life associated with such a spill, and specify measures to avoid and minimize such impacts. Broadwater would implement its offshore SPCC Plan to minimize the likelihood of any release and to maximize the containment and cleanup of any accidental spills of fuels, lubricants, or solvents in an appropriate manner. For these reasons, any impacts to water resources from accidental releases would not be expected and, should they occur, would be minor and temporary.

3.10.3 FSRU Thermal and Vapor Dispersion Modeling

3.10.3.1 Onboard Spill Control

Both LNG and natural gas vapors would be transferred between an LNG carrier and the FSRU through mechanical loading arms designed for cryogenic service. This transfer system would incorporate an emergency shutdown system capable of automatic or manual activation that would stop all transfers. This system would be triggered by such events as high LNG tank level, high LNG tank pressure, fire detection, loss of electrical power, loss of instrument air pressure, high pressure in an unloading arm, or other critical process upsets.

In addition, position sensors on each arm would monitor for excessive movement between the FSRU and an LNG carrier. A mooring system failure or other causes of excessive motion would result in shutdown of transfer operations, including automatic disconnection of the unloading arms. The arms would be equipped with powered emergency release couplings designed to close and disconnect with minimal LNG discharge. The design strategy for the LNG transfer system would include the following measures:

- Leak prevention through proper materials selection, minimization of leak paths, and system integrity management;
- An automated emergency shutdown system that includes detection, isolation, shutdown, and depressurization systems;
- Deck curbing, drip pans, and drain systems to direct LNG spills overboard;
- Structural cold protection for important structures, at areas where contact with LNG could occur; and
- Emergency response planning and procedures.

The process equipment would be located on the deck of the FSRU. Potential spill sources associated with this equipment would include the LNG unloading arms, the cargo piping and recondenser, and the suction and discharge piping from the LNG pumps. Broadwater proposes to design the spill control system to direct any potential spills from these sources overboard, rather than impounding them on the FSRU. This system would be designed to allow gravity drainage to the port side of the FSRU, opposite the unloading arms and berth located on the starboard side. This would minimize the possibility of vapors from a spill migrating to the space between the sides of the FSRU and an LNG carrier during unloading. Although conceptual plans for this system have been provided, detailed design of the spill containment system has not been completed. Therefore, **we recommend that:**

- **The final design should provide detailed engineering specifications for the appropriate cryogenic material for the spill control system, the slope and sizing of the diversion channels, and the measures that would be used to avoid LNG splashing against the FSRU or LNG carrier hull side.**

Thermal Modeling

If a large quantity of LNG is spilled in the presence of an ignition source, the resulting LNG pool fire could cause high levels of thermal radiation. Using the LNGFIRE III computer program model developed by the Gas Research Institute, Broadwater calculated thermal radiation distances for 1,600 to 10,000 British thermal units per square foot per hour (BTU/ft^2-hr) incident flux levels for several spill scenarios from the FSRU process equipment. The following ambient conditions were used: wind speed of 27 miles per hour; ambient temperature of 14 °F; and 80 percent relative humidity. The pool fire simulations were run for spills from a 32-inch-diameter loading arm manifold break, a 16-inch-diameter loading arm break, and a 50-millimeter hole in the high pressure LNG piping. Table 3.10.3-1 shows the thermal radiation isopleths for the selected scenarios that Broadwater modeled. Although these thermal radiation isopleths would be useful in terms of facility emergency response planning, the calculated distances are smaller than those used for the spill scenarios described in Section 3.10.3.2.

Table 3.10.3-1
Thermal Modeling Scenarios and Distances

	32-inch Loading Arm Manifold Break	16-inch Loading Arm Break	50-millimeter Hole in Piping
Discharge rate (kilograms per second)	3,190	798	27
Pool radius (feet)	157	79	None
Distance (feet) to:			
1,600 BTU/ft^2-hr	1,188	679	161
3,000 BTU/ft^2-hr	1,037	597	111
10,000 BTU/ft^2-hr	843	495	< 33

Vapor Modeling

A large quantity of LNG spilled without ignition would form a flammable vapor cloud that would travel with the prevailing wind until it either dispersed below the flammable limits or encountered an ignition source. Broadwater used the DEGADIS Dense Gas Dispersion Model to compute dispersion distances. For its vapor dispersion analysis, Broadwater selected the following ambient conditions: stability Class F, 4.5-mile per hour wind speed, 75 percent relative humidity, and an average regional temperature of 51 °F. Table 3.10.3-2 shows the estimated vapor dispersion isopleths. Although these flammable vapor dispersion distances would be useful in terms of facility emergency response planning, the calculated distances are smaller than those used for the spill scenarios described in Section 3.10.3.2.

Table 3.10.3-2
Vapor Dispersion Scenarios and Distances

	32-inch Loading Arm Manifold Break	16-inch Loading Arm Break	50-millimeter Hole in Piping
Pool radius (feet)	157	79	None
Distance (miles) to:			
½ Lower Flammable Limit	2.5	2.1	Negligible
Lower Flammable Limit	0.5	0.4	Negligible

3.10.3.2 Hazard Zones from an FSRU Cargo Tank Breach

In December 2004, the DOE released a study by Sandia National Laboratories titled *Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill over Water* (Sandia Report). The Sandia Report included an LNG cargo tank breach analysis using modern finite element modeling and explosive shock physics modeling to estimate a range of breach sizes for credible accidental and intentional LNG spill events. For intentional scenarios, the report concluded that the size of the cargo tank hole depends on the location of the ship and source of threat. Intentional breach areas were estimated to range from 2 to 12 m^2. In most cases, an intentional breaching scenario would not result in a nominal hole of more than 5 to 7 m^2, which is a more appropriate range to use in calculating potential hazards from spills. These hole sizes are equivalent to circular hole diameters of 2.5 and 3 meters.

In 2003, FERC commissioned a study by ABSG Consulting, Inc. (ABSG) to search and review the literature on experimental LNG spills and on consequence methodologies that are applicable to modeling incidents of LNG spills on water. The methodology described in the ABSG study, *Consequence Assessment Methods for Incidents Involving Releases from Liquefied Natural Gas Carriers*, and revised in staff's responses to comments on the report (issued June 18, 2004), was used to calculate thermal radiation distances from a potential spill of 35,560 m^3 for several hole sizes ranging in diameter from 1 to 3.9 meters. The estimated pool spread results and thermal radiation hazard distances from the 350,000-m^3 FSRU are identified in Table 3.10.3.-3. Thermal radiation calculations are based on an ambient temperature of 68°F, a relative humidity of 70 percent, and a 17-mile per hour wind speed.

TABLE 3.10.3-3
Thermal Radiation Distances for Varying Hole Sizes

LNG Release and Spread					
Hole Area (m^2)	0.8	1.5	5	7	12
Hole diameter (meters)	1.0	1.4	2.5	3.0	3.9
Spill time (minutes)	115	59	18	13	8
Pool Fire Calculations					
Maximum pool radius (feet)	385	541	931	1,076	1,273
Fire duration (minutes)	115	59	18	13	8
Distance (feet) to:					
1,600 BTU/ft^2-hr	3,211	2,978	4,521	4,996	5,670
3,000 BTU/ft^2-hr	1,791	2,299	3,458	3,832	4,344
10,000 BTU/ft^2-hr	1,063	1,356	2,024	2,240	2,536

As part of the waterways suitability review process, the Coast Guard also used criteria developed by Sandia to define the outer limits of the hazard zones for assessing potential risks associated with the proposal. The size of the Sandia Report hazard zones are based on large releases from LNG carriers with individual tank capacities of approximately 25,000 m^3. During the Coast Guard review, Broadwater presented a relative comparison of the strength and configuration of the FSRU hull against a typical LNG carrier hull. As discussed in Section 1.4.2 of the Coast Guard's WSR (see Appendix D), the comparison indicates that the use of a nominal breach of 5 m^2 in the FSRU would be an acceptable assumption for hazard modeling.

Applying the thermal radiation modeling to the larger 350,000 m^3 FSRU results in increased distances from the nominal case of an LNG carrier with individual tank capacities of 25,000 m^3 and an initial head of 15 meters examined by the Sandia Report. For the 1,600 BTU/ft^2-hr flux level there would be an approximate 35 percent increase in distance and for the 10,000 BTU/ft^2-hr flux level there would be an approximate 18 percent increase in distance. Applying these factors to the original Sandia Report hazard zones increases the areas of concern to 2,208- and 6,204-feet from the FSRU.

Flammable vapor dispersion calculations were based on an ambient temperature of 68ºF, 50 percent relative humidity, a 4.5-mile per hour wind speed, and atmospheric stability Class F. Based on a 1-meter diameter hole, an unignited release would result in an estimated pool radius of 478 feet. The unignited vapor cloud would extend 11,371 feet to the lower flammable limit (LFL) and 16,152 feet to one-half the LFL. It is important to identify certain key assumptions of conditions that must exist in order to achieve these vapor cloud distances. First it would be necessary for an event to create a 1-meter diameter hole by penetrating the outer hull, the inner hull, and cargo containment without ignition. Far more credible is that the event creating a 1-meter diameter hole would also result in a number of ignition sources which would lead to an LNG pool fire and subsequent thermal radiation hazards. It is also unlikely that a flammable vapor cloud could achieve these distances over land surfaces without encountering an ignition source, and subsequently burning back to the source. In addition, the Coast Guard examined vapor dispersion distances for a 5 m^2 breach for three tanks in the FSRU to maintain consistency with the scenarios examined in the Sandia report. FERC staff calculated this dispersion distance to be 4.7 miles to the LFL.

The proposed mooring location for the FSRU is 9 miles from the nearest shoreline. None of the thermal hazard zones calculated for the FSRU would impact any population centers due to the facility's distance from land. Figure 1-1 of the WSR, which is included as Appendix D of the EIS, depicts the thermal hazard zone for the FSRU. However, vessels within 4.7 miles of the FSRU could be exposed to an ignitable vapor cloud in the event of an accidental or intentional release of LNG.

Based on its waterways suitability review, the Coast Guard proposed a combined safety and security zone around the FSRU, centered on the yoke mooring tower, with a radius of 1,210 yards (0.7 mile). As Long Island Sound is approximately 1,320 square miles, the area covered by the proposed safety and security zone would be approximately 0.1 percent of the total area of Long Island Sound. Further discussion of this proposed safety and security zone can be found in Section 4.6.1.5 of the WSR, which is provided in Appendix D.

3.10.4 LNG Carrier Safety

Since 1959, LNG has been transported by ship without a major release of cargo or a major accident involving an LNG carrier. Over the last 45 years, LNG carriers have made over 44,000 voyages worldwide. Starting in 1971, LNG began arriving at the Distrigas facility in Everett, Massachusetts. To date, more than 680 cargoes, with volumes ranging from 60,000 to 125,000 m^3, have been delivered into the Port of Boston without incident. During 2005, a total of 241 cargoes of LNG were imported into the United States. For 35 years, LNG shipping operations have been safely conducted in the United States.

3.10.4.1 History

During the 44,000 voyages that have been completed since the inception of LNG maritime transportation, there has not been a serious accident, at sea or in port, that resulted in a spill due to rupturing of the cargo tanks. However, insurance records, industry sources, and public websites identify a number of incidents involving LNG carriers, including minor collisions with other vessels of all sizes, groundings, minor LNG releases during cargo unloading operations, and mechanical/equipment failures typical of large vessels. Some of the more significant LNG carrier incidents, as well as some incidents identified in comment letters received during the scoping period, are described below:

- ***Jules Verne*** suffered cracking of tank cover and deck plating in 1965 after an LNG release due to overfilling during LNG loading. There were no injuries.
- ***Methane Princess*** suffered cracking of deck plating in 1965 after an LNG release due to valve leakage while disconnecting following an LNG transfer. There were no injuries.
- ***Massachusetts***, an LNG barge, suffered cracking of deck plating in 1974 after an LNG release due to valve leakage during loading. There were no injuries.
- ***Pollenger*** had an LNG spill onto the steel cover of cargo tank number one during unloading at Everett, Massachusetts in April 1979. The spill caused cracking of the steel plate.
- ***El Paso Paul Kayser*** grounded on a rock in June 1979 in the Straits of Gibraltar during a loaded voyage from Algeria to the United States. Extensive bottom damage to the ballast tanks resulted; however, the cargo tanks were not damaged, and no cargo was released. The complete cargo of LNG was subsequently transferred to another LNG carrier and delivered to its U.S. destination.
- ***LNG Taurus*** grounded in December 1980 near the entrance to Taboata Harbor, Japan. The grounding resulted in extensive bottom damage, but the cargo tanks were not affected. The ship was refloated and the cargo unloaded.
- ***Isabella*** had LNG spill onto its deck due to a cargo tank overflow in June 1985, causing severe cracking of the steelwork. The spill was attributed to a cargo valve failure during discharging of cargo.
- ***Tellier*** was blown by severe winds from its docking berth at Skikda, Algeria in February 1989 causing damage to the loading arms and the ship and shore piping. The cargo loading had been secured just before the wind struck, but the loading arms had not been drained. Consequently, the LNG remaining in the loading arms spilled onto the deck, causing fracture of some plating.
- ***Mostefa Ben Boulaid*** had LNG spill onto its deck during loading operations in Algeria in 2002. The spill, which is believed to have been caused by overflow rather than a mechanical failure, caused significant brittle fracturing of the steelwork. The ship was required to discharge its cargo, after which it proceeded to dock for repair.
- ***Khannur*** had a cargo tank overfill into the ship's vapor handling system on September 10, 2001, during unloading at Everett, Massachusetts. Approximately 100 gallons of LNG were vented and sprayed onto the protective decking over the cargo tank dome, resulting in several cracks. After reinspection by the Coast Guard, the Khannur was allowed to discharge its LNG cargo.
- ***Norman Lady*** was struck by the USS Oklahoma City nuclear submarine while the submarine was rising to periscope depth near the Strait of Gibraltar in November 2002. The 87,000-m^3 LNG tanker, which had just unloaded its cargo at Barcelona, Spain, sustained only minor damage to the outer layer of its double hull but no damage to its cargo tanks.
- ***Tenaga Lima*** grounded on rocks while proceeding to open sea east of Mopko, South Korea due to strong current in November 2004. The shell plating was torn open and fractured over

an approximate area of 20 by 80 feet, and internal breaches allowed water to enter the insulation space between the primary and secondary membranes. The ship was refloated, repaired, and returned to service.

- ***Golar Freeze*** moved away from its docking berth during unloading on March 14, 2006, in Savannah, Georgia. The powered emergency release couplings on the unloading arms activated as designed, and transfer operations were shut down.

3.10.4.2 Vessel Construction

In 1980, at the initial peak of LNG import activity in the United States, the Coast Guard published the report *Liquefied Natural Gas and Liquefied Petroleum Gas – Views and Practices – Policy and Safety*. The report summarized the Coast Guard's extensive research into the safety hazards of LNG and its view that "...the nature of both LNG and LPG presents an acceptable risk for transportation in maritime commerce." This is due to the fact that LNG carriers are well constructed, robust vessels designed to withstand low-energy-type incidents that are prevalent in harbors and during docking operations. Moreover, safety measures, both equipment and training, are planned and designed into these LNG carriers to prevent or control all types of potential incidents. The Sandia National Laboratory reached a similar conclusion in 2005 in its report.

The world's LNG carrier fleet currently exceeds 173 carriers. Currently, all of the ships in the LNG fleet operate under a foreign flag with foreign crews. The LNG carriers used to import LNG to the United States would be constructed and operated in accordance with the International Maritime Organization (IMO) *Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk*, the SOLAS, and 46 CFR Part 154, which contain the U.S. safety standards for vessels carrying bulk liquefied natural gas. Foreign-flag LNG carriers are required to possess a valid IMO Certificate of Fitness and a Coast Guard Certificate of Compliance.

As required by the IMO conventions and design standards, the vessel inner hull adjacent to the cargo tanks is required to be protected against contact from liquid cargo through a combination of proper material selection, adequate insulation, and the use of heating systems. In addition, hold spaces and insulation areas on an LNG carrier are equipped with gas detection and low-temperature alarms. These devices monitor for leaks of LNG into the insulation between primary and secondary LNG cargo tank barriers. Hazard detection systems are also provided to monitor the hull structure adjacent to the cargo tank, compressor rooms, motor rooms, cargo control rooms, enclosed spaces in the cargo area, specific ventilation hoods and gas ducts, and air locks.

LNG carriers are equipped with a firewater system, with the ability to supply at least two jets of water to any part of the deck in the cargo area and parts of the cargo containment and tank covers above deck. In addition, the relief valve capacity of cargo tanks is designed to compensate for over pressure caused by fire. A water spray system is available for cooling, fire prevention, and crew protection in specific areas. Certain areas of LNG carriers are also fitted with dry chemical, powder-type extinguishing systems and CO_2 smothering systems for fighting fires.

In 1993, amendments to the IMO's Code for the *Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk* established that all tankers must have monitoring equipment with an alarm facility that is activated by detection of over pressure or under pressure conditions within a cargo tank. In addition, the cargo tanks are heavily instrumented, with gas detection equipment in the hold and inter-barrier spaces, temperature sensors, and pressure gauges. Fire protection must include the following systems:

- A water spray (deluge) system that covers the accommodation house control room and all main cargo valves;
- A traditional firewater system that provides water to fire monitors on deck and to fire stations found throughout the ship;
- A dry chemical fire extinguishing system for hydrocarbon fires; and
- A CO_2 system for protecting machinery including the ballast pump room, emergency generators, and compressors.

As a result of the attacks of September 11, 2001, the IMO agreed to new amendments to the 1974 SOLAS addressing port facility and ship security. The International Ship and Port Facility Security Code was adopted in 2003 by the IMO. This code requires both ships and ports to conduct vulnerability assessments and to develop security plans. The purpose of the code is to: prevent and suppress terrorism against ships; improve security aboard ships and ashore; and reduce the risk to vessels, cargoes, and passengers, crew, and port personnel onboard ships and in port areas. All LNG carriers, as well as other cargo vessels 300 gross tons and larger, and ports servicing those regulated vessels, must adhere to these IMO and SOLAS standards. Some of the IMO requirements are listed below:

For the ships, these requirements include:

- Ships must develop security plans and have a Vessel Security Officer (VSO);
- Ships must be provided with a ship security alert system. These alarms transmit ship-to-shore security alerts to a competent authority designated by the Administration, which may include the company, identifying the ship, its location, and indicating that the security of the ship is under threat or has been compromised;
- Ships must have a comprehensive security plan for international port facilities, focusing on areas having direct contact with ships; and
- Ships may have certain equipment onboard to help maintain or enhance the physical security of the ship.

For the facilities, the requirements include:

- The facility must have a security plan and a Facility Security Officer (FSO); and
- Certain security equipment may be required to maintain or enhance the physical security of the facility.

Both ships and facility security plans must address the following:

- Monitoring and controlling access;
- Monitoring activities of people and cargo;
- Ensuring security communications and that they are readily available; and
- Completion of a Declaration of Security that is signed by the FSO and VSO.

3.10.4.3 Hazards

The history of LNG shipping has been free of major incidents, and none have resulted in significant quantities of cargo being released (see Section 3.10.4.1). No incidents have occurred at existing LNG facilities during the 50 years of operation that resulted in any significant quantities of cargoes being released. However, the possibility of an LNG spill from a ship over the duration of the proposed Project must be considered. Historically, the events most likely to cause a significant release of LNG were a ship casualty such as:

- A grounding sufficiently severe to puncture an LNG cargo tank;
- A vessel colliding with an LNG carrier in transit; or
- A vessel alliding[7] with an LNG carrier while moored at the FSRU.

However, the attacks on September 11, 2001, have made the public keenly aware of an additional risk that must be considered in the evaluation of marine safety and security:

- A deliberate attack on an LNG carrier by a terrorist group.

To result in a spill of LNG, any of the above events would need to occur with sufficient impact to breach the LNG carrier's double hull and cargo tanks. All LNG carriers used to deliver LNG to this proposed Project would have double-hull construction, with the inner and outer hulls separated by about 10 feet (2 to 3 meters). Furthermore, the cargo tanks are normally separated from the inner hull by a layer of insulation approximately 1-foot thick.

As a result, many grounding incidents severe enough to cause a cargo spill on a single-bottom oil tanker would be unable to penetrate both inner and outer hulls of an LNG carrier. An earlier Federal Power Commission (predecessor to the FERC) study estimated that the double bottom of an LNG carrier would be sufficient to prevent cargo tank penetration in about 85 percent of the cases that penetrated a single-bottom oil tanker. Previous incidents with LNG carriers have primarily involved grounding, and none of these have resulted in a breach of the double hull and subsequent release of LNG cargo.

The probability of an LNG carrier sustaining cargo tank damage in a collision would depend on several factors – the displacement and construction of both the struck and striking vessels, the velocity of the striking vessel and its angle of impact with the struck vessel, and the location of the point of impact. The previous Federal Power Commission study estimated that the additional protection afforded by the double hull would be effective in low-energy collisions; overall, it would prevent cargo tank penetration in about 25 percent of the cases that penetrated a single-hull oil tanker.

In 1995, to assist the Coast Guard in San Juan, Puerto Rico, EcoEléctrica L.P. prepared an analysis of the damage that could result from an oil tanker striking an LNG carrier at berth (FERC 1996). The analysis assumed a 125,000-m^3 LNG carrier and an 82,000-dead-weight-ton tanker carrying number 6 fuel oil without tug assistance. The analysis determined the minimum striking speed to penetrate the cargo tanks of an LNG carrier for a range of potential collision angles. The resulting minimum striking speeds are presented in Table 3.10.4-1 for the two principal cargo systems.

For membrane tanks, the critical beam-on striking speed is 3.0 knots; for spherical tanks, the critical on-beam speed is 4.5 knots. For both containment types, lower angles of impact result in much greater minimum striking speeds to penetrate LNG cargo tanks. In the July/August 2002 issue of *LNG Journal*, the SIGTTO General Manager provides a table that indicates the critical speed necessary for a 20,000-ton vessel to puncture the outer hull of an LNG carrier is 7.3 knots. For a 93,000-ton ship, the

[7] "Allision" is the action of dashing against or striking upon a stationary object (for example, the running of one ship upon another ship that is docked) – distinguished from "collision," which is used to refer to two moving ships striking one another.

impact speed is 3.2 knots. In neither case does such an impact result in damage to the LNG cargo containment system, nor does it result in release of LNG.

TABLE 3.10.4-1
Minimum Striking Speed to Penetrate LNG Cargo Tanks

Angle of Impact	Minimum Striking Speed (knots)	
	Spherical Tanks	Membrane Tanks
Greater than 60 degrees	4.5	3
45 degrees	6.3	4
30 degrees	9	6
15 degrees	18	12

The Sandia Report included an LNG cargo tank breach analysis using modern finite element modeling and explosive shock physics modeling to estimate a range of breach sizes for both credible accidental and intentional LNG spill events. The analysis of accidental events found that groundings, collisions with small vessels, and low-speed (less than 7 knots) collisions with large vessels striking at 90 degrees could cause minor ship damage but would not result in a cargo spill. This is due to the protection provided by the double-hull structure, the insulation layer, and the primary cargo tank of an LNG carrier. High-speed (12 knots) collisions with large vessels striking at 90 degrees were found to potentially cause cargo tank breach areas of from 0.5 to 1.5 m^2.

In the event of a collision or allision of sufficient magnitude to rupture an LNG cargo tank, it is likely that sparks or flames would ignite the flammable vapors at the spill site. In a grounding of sufficient magnitude to rupture an LNG cargo tank, the damage would occur underwater, and the potential for ignition would be less than for collisions or allisions. In this case, an LNG spill would rapidly vaporize on water and form a potentially flammable cloud. If not ignited, the flammable vapor cloud would drift downwind until the effects of dispersion would dilute the vapors below the LFL for methane. The maximum range of potentially flammable vapors, or the distance to the LFL, is a function of the volume of LNG spilled, the rate of the spill, and the prevailing meteorological conditions. If the flammable vapor cloud encountered an ignition source, the cloud would burn back to the spill site.

The final EIS for the Calcasieu LNG Project (FERC 1976) analyzed the maximum range of a flammable vapor cloud and hazardous radiation levels from an instantaneous one-tank spill. As was consistent with risk analyses at that time and for nearly 25 years thereafter, the instantaneous spillage of one cargo tank was considered to be the "worst-case" scenario. Physical constraints on maximum vessel speeds and maximum depths of penetration required to rupture one LNG cargo tank render the possibility of an instantaneous release of more than one cargo tank to be implausible. This is not to imply that the loss of multiple cargo tanks could never occur, but that the extent of the hazard would not exceed that of the instantaneous spillage of one tank.

For an instantaneous one-tank spill with ignition, the final EIS for the Calcasieu LNG Project estimated that a hazardous thermal radiation level of 5,300 BTU/hr-ft^2 would extend 3,595 feet from the center of the spill. For an instantaneous one-tank spill without ignition, the final EIS for the Yukon Pacific LNG Project (FERC 1995) estimated that potentially flammable vapors could travel up to 3.3 miles, with a 10-mile per hour wind and typical atmospheric stability.

In October 2001, the use of a one-tank instantaneous release as the worst-case scenario was re-examined by Quest Consultants, Inc (Quest) as part of an effort by the DOE to determine the hazards associated with reopening the Distrigas LNG import terminal following the terrorist attacks of September 11, 2001. It was determined that time-release spills through 1-meter and 5-meter diameter holes would more accurately simulate credible worst-case damage scenarios. The maximum flammable vapor cloud and radiation hazards were calculated for the two spill scenarios. For a spill on water with ignition, the maximum distance to a radiant flux level of 1,500 BTU/ft^2-hr was estimated to be 1,770 feet. For a spill on water without ignition, a flammable vapor cloud of 2.5 miles was estimated. In November 2003, in response to comments concerning its October 2001 study, Quest clarified that its study applied only to LNG spills resulting from a collision with a large ship in Boston's Outer Harbor, where waves would restrict the spreading of LNG on water.

Since the Quest study, there has been an emergence of studies by various parties to define the worst-case scenario that would result from a deliberate terrorist attack on an LNG carrier and the subsequent release of cargo. Distances have been estimated to range from 1,770 to 4,200 feet for a thermal radiation level of 1,500 BTU/ft^2-hr. Part of the reason for the apparent discrepancies is the lack of large-scale historical incidents, and the need to extrapolate small-scale field test data to a worst-case event. This inevitably leads to differing conservative assumptions among the various parties. For example, some models calculate a time-release cargo discharge through 1-meter or 5-meter diameter holes, while others assume that the cargo tank empties instantaneously.

As a result, the FERC commissioned a study by ABSG to search and review the literature on experimental LNG spills and on consequence methodologies that are applicable to modeling incidents of LNG spills on water. Further, the goal of the study was to identify appropriate methods for estimating flammable vapor and thermal radiation hazard distances for potential LNG carrier cargo releases during transit and while at berth. The resulting study, *Consequence Assessment Methods for Incidents Involving Releases from Liquefied Natural Gas Carriers*, was released for public comment on May 14, 2004. On June 18, 2004, staff's responses to comments on the consequence assessment methods were issued. In addition, the model was updated to include a lower limit on the characteristic wind speed. As discussed in greater detail in staff's responses, various components of the consequence assessment methodologies were revised based on comments received. The revised methodology provides procedures for calculating: (1) the rate of release of LNG from a cargo tank penetration for various-sized holes, (2) the spreading of an unconfined LNG pool on water for both continuous spills and rapid (nearly instantaneous) releases, (3) the rate of vapor generation from an unconfined spill on water, (4) thermal radiation distances for LNG pool fires on water, and (5) and flammable vapor dispersion distances.

A detailed evaluation of the consequences of a terrorist attack on a modern membrane LNG tanker was prepared by Lloyds Register North America for the Weaver's Cove LNG Project. The study evaluated the consequences of attacks on an LNG tanker by missiles and explosives. Finite element analysis was used to evaluate the effect of various-sized charges on both the outer and inner hulls. A 1-meter diameter hole of the inner hull at the waterline was found to be the worst-case scenario for hazard consequence assessments. This finding is consistent with the attack on the double-hull oil tanker *Limberg* that caused greater than a 5-meter diameter hole on the outer hull but only minor damage to the inner hull. A failure modes and effects analysis was used to understand internal LNG release characteristics, and a residual strength analysis was used to investigate damage scenarios for a loaded LNG tanker.

As previously discussed, the DOE released the Sandia Report in December 2004. The report included an LNG cargo tank breach analysis, using modern finite element modeling and explosive shock physics modeling to estimate a range of breach sizes for credible accidental and intentional LNG spill events. For intentional scenarios, the size of the cargo tank hole depends on the location of the ship and source of threat. Intentional breach areas were estimated to range from 2 to 12 m^2. In most cases, an intentional breaching scenario would not result in a nominal hole of more than 5 to 7 m^2, which is a more appropriate range to use in calculating potential hazards from spills. These hole sizes are equivalent to circular hole diameters of 2.5 and 3 meters.

The Sandia Report also included guidance on risk management for intentional spills, based on the findings that the most significant impacts to public safety and property exist within approximately 500 meters (1,640 feet) of a spill due to thermal hazards from a fire, with lower public health and safety impacts beyond 1,600 meters (approximately 1 mile). Large unignited LNG vapor releases were found to be unlikely, but could extend to 2,500 meters (8,200 feet) for a nominal intentional spill. As part of the waterway suitability review process, the Coast Guard uses these criteria developed by Sandia to define the outer limits of the hazard zones for assessing potential risks associated with the proposal. Cascading damage due to brittle fracture from exposure to cryogenic liquid or fire-induced damage to foam insulation was evaluated and, while possible under certain conditions, is not likely to involve more than two or three cargo tanks. Cascading events are not expected to increase the overall fire hazard by more than 20 to 30 percent (1,920 to 2,080 meters [6,300 to 6,825 feet]) but would increase the expected fire duration. RPTs are possible for large spills, but the effects would be localized near the spill source and should not cause extensive structural damage.

The methodology described in the ABSG study and revised in staff's responses to comments was used to calculate the thermal radiation and flammable vapor dispersion distances for several holes ranging in diameter from 1 to 3.9 meters. Based on the penetration of the largest cargo tank of a 140,000-m^3 LNG carrier, a potential spill of 23,000 m^3 is estimated for the volume of LNG above the waterline. The estimated pool spread results and thermal radiation hazard distances are identified in Table 3.10.4-2 below. Thermal radiation calculations are based on an ambient temperature of 68°F, a relative humidity of 70 percent, and a 17-mph wind speed.

TABLE 3.10.4-2
LNG Spills on Water

LNG Release and Spread					
Hole area (m^2)	0.8	1.5	5	7	12
Hole diameter (meter)	1.0	1.4	2.5	3.0	3.9
Spill time (minutes)	94.0	48.0	15.0	10.4	6.2
Pool Fire Calculations					
Maximum pool radius (feet)	341	476	817	938	1,102
Fire duration (minutes)	94.1	48.1	15.2	10.7	6.5
Distance (feet) to:					
1,600 BTU/ft2-hr	2,105	2,710	4,055	4,508	5,086
3,000 BTU/ft2-hr	1,634	2,095	3,117	3,462	3,900
10,000 BTU/ft2-hr	973	1,239	1,828	2,026	2,279

Flammable vapor dispersion calculations were based on an ambient temperature of 68 °F, 50 percent relative humidity, a 4.5-mile per hour wind speed and atmospheric stability Class F. Based on a 1-meter diameter hole, an unignited release would result in an estimated pool radius of 421 feet. The unignited vapor cloud would extend to 9,776 feet to the LFL and 14,377 feet to one-half the LFL. It is important to identify certain key assumptions of conditions that must exist in order to achieve these vapor cloud distances. First it would be necessary for an event to create a 1-meter diameter hole by penetrating the outer hull, the inner hull, and cargo containment without ignition. Far more credible is that the event creating a 1-meter diameter hole would also result in a number of ignition sources which would lead to an LNG pool fire and subsequent thermal radiation hazards. It is also unlikely that a flammable vapor cloud could achieve these distances over land surfaces without encountering an ignition source, and subsequently burning back to the source.

Broadwater proposes the potential use of up to a 250,000 m^3 LNG carrier. Based on preliminary information provided by Broadwater on future 250,000 m^3 LNG carriers with an initial head of 20.3 meters, the estimated distance to the 1,600 BTU/ft^2-hr zone would be less than approximately 16 percent farther than the Sandia models using a 125,000 m^3 LNG carrier with individual tank capacities of 25,000 m^3 with an initial head of 15 meters. The estimated distance to the 10,000 BTU/ft^2-hr zone would be less than approximately 32 percent farther than the Sandia models. In addition, the Coast Guard examined vapor dispersion distances for a 5 m^2 breach for three tanks in the LNG carrier to maintain consistency with the scenarios examined in the Sandia report. FERC staff calculated this dispersion distance to be 4.3 miles from a 250,000 m^3 LNG carrier to the LFL.

Based on its waterways suitability review, the Coast Guard proposes a combined safety and security zone of 2 nautical miles (2.3 miles) in front of, 1 nautical mile (1.2 miles) behind, and 750 yards (0.4 mile) to either side of the LNG carriers that would service the proposed facility. Further discussion of this proposed safety and security zone can be found in Section 4.6.1.4 of the WSR, which is provided in Appendix D.

3.10.4.4 LNG Vessel Transit to the Broadwater LNG Project

Long Island Sound consists of approximately 1,320 square miles surrounded by 600 miles of coastline. Even though Long Island Sound is over 20 miles wide at its widest point, the Sound consists entirely of internal waters of the United States. The Sound has two natural exits: to the east, the Race connects Long Island Sound to Block Island Sound and the Atlantic; the western side of the Sound exits to the west, through the East River into the Port of New York and New Jersey. Long Island Sound is a thoroughfare for commercial vessels transiting to and from the Port of New York and New Jersey from ports north and east of the Race. Ports within the Sound also receive between 2,300 and 2,700 U.S.-flagged and foreign-flagged vessel arrivals annually at ports within the Sound.

Imported LNG could be obtained from exporting terminals throughout the world and delivered by LNG carriers to the proposed FSRU. Exporting countries include Algeria, Australia, Brunei, Indonesia, Malaysia, Nigeria, Oman, Qatar, Trinidad, and United Arab Emirates. In 2003, LNG imports to the United States included 72 percent from Trinidad, 12 percent from Nigeria, 10 percent from Algeria, 3 percent from Qatar, 2 percent from Oman, and 1 percent from Malaysia. At this time, Broadwater has not confirmed the source(s) of LNG supplies for the proposed Project.

LNG carriers would transit from open seas to the proposed FSRU from either the Point Judith Pilot Station or the Montauk Point Pilot Station. From either pilot station, LNG carriers would travel approximately 29 miles to the Race. The Race is the main entrance to Long Island Sound from the east, and is defined as the waters between the southwestern tip of Fishers Island running southwest to Little Gull Island Light. Transit of LNG carriers through the Race would be the most navigationally constrained portion for carriers calling on the FSRU. Under ideal conditions, LNG carriers would transit the Race in approximately 15 minutes, at speeds between 12 and 15 knots. However, weather, sea state, and vessel traffic may require reduced vessel speed and result in increased transit times through this segment. After passing through the Race, LNG carriers would turn to a west-southwest course through the middle of the Sound. Depending on navigation constraints, tankers may pass into Connecticut State waters along this portion of the transit route. LNG carriers would then arrive at the FSRU for off-loading. A detailed description of the anticipated LNG carrier routes can be found in Section 3.2 of the WSR, which is provided as Appendix D.

No lands along the LNG carrier transit route would be contained within the 1,600-BTU/ft^2-hr or the 10,000-BTU/ft^2-hr thermal radiation hazard zones associated with a 5 m^2 hole in the largest capacity LNG carrier (250,000 m^3) that is expected to call at the proposed facility. However, the flammable vapors from an unignited release from the 5 m^2 breach for three tanks in the LNG carrier spill could impact land along some portions of the transit route. Figure 1-1 of the WSR, which is provided as Appendix D of the EIS, depicts the anticipated LNG carrier transit routes and associated thermal radiation hazard zones. As stated in Section 3.2 of the WSR (see Appendix D), the following areas would be located within 4.3 miles of the transit route:

- The northern tip of Block Island, Rhode Island;
- The southern tip of Weekapaug Point, Westerly, Rhode Island;
- The southern tip of Watch Hill, Rhode Island;
- Fisher's Island, New York;
- Plum Island, New York;
- The northeastern-most third of the North Fork of eastern Long Island, New York;
- A portion of Goshen Point straddling the City of New London, Connecticut; and
- The town of Waterford, Connecticut.

LNG carriers transiting through the Sound would be required to comply with any operational controls imposed by the Coast Guard. In addition, they would also be required to have a state-licensed pilot on board. All U.S.- and foreign-flagged vessels bound for or departing from ports or places in the United States must submit an Advance Notice of Arrival at least 96 hours prior to entering a port or place of destination or, if the voyage time for the vessel is less than 96 hours, the Notice of Arrival must be submitted at least 24 hours in advance. Prior to receiving approval to enter U.S. waters, all foreign vessels must meet a number of requirements prescribed by international convention, U.S. laws, and regulations applicable to vessel security, safety, and environmental compliance.

3.10.4.5 Requirements for LNG Carrier Operations in the Long Island Sound

The Coast Guard exercises regulatory authority over LNG facilities that affect the safety and security of port areas and navigable waterways under Executive Order 10173; the Magnuson Act (50 USC Section 191); the Ports and Waterways Safety Act of 1972, as amended (33 USC Section 1221, et seq.); and the Maritime Transportation Security Act of 2002 (46 USC Section 701). The Coast Guard is responsible for matters related to navigation safety, vessel engineering and safety standards, and all matters pertaining to the safety of facilities or equipment located in or adjacent to navigable waters up to the last valve immediately before the receiving tanks. The Coast Guard also has authority for LNG facility security plan review, approval, and compliance verification as provided in Title 33 CFR Part 105 and siting as it pertains to the management of vessel traffic in and around the LNG facility.

The Coast Guard regulations in 33 CFR 127 apply to the marine transfer area of waterfront facilities between the LNG carrier and the last manifold or valve located immediately before a storage tank. Title 33 CFR 127 regulates the design, construction, equipment, operations, inspections, maintenance, testing, personnel training, firefighting, and security of LNG waterfront facilities. The safety systems, including communications, emergency shutdown, gas detection, and fire protection, must comply with the regulations in 33 CFR 127. Under 33 CFR 127.019, Broadwater would be required to submit two copies of its Operations and Emergency Manuals to the Captain of the Port for examination.

Title 33 CFR 127 separates cargo transfer operations into three distinct phases: Preliminary Transfer Inspection (Section 127.315), Declaration of Inspection (Section 127.317), and LNG Transfer (Section 127.319). These different sections require specific actions to be completed prior to and during the transfer. Additionally, there are specific actions required in the case of a release of LNG (Section 127.321).

As required by its regulations (Section 127.009), the Coast Guard is responsible for issuing a Letter of Recommendation as to the suitability of the waterway for LNG marine traffic with respect to the following items:

- Density and character of marine traffic;
- Locks, bridges, or other manmade obstructions in the waterway; and
- The following factors adjacent to the facility:
  - depth of water;
  - tidal range;
  - protection from high seas
  - natural hazards, including reefs, rocks, and sandbars
  - underwater pipes and cables; and
  - distance of berthed vessels from the channel and the width of the channel.

The process of preparing the Letter of Recommendation begins when an applicant submits a Letter of Intent to the Captain of the Port. In accordance with 33 CFR 127.007, Broadwater submitted an Letter of Intent to the Coast Guard on November 9, 2004, and later amended the Letter of Intent on April 26, 2005. Accordingly, the Coast Guard Captain of the Port Long Island Sound will issue a Letter of Recommendation to Broadwater. The Letter of Recommendation will be based on the WSR and will be the official determination regarding the suitability or unsuitability of the waterway to support the proposed LNG facility and associated LNG carrier traffic. However, the Letter of Recommendation will not be issued until after the NEPA process has been completed.

Coast Guard Waterways Suitability Report

On June 14, 2005, the Coast Guard published NVIC 05-05 to provide Coast Guard Captains of the Port/Federal Maritime Security Coordinators, members of the LNG industry, and port stakeholders with guidance on assessing the suitability of a waterway for LNG marine traffic. The assessment should take into account conventional navigation safety/waterway management issues contemplated by the existing Letter of Intent/Letter of Recommendation process and also should consider maritime security implications.

Based on Coast Guard policy guidance contained in NVIC 05-05, the Captain of the Port can generally make one of three conclusions regarding the suitability of a waterway to support LNG marine traffic. The first is that the waterway is suitable without the implementation of additional measures. The second is that the waterway is unsuitable. The third is that to make the waterway suitable, additional measures are necessary to responsibly manage risks to navigation safety or maritime security associated with LNG marine traffic.

On September 21, 2006, the Coast Guard Captain of the Port Long Island Sound released the WSR for the proposed Broadwater Project. The WSR, which was prepared in accordance with paragraph 6.b of NVIC 05-05, documents the Coast Guard's assessment of potential risks to navigation safety and port security associated with the proposed Project. Based on its assessment, the Coast Guard has determined that, to make the waters of Block Island Sound and Long Island Sound suitable for LNG carrier traffic and operation of the FSRU, additional measures would be necessary to responsibly manage the potential risks to navigation safety and maritime security associated with Broadwater's proposal (see Appendix D). Some of these measures relate to the design and operational requirements of the FSRU and the YMS. In addition to recommendations included in Section 3.10.2 related to review of the technical design information performed by FERC and Coast Guard staff, the WSR specifically suggests the following mitigation measures. Consequently, either the Commission's Order or the Coast Guard's Letter of Recommendation would include the following recommendations, if the Project is authorized.

- The final design of the FSRU should include appropriate navigation equipment to assess the risk of allision and to communicate with vessels transiting in the vicinity, as well as appropriate lights and sound signals. The minimum equipment requirements that should be met are listed in Appendix I of the WSR.
- The final design of the FSRU should specify a marine crew, in addition to the Port Superintendent, Mooring Master, Cargo Supervisor, and Cargo Transfer Assistant, as discussed in Section 11.3.6.1 of Resource Report 11, which includes three Vessel Traffic Supervisors. The professional training requirements and duties of the Vessel Traffic Supervisors should be in accordance with Appendix I of the WSR.
- Broadwater should conduct simulations as discussed in Section 4.6.1.3 of the WSR to determine the number and capabilities of the assist tugs required to support LNG carrier berthing and unberthing. In addition, Broadwater should provide to FERC and the Coast Guard suitable documentation (for example, a contract), indicating that the required number of assist tugs would be available at all times while the FSRU is in operation.
- Broadwater should schedule LNG carrier arrivals and departures to minimize conflicts with other waterway users, including the U.S. Navy, as discussed in Section 4.6.1.2 of the WSR.
- Broadwater, in coordination with the Connecticut Department of Transportation, the New York Board of Pilot Commissioners, and the Coast Guard, should conduct full mission bridge simulator training for all pilots who may be responsible for serving as a pilot on an LNG carrier calling at the FSRU. In addition, Broadwater should arrange to have a pilot that is licensed by either the State of New York or the State of Connecticut remain onboard LNG carriers while they are moored at the FSRU.
- Broadwater should conduct the modeling necessary to establish the performance requirements for escort tugs as discussed in Section 6.3.1 of the WSR. In addition Broadwater should provide to FERC and the Coast Guard suitable documentation (for example, a contract), indicating that the required number of escort tugs will be available at all times to escort LNG carriers through the Race and eastern Block Island Sound. It should be noted that additional requirements for escort tugs may be identified during the emergency response planning process.
- Broadwater should mark the outer limits of the safety/security zone around the FSRU as follows: the cardinal points would be marked with lighted buoys and the inter-cardinal points

with unlighted buoys. Broadwater would be responsible for applying for all required permits and for maintaining these buoys in accordance with the requirements in 33 CFR Part 66.

- A Facility Security Plan prepared in accordance with 33 CFR Part 105 should be submitted for review and approval at least 6 months, but no more than 12 months, before the FSRU would receive LNG deliveries.
- Broadwater should prepare and submit to the Captain of the Port Long Island Sound for review and approval an Operations Manual (as required by 33 CFR 127.305 and an Emergency Manual as required by 33 CFR 127.307) at least 6 months, but no more than 12 months, before the FSRU would receive LNG deliveries. These manuals should include the applicable requirements stipulated on the facility license and should be consistent with the facility's Emergency Response Plan. The facility would be required to adhere to any reporting requirements stipulated by the Coast Guard, in addition to any actions that may be directed by the Captain of the Port Long Island Sound per 33 CFR 160.109.

In addition, the Coast Guard has determined that specific security-related measures, and, where applicable, the resources needed to implement them, are required. These are described in a separate supplementary report from the Coast Guard to FERC on September 21, 2006. This supplementary report, and the specific details of these measures, have been designated as Sensitive Security Information as defined in Title 49 CFR Part 1520. Because any unauthorized disclosure of these details could be used to circumvent the proposed security measures, it is not releasable to the public. Additionally, any security plan is a dynamic document that would account for the existing threat environment and be subject to change with advances in technologies. The Coast Guard has preliminarily identified the additional resources, public and/or private, that would be needed to implement prevention and mitigation strategies necessary for LNG operations. Accordingly, we have recommended that Broadwater submit to FERC a comprehensive plan identifying the mechanisms for funding all Project-specific security/emergency management costs (see Section 3.10.6).

The necessary security measures would be further developed into the FSRU's facility security plan and as appropriate in the facility's Operations and Emergency Manuals, which would become the basis for appropriate security measures for each Coast Guard Maritime Security (MARSEC) threat level. These plans would clearly spell out roles, responsibilities, and specific procedures for an LNG carrier transiting Long Island Sound to the proposed Broadwater FSRU, as well as for all agencies involved in implementing security and safety during the operation. It would be required that, prior to an LNG carrier being granted permission to enter the waters of Block Island or Long Island Sounds, both the carrier and facility must be in full compliance with the appropriate requirements of the Maritime Transportation Security Act and International Ship and Port Facility Security Code, and the security protocols to be established by the Captain of the Port. These security protocols may include measures such as escort by the Coast Guard and other law enforcement agency vessels to enforce safety and security zones around the LNG carriers while in transit and moored at the terminal, shoreside surveillance and monitoring, and other prevention/mitigation strategies.

Security of the LNG carrier would be the responsibility of the owner/operator and the master of the carrier. Security of the FSRU would be the responsibility of Broadwater. Protection of the LNG carrier and the import terminal would involve personnel from the Coast Guard, Broadwater security staff, and possibly state and local law enforcement. Broadwater would provide security for the terminal according to the Facility Security Plan that must be prepared under 33 CFR 105. This plan would need to be approved by the Coast Guard Captain of the Port. The requirements of this plan include:

- A Facility Security Assessment to identify site vulnerabilities, possible security threats, consequences of an attack, and facility protective measures;

- A Facility Security Plan with procedures for responding to security incidents;
- A designated FSO responsible for implementing and periodically updating the Facility Security Plan and Assessment;
- Scalable security measures to provide increasing levels of security at increasing MARSEC levels;
- Security exercises at least once each calendar year and drills at least every three months; and
- Mandatory reporting of all breaches of security and security incidents.

We recognize that the security protocols would be dynamic documents that would be prepared well before import operations would commence, and that the port's overall security picture may change over that time period. New port activities may commence, infrastructure may be added, or population density may change. Improvements in technology to detect, deter, and defend against intentional acts may also develop. Therefore, in accordance with the Coast Guard WSR, **we recommend that:**

- **Broadwater should amend its Preliminary Project Security Assessment Overview (PPSAO) to incorporate the recommendations in Sections 5.5.1, 5.5.2, 5.5.3, 5.5.7, 5.5.8, 5.5.9, 5.5.11, 5.5.14, and 5.5.17 of the SSI Supplement to the WSR. In addition, Broadwater should annually review and amend, as necessary, the PPSAO and submit it to the Coast Guard Captain of the Port Long Island Sound for review.**

As described in the Coast Guard's WSR, Coast Guard Sector Long Island Sound currently does not have the resource required to implement the measures that have been identified as being necessary to effectively manage the potential risks to navigation safety and maritime security associated with the proposed project in addition to current levels of mission activity. Obtaining the required resources would require either curtailing current activities within the Sector, reassigning resources from outside of the Sector, or for the Coast Guard to seek additional resources through the President's budget process.

As noted in Section 7.4 of the WSR, state or local law enforcement agencies could potentially assist with implementing some of the measures identified for managing potential risks to maritime security associated with the proposed project. FERC has received comments on other LNG terminal proposals expressing concern about the cost of applying additional security measures and the potential burden on local taxpayers. Accordingly, we have recommended that Broadwater submit to FERC a comprehensive plan identifying the mechanisms for funding all project-specific security/emergency management costs as required by Section 3A(e) of the Natural Gas Act, added by Section 311 of the EPAct of 2005, (see section 3.10.6).

Impact of Vessel Security Requirements

The potential impacts of the proposed LNG carrier traffic for Broadwater on other commercial and recreational boaters can be addressed in relation to several general security requirements: (1) a moving safety and security zone for inbound LNG carriers, (2) a safety and security zone around the FSRU encompassing a moored LNG carrier, and (3) other measures as deemed appropriate.

If the Coast Guard issues a Letter of Recommendation with conditions finding the waterway suitable for LNG marine traffic, the Coast Guard would establish a moving safety and security zone that would affect other vessels. Pursuant to such a regulation, no vessel would be allowed to enter the safety and security zone without first obtaining permission from the Coast Guard Captain of the Port. As stated in Section 8.2 of the WSR, the proposed safety and security zone around the LNG carrier while in transit in Long Island Sound would extend 2 nautical miles (2.3 miles) in front of, 1 nautical mile (1.2 miles) behind, and 750 yards (0.4 mile) to either side of the LNG carrier. The safety and security zone would move with the LNG carrier.

It is anticipated that the LNG carriers would transit about 70 miles within Long Island Sound from the Point Judith/Montauk Point Pilot Stations to the proposed Broadwater FSRU. At transit speeds of 12 to 15 knots, it would take about 5 to 6 hours for LNG carriers to complete the trip to the FSRU. As stated above, the Coast Guard would establish a moving safety and security zone around the LNG tanker while in transit. At typical LNG tanker speeds of 12 to 15 knots, it would take the entire zone approximately 15 minutes to pass any given point. Additional time would be required to maneuver the LNG carrier into the berth. Minimum visibility conditions would need to be satisfied before the LNG carrier would be allowed to proceed inbound from the Atlantic Ocean, ensuring that the Coast Guard could adequately monitor the safety and security zone.

The moving safety/security zone could cause impacts on recreational and other commercial vessels, but the impacts would be temporary while the LNG carrier is in transit or moored at the unloading facility. Because the safety/security zone would be a moving zone around the ship, the impacts would be of short duration at any given point along the shipping route. A recreational craft attempting to travel in the opposite direction of an LNG carrier traveling at 8 to 10 knots may need to wait up to 15 minutes for the LNG carrier to pass before proceeding on its way. The delay would increase to up to 36 minutes when the LNG carrier is traveling at 5 knots and up to 60 minutes when the LNG carrier is traveling at 3 knots. For other vessels near the facility, an additional 60-minute delay may be experienced while the LNG carrier is berthed. It should be noted that the Coast Guard moving safety and security zone zones would not be an absolute exclusion zone that would preclude all other vessel movements. Other vessels may be allowed to transit through the moving safety and moored vessel security zones with the permission of the Captain of the Port.

Because any moving safety and security zone regulation that may be promulgated by the Coast Guard would affect a moving zone around the LNG carrier, these impacts would be of short duration at any given point along the shipping route. In addition, depending on their individual drafts, commercial and recreational vessels might be able to go around the LNG carriers at points in the waterway that are sufficiently wide for them to be outside of any moving safety zone. The Coast Guard may routinely provide Notice to Mariners prior to the arrival and departure of LNG carriers. The notification system may include broadcasts on radio frequencies used by mariners. These practices and impacts currently occur in other waterways during LNG carrier transits.

FERC has received comments on this and other LNG terminal proposals expressing concern about the cost of applying additional security measures and the potential burden on local taxpayers. To meet its anticipated security responsibilities, the Coast Guard most likely would need to request additional resources through its internal resource reprogramming process for inclusion in future appropriations. Additional funding for state and local resources would be provided by Broadwater. In order to precisely determine the additional resources that would be necessary to provide the additional security to ensure safe transit of the LNG carriers, it would be necessary to develop and finalize the Operation and Emergency Manuals. Funding for security and management costs are discussed further in Section 3.10.6.

3.10.5 Environmental Impacts Associated with Coast Guard Actions

The Coast Guard's issuance of a Letter of Recommendation is a federal action that requires compliance with NEPA, just as the FERC's authorization for construction and operation of a LNG facility requires compliance with NEPA. Alternatives regarding these actions are discussed in Section 4.

Some of the potential environmental impacts resulting from LNG carrier activities and transit would not be unique to LNG carriers and may also be addressed by previous Coast Guard NEPA analyses for existing regulations. As noted in the Coast Guard NVIC 05-05, all required Coast Guard NEPA analysis and documentation must be complete prior to the issuance of any Letter of Recommendation.

Potential impacts on wildlife and aquatic resources are discussed in Sections 3.3 and 3.4. The potential impacts that result from LNG carriers in transit would be similar to those resulting from other ships using Long Island Sound. No significant impact on wildlife or aquatic resources as a result of LNG marine traffic is expected.

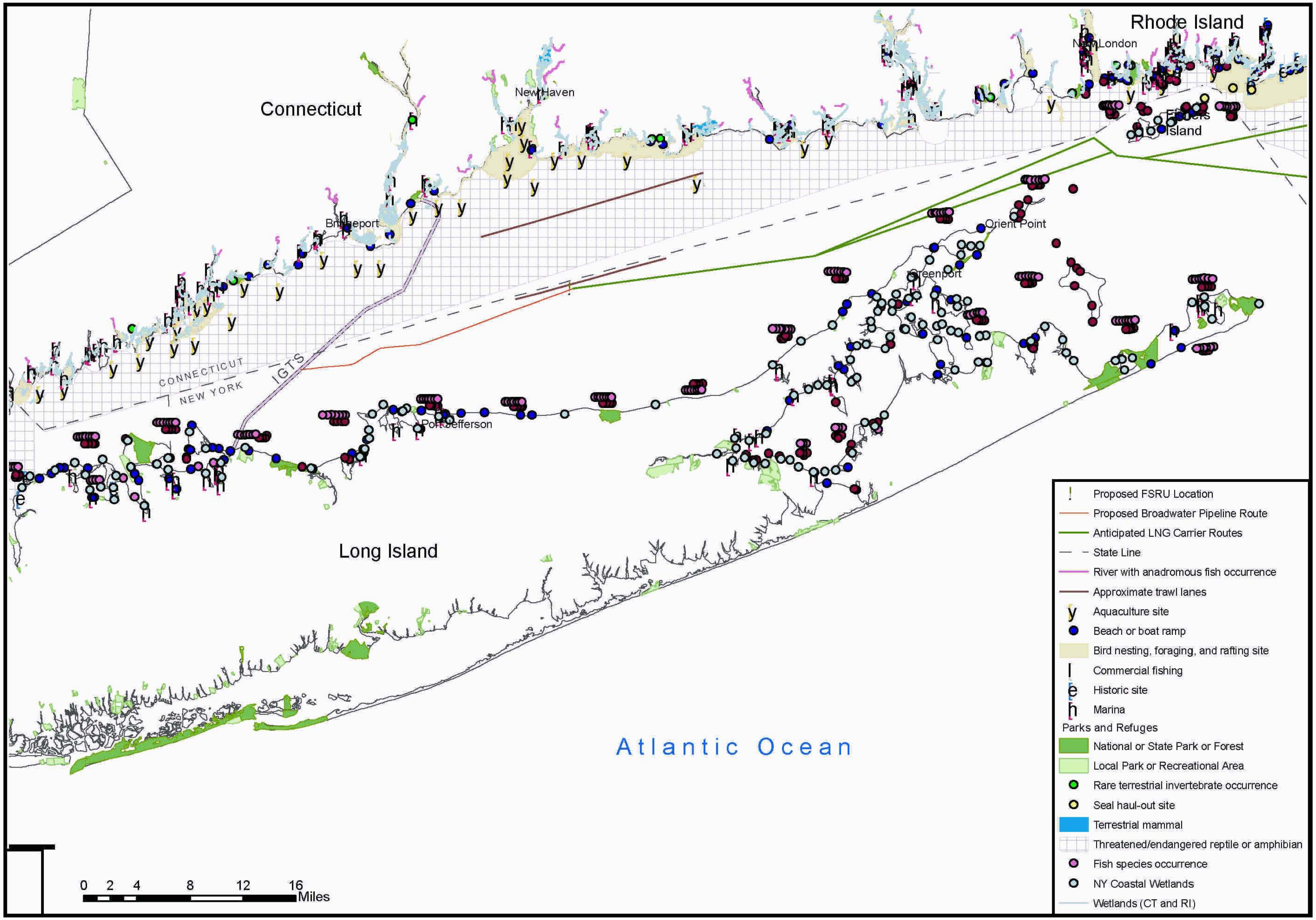
LNG carriers and support vessels would emit criteria pollutants, VOCs, and HAPS during transit. We have identified the magnitude of these emissions in Section 3.9. LNG carrier emissions while in transit and during maneuvers are considered indirect emissions and are applicable toward the General Conformity Determination. The emissions from the LNG carriers while at berth would be included in the General Conformity Determination. All LNG carrier and support vessel emissions while in transit would be required to conform to the New York SIP.

The potential impacts associated with a release of LNG are discussed generally in the preceding and following sections. The establishment of temporary safety and security zones by the Coast Guard has been considered as a potential effect on recreational use of the waterway (see Section 3.5.5). However, we do not expect these zones to significantly affect environmental resources.

The transit corridor for the LNG carriers would traverse open water and estuarine habitats within Rhode Island, Block Island, and Long Island Sounds. Shoreline habitats in the general vicinity of the routes support a wide variety of species, and human population densities vary from low to high. The anticipated routes are at least 3 miles from the shoreline, except in the vicinity of Fishers Island and Plum Island – where the shoreline is from approximately 1.1 to 1.3 miles from the routes, respectively. Figure 3.10-1 identifies environmentally sensitive areas along the shorelines in the vicinity of the anticipated transit routes. More detailed figures are provided in the Environmental Sensitivity Index Maps, which are included as Appendix G of the WSR (see Appendix D of the EIS). Figure 3.10-2 depicts three categories of population densities along the shorelines closes to the anticipated LNG carrier routes: low density (0 to 999 individuals per square mile), medium density (1,000 to 8,999 individuals per square mile), and high density (9,000 to 25,000 individuals per square mile).

Because LNG is less dense than fresh or seawater, it floats on the surface of these liquids. Immediately upon contact with any warmer substance, such as water or air, LNG begins to evaporate. As the LNG vaporizes, a vapor cloud may form that is initially heavier than air and may be dispersed by wind. As described in Section 3.10.1, an LNG vapor cloud cannot explode in the open atmosphere, but it can burn provided that the necessary combination of air and natural gas is present along with an ignition source.

Because LNG is a cryogenic liquid, the greatest threat to aquatic life from an LNG spill would be thermal stress. Any aquatic life (including plankton, fish, birds, sea turtles, marine mammals, and any federally listed species) that came into direct contact with the LNG would probably experience a sudden cold shock and, depending on what context that contact occurred, the exposure could be lethal, especially to non-motile species. Most motile underwater organisms would detect the temperature change and avoid the area. Wildlife occupying the water's surface near the release could intercept the vapor cloud and suffer asphyxiation. However, the duration of this exposure would be short, as noted below. Impacts to shoreline habitats and associated wildlife could occur, primarily, through subsequent ignition of LNG. The potential damage could involve the combustion of both vegetation and wildlife.



Sources: ArcGIS 9 Media Kit ESRI Data & Maps 2004;
SRI Atlas Rhode Island, Connecticut and the New York-New Jersey Metropolitan Area April 2002.
Note: Approximate locations on Long Island depicted in a different format since digital data were not available.

Figure 3.10-1
Broadwater LNG Project
Environmentally Sensitive Areas
along Shorelines in the Vicinity of the Anticipated LNG Carrier Routes

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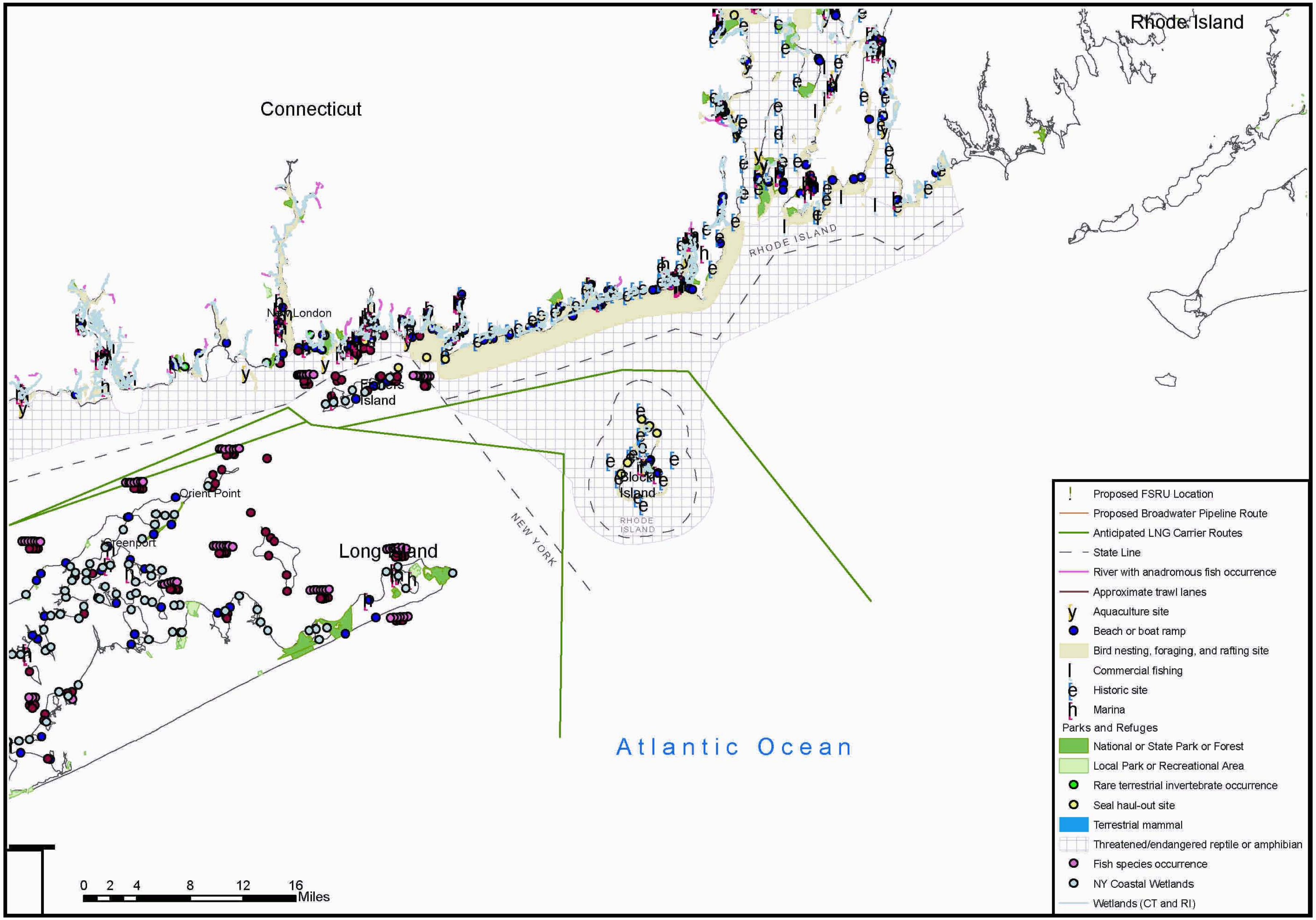
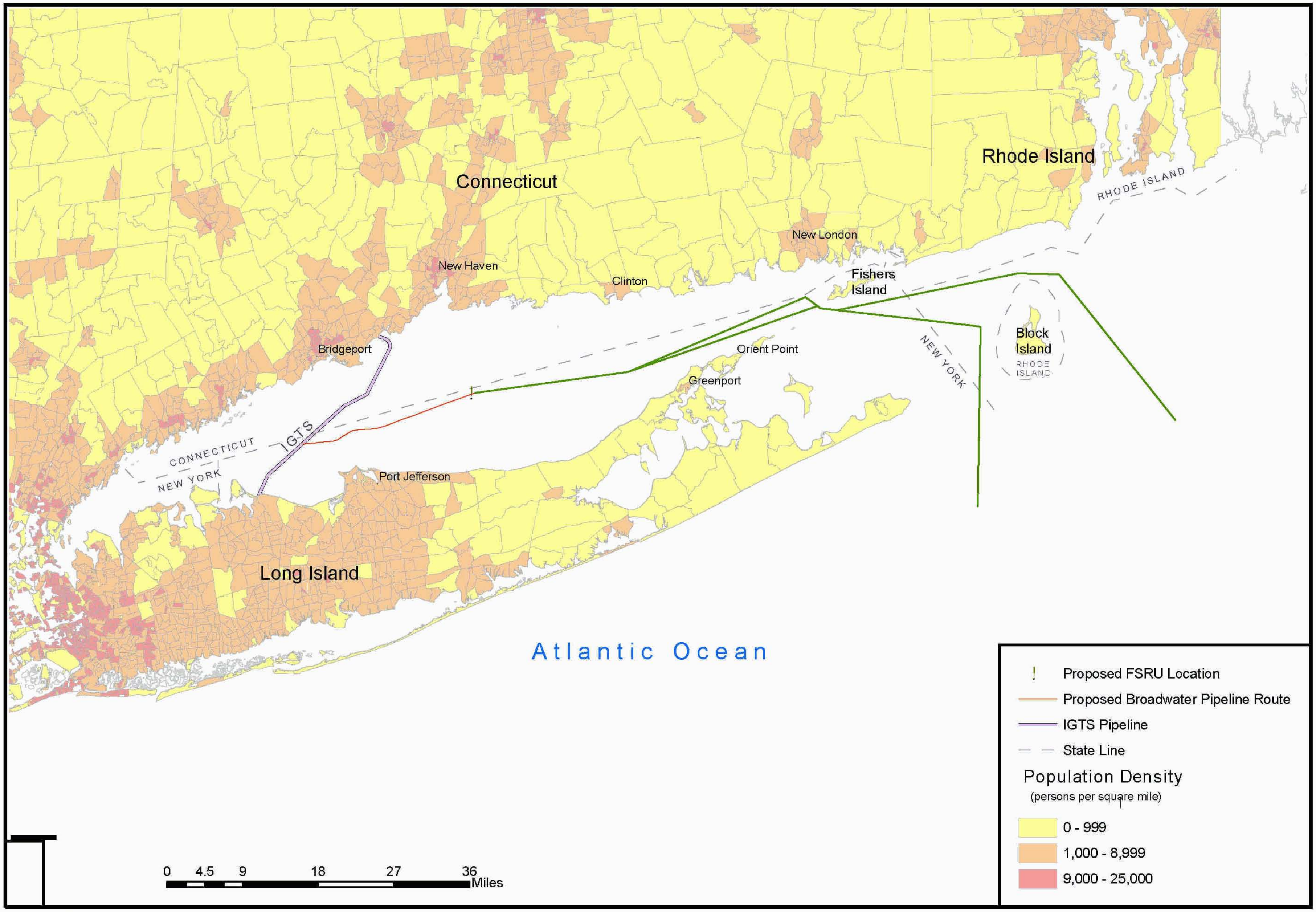


Sources: ArcGIS 9 Media Kit ESRI Data & Maps 2004;
SRI Atlas Rhode Island, Connecticut and the New York-New Jersey Metropolitan Area April 2002.
Note: Approximate locations on Long Island depicted in a different format since digital data were not available.

Figure 3.10-1
Broadwater LNG Project
Environmentally Sensitive Areas
along Shorelines in the Vicinity of the Anticipated LNG Carrier Routes

Page 2 of 2



Source: ArcGIS 9 Media Kit ESRI Data and Maps 2004

Figure 3.10-2
Broadwater LNG Project
Medium- and Low-Density Population Areas
along Shorelines near the Anticipated LNG Carrier Routes

The accident scenarios evaluated in Section 3.10.4.3 include release and ignition of natural gas formed by evaporation of spilled LNG. Natural gas combustion typically is not complete in spill scenarios. The products of incomplete combustion of natural gas include criteria pollutants, ozone precursors, toxic air contaminants, and soot (carbon particulates). It should be noted that LNG fires typically do not last as long as liquid petroleum fires.

The duration of an ignited accidental LNG spill detailed in Section 3.10.4.3 is approximately 48 minutes. For an ignited intentional LNG spill, the duration is approximately 7 minutes. The maximum increases in ambient pollutant concentrations due to the natural gas fire would occur downwind of the LNG spill. Ambient air pollutant concentrations in downwind areas could potentially exceed short-term NAAQS and state ambient air quality standards over the duration of the fire, as well as experience soot deposition and diminished visibility due to soot transport. Given the distance to shore from a potential fire along most of the transit route in the Long Island Sound, it is unlikely that sensitive receptors, such as schools, day care centers, hospitals, retirement homes, convalescence facilities, and residences, would be exposed to substantial pollutant concentrations for a significant period. There would be no long-term effects.

The pool formed from an unignited accidental LNG spill would completely evaporate in approximately 94 minutes. For an unignited intentional LNG spill, the pool would completely evaporate in approximately 7 minutes. As natural gas is not a criteria pollutant, no air quality impact would be expected from the evaporation of the LNG spill. However, methane – the primary component of LNG – is considered a greenhouse gas and may contribute to global warming.

As noted earlier, the history of LNG shipping has been free of major incidents, and none have resulted in significant quantities of LNG being released. No incidents have occurred at existing LNG terminals during the 50 years of operation that resulted in any significant quantities of cargoes being released. Historically, the events most likely to cause a significant release of LNG were ship casualties such as collisions, allisions, or groundings. Any event causing a release of LNG would need to occur with sufficient impact to breach the LNG carrier's double hull and cargo tanks. During the 44,000 voyages that have been completed since the inception of LNG maritime transportation, there has not been a serious accident at sea or in a port that resulted in a spill due to rupturing of the cargo tanks. Based on the extensive operational experience of LNG shipping, the structural design of an LNG carrier, and the operational controls that would be imposed by the Coast Guard and local pilots, the likelihood of a cargo containment failure and subsequent LNG spill from a carrier casualty – collision, grounding, or allision – would be highly unlikely. However, the possibility of an LNG spill from a carrier over the duration of the proposed Project must be considered.

Given that an LNG cargo spill would be highly unlikely, no significant socioeconomic impact associated with an accidental LNG release along the transit route would be expected. As described below, the duration of an LNG pool fire would be of short duration (from 1 to 2.5 hours). If there were an LNG spill along the transit route, it could result in a temporary interruption in ship traffic in the Long Island Sound; however, traffic in the Long Island Sound would quickly resume normal operations and any economic impact on the maritime industry would be minimal.

If a pool fire occurred where the transit route is closer to shore, businesses within 2,195 feet of the center of a spill could be subject to a long-term loss of use. Vegetation and wooden structures subjected to greater than 3,000 BTU/ft^2-hr may ignite. Because the hazard area surrounding an LNG carrier is transient (moving with the carrier along its route) it is not possible to accurately quantify the economic impact of such an incident. Section 3.10.4.3 discusses the effects of an LNG spill in greater detail.

In accordance with Section 311 of the EPAct of 2005, we recommend in Section 3.10.6 that Broadwater develop an Emergency Response Plan in consultation with the Coast Guard and state and local agencies that includes a Cost-Sharing Plan before any final approval to begin construction. Therefore, no long-term impact relating to emergency evacuation of communities would be expected.

As discussed in Section 3.10.4.3, the Sandia Report included an analysis of potential LNG cargo tank breaches due to accidental causes. The report found that accidental groundings, collisions with small vessels and low speed collisions with large vessels could cause minor ship damage but would not result in a cargo spill. This is due to the protection provided by the double hull structure, the insulation layer, and the primary cargo tank of an LNG carrier. We do not believe that there would be any environmental significance attributed to these types of accidents as a result of an LNG release.

High-speed collisions with large vessels striking at 90 degrees were found to potentially cause cargo tank breach areas of 0.5 to 1.5 square meters. For the resulting LNG spill and pool fire on water, the report determined that the most significant impact to public safety and property would exist within about 800 feet, with minimal impact beyond 2,400 feet. Depending on the actual size of the cargo tank breach, the duration of the spill and ensuing pool fire could range from approximately 1 to 2.5 hours. Using the methodology in the ABSG study, FERC staff determined that the site-specific distance to the 1,600-BTU/ft^2-hr transient hazard area for an accidental cargo tank breach in the Long Island Sound would be approximately 2,710 feet.

However, it must also be recognized that the operational controls imposed by the Coast Guard and local pilots, such as a moving LNG carrier safety zone, would be specifically designed to prevent the collision scenarios that could result in an LNG cargo tank breach. As a result, the likelihood of an LNG spill from accidental causes is considered to be negligible.

In the unlikely event of an LNG spill, the physical properties of LNG would limit any potential impacts. If spilled into water, the cryogenic liquid would vaporize rapidly upon contact with the warm air and water over a period of approximately 1 to 2.5 hours. Being less dense than water, LNG would float on the surface prior to vaporizing. Because LNG is not soluble in water and the LNG would completely vaporize shortly after being spilled, there would be no liquid left that could mix with and/or contaminate the water.

In the event of a collision or allision of sufficient magnitude to rupture an LNG cargo tank, it is likely that sparks or flames would ignite the flammable vapors at the spill site. In the unlikely event that ignition did not occur, an LNG spill would rapidly vaporize on water and form a potentially flammable cloud. If the flammable vapor cloud encountered an ignition source, the cloud would burn back to the spill site, rather than outward toward shoreline habitats.

Given these considerations, impacts to shoreline habitats as a result of an accidental LNG spill are unlikely to occur. A spill would be unlikely to result in significant impacts to shoreline habitats and wildlife that occur along the transit route. Hazard distances for intentional breaches are discussed in Section 3.10.4.3. Although an intentional breach scenario may result in greater hazard distances, such scenarios are associated with the desire to inflict damage to major infrastructure, population and commercial centers, rather than to environmentally sensitive areas along the carrier route. Also, given the navigation controls and safety and security procedures in place to specifically prevent such accidents and intentional spill scenarios, the indirect impact associated with Coast Guard actions are not reasonably foreseeable events.

As discussed in Section 3.10.4.5, if the Coast Guard issues a Letter of Recommendation finding the waterway suitable for LNG marine traffic, the Coast Guard may establish a moving safety zone, moored vessel security zone, and/or regulated navigation areas around the transiting LNG carriers and provide some level of escort as part of finalizing the Operations and Emergency Manuals. The LNG carriers would also undergo safety and security inspections to ensure compliance with U.S. and international standards. In addition, the LNG facility would submit a Facility Security Plan for review and approval by the Coast Guard. However, due to uncertainty in the scope, frequency, prevailing maritime security levels, and the number of resources that would be dedicated on a recurring or episodic basis, the Coast Guard would ensure that the appropriate NEPA environmental documentation for such actions is complete when these qualifiers can be more specifically defined.

3.10.6 Emergency Response and Evacuation Planning

While the scenarios evaluated for the FSRU in Section 3.10.3 and for LNG carriers in Section 3.10.4.3 provide guidance on the extent of potential hazards, it should not be assumed that these scenarios are the assured outcome of an FSRU or LNG carrier accident or attack, given the conservatism in each of the models and the level of damage required to yield such large-scale releases. As such, the presented scenarios should not be assumed to represent the evacuation zone for <u>every</u> potential incident. Rather they provide guidance in developing the operating restrictions for LNG carrier movements in Rhode Island Sound, Block Island Sound, and Long Island Sound, and in the immediate vicinity of the FSRU. These worst-case scenarios would be used to establish potential impact areas for emergency response and evacuation planning. As with any other fuel or hazardous material, the actual severity of the incident would determine what area needs to be evacuated, if any, rather than a worst-case maximum zone. It is anticipated that the emergency evacuation plans would identify evacuation distances based upon increasing severity of events.

On several LNG import terminal proposals, a number of organizations and individuals commented on the need to consider emergency response procedures. Subsequently, Section 3A(e) of the Natural Gas Act, added by Section 311 of the EPAct of 2005, stipulated that in any Order authorizing an LNG terminal, the Commission shall require the LNG terminal operator to develop an Emergency Response Plan in consultation with the Coast Guard and state and local agencies. The FERC must approve the Emergency Response Plan prior to any final approval to begin construction. Therefore, **we recommend that:**

- **Broadwater should develop an Emergency Response Plan and coordinate procedures with the Coast Guard; state, county, and local emergency planning groups; fire departments; state and local law enforcement; and appropriate Federal agencies. This plan should include at a minimum:**

  a. **designated contacts with state and local emergency response agencies;**
  b. **scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and severity of potential incidents;**
  c. **procedures for notifying residents and recreational users within areas of potential hazard;**
  d. **evacuation routes/methods for residents and other public use areas that are within any transient hazard areas along the route of the LNG carrier transit;**
  e. **locations of permanent sirens and other warning devices;**
  f. **an "emergency coordinator" on each LNG carrier to activate sirens and other warning devices;**
  g. **provisions to address the recommendations contained in Section 6.2 of the WSR;**
  h. **procedures for off-loading LNG from the FSRU to LNG carrier in the event that the FSRU must be removed from the mooring; and**

i. **procedures for pumping down the LNG onboard the FSRU in preparation for severe weather events such as a hurricane.**

The Emergency Response Plan should be filed with the Secretary for review and written approval by the Director of OEP prior to keel laying or any other Project-related construction activity. Broadwater should notify FERC staff of all planning meetings in advance and should report progress on the development of its Emergency Response Plan at 3-month intervals.

FERC has also received comments on other LNG terminal proposals expressing concern that the local community would need to bear some of the cost of ensuring the security and emergency management of the LNG facility and the LNG carriers while in transit and unloading at the berth. In addition, Section 311 of the EPAct of 2005 specifies that the Emergency Response Plan shall include a Cost-Sharing Plan that contains a description of any direct cost reimbursements the applicant agrees to provide to any state and local agencies with responsibility for security and safety at the LNG terminal and in proximity to vessels that serve the facility. To allow the FERC an opportunity to review the plan, **we recommend that**:

- **The Emergency Response Plan should include a Cost-Sharing Plan identifying the mechanisms for funding all Project-specific security/emergency management costs that would be imposed on state and local agencies. In addition to the funding of direct transit-related security/emergency management costs, this comprehensive plan should include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. The Cost-Sharing Plan should be filed with the Secretary for review and written approval by the Director of OEP prior to keel laying or any other Project-related construction activity.**

3.10.7 Conclusions on Marine Safety

The operational safety of LNG carriers is under the jurisdiction of the Coast Guard. The LNG carriers would be subject to Coast Guard inspection and enforcement practices, and the Coast Guard would also implement and enforce a moving safety and security zone around incoming and departing carriers.

The Coast Guard Captain of the Port Long Island Sound has issued a WSR that addresses the safety and security aspects of the Project from a marine perspective. As described in the WSR, Coast Guard Sector Long Island Sound currently does not have the resources required to implement the measures that have been identified as being necessary to effectively manage the potential risk to navigation safety and maritime security associated with the proposed project in addition to current levels of mission activity. Obtaining the required resources would require either curtailing current activities within the Sector, reassigning resources from outside of the Sector, or for the Coast Guard to seek additional resources through the President's budget process. Consequently, the Coast Guard has determined that, to make the waters of Block Island Sound and Long Island Sound suitable for LNG carrier traffic and the operation of the FSRU, additional measures would be necessary to responsibly manage the potential risks to navigation safety and maritime security associated with Broadwater's proposal.

After completion of the NEPA process, the Captain of the Port will issue a Letter of Recommendation to Broadwater. The Letter of Recommendation will be based on the WSR and will be the official determination regarding the suitability or unsuitability of the waterways to support the proposed LNG facility and associated LNG carrier traffic. If the Coast Guard determines the waterway to be suitable, the Letter of Recommendation would stipulate the specific operating procedures that Broadwater would be required to follow.

3.10.8 Terrorism and Security Issues

The security requirements for the proposed Project are governed by 33 CFR 105 and would also be addressed in the Letter of Recommendation. Requirements for maintaining safety of the marine terminal are provided in 33 CFR 127.

In the aftermath of the terrorist attacks that occurred on September 11, 2001, terrorism has become a very real issue for the facilities under the Commission's jurisdiction. The FERC, like other federal agencies, is faced with a dilemma in how much information can be offered to the public while still providing a significant level of protection to the facility. Consequently, the FERC has removed energy facility design plans and location information from its website to ensure that sensitive information filed under CEII is not readily available (RM02-4-000 and PL02-1-000 issued February 20, 2003).

Since September 11, 2001, the FERC has been involved with other federal agencies in developing a coordinated approach to protecting the energy facilities of the United States. The FERC continues to coordinate with these agencies – and specifically with the Coast Guard – to address this issue. The Coast Guard now requires arriving ships to provide them with a 96-hour advance notice of arrival that includes key information about the vessel and its crew which allows the Coast Guard to conduct a terrorism risk assessment and put in place appropriate mitigation before the ship reaches the ship channel. In addition, interstate natural gas companies are actively involved with several industry groups to chart how best to address security measures in the current environment. A Security Task Force has been created and is addressing ways to improve pipeline security practices, strengthen communications within the industry and the interface with government, and extend public outreach efforts.

On October 22, 2003, the Coast Guard issued a series of six final rules, which promulgated the maritime security requirements of the Marine Transportation Security Act of 2002: Implementation of National Maritime Security Initiatives; Area Maritime Security; Vessel Security; Facility Security; Continental Shelf Facility Security; and the Automatic Identification System. The entire series of rulemakings establishes a new Subchapter H in 33 CFR. In support of the rulemakings, the Coast Guard applied a risk-based decision making process to comprehensively evaluate the relative risks of various target and attack mode combinations and scenarios for those vessel types and port facilities that pose a risk of a security incident. This approach provides a more realistic estimation of risk than a simple worst-case outcome assessment. Risk management principles acknowledge that, while risk generally cannot be eliminated, it can be reduced by adjusting operations to lower consequences, threats, or vulnerability – recognizing that it is easier to reduce vulnerabilities by adding security measures.

On December 29, 2003, all terminal owners or operators subject to 33 CFR 105 were required to submit a Facility Security Assessment and Facility Security Plan to the Coast Guard Captain of the Port for review and approval. The Facility Security Plans were required to be implemented no later than July 1, 2004, or – for facilities constructed after July 1, 2004, 60 days prior to operations. Some of the principal owner or operator responsibilities include:

- Designating an FSO with a general knowledge of current security threats and patterns, risk assessment methodology, and the responsibility for implementing the Facility Security Plan and Assessment and performing an annual audit for the life of the project;
- Conducting a Facility Security Assessment to identify site vulnerabilities, possible security threats and consequences of an attack, and facility protective measures;

- Developing a Facility Security Plan based on the Facility Security Assessment, with procedures for responding to transportation security incidents, notification and coordination with local, state, and federal authorities, prevent unauthorized access; measures and equipment to prevent or deter dangerous substances and devices; training; and evacuation;
- Implementing scalable security measures to provide increasing levels of security at increasing MARSEC levels for facility access control, restricted areas, cargo handling, vessel stores and bunkers, and monitoring;
- Conducting security exercises at least once each calendar year and drills at least every three months; and
- Reporting all breaches of security and security incidents.

Increased security awareness has occurred throughout the industry and the nation. President Bush established the Office of Homeland Security with the mission of coordinating the efforts of all executive departments and agencies to detect, prepare for, prevent, protect against, respond to, and recover from terrorist attacks within the United States. The Commission, in cooperation with other federal agencies and industry trade groups, has joined in the efforts to protect the energy infrastructure, including the more than 300,000 miles of interstate natural gas transmission pipeline and associated LNG facilities.

Safety and security are important considerations in any Commission action. The attacks of September 11, 2001, have changed the way pipeline operators as well as regulators must consider terrorism, both in approving new projects and in operating existing facilities. However, the likelihood of future acts of terrorism or sabotage occurring at the proposed LNG import terminal, or at any of the myriad natural gas pipeline or energy facilities throughout the United States is unpredictable given the disparate motives and abilities of terrorist groups. The continuing need to construct facilities to support the future natural gas pipeline infrastructure is not diminished from the threat of any such unpredictable acts.

As discussed in this section, potential risks associated with the proposed Project were assessed by the Coast Guard. The results of this assessment are documented in Section 5 of the WSR (see Appendix D).

3.10.9 Pipeline Reliability and Safety

The transportation of natural gas by pipeline involves some risk to the public in the event of an accident and subsequent release of gas. For onshore pipelines, the greatest hazard is a fire or explosion following a major pipeline rupture. (see Section 3.10.1 for information on the hazardous properties of natural gas); however, the pipeline proposed for the Broadwater Project is a subsea pipeline that has limited for fires or explosions as described in this section.

3.10.9.1 Safety Standards

The DOT is mandated to provide pipeline safety under Title 49, USC Chapter 601. The Pipeline and Hazardous Materials Safety Administration's (PHMSA), Office of Pipeline Safety (OPS), administers the national regulatory program to ensure the safe transportation of natural gas and other hazardous materials by pipeline. It develops safety regulations and other approaches to risk management that ensure safety in the design, construction, testing, operation, maintenance, and emergency response of pipeline facilities. Many of the regulations are written as performance standards which set the level of safety to be attained and allow the pipeline operator to use various technologies to achieve safety. PHMSA ensures that people and the environment are protected from the risk of pipeline incidents. This work is shared with state agency partners and others at the federal, state, and local level. Section 5(a) of the Natural Gas Pipeline Safety Act provides for a state agency to assume all aspects of the safety program for intrastate facilities by adopting and enforcing the federal standards, while Section 5(b) permits a state agency that does not qualify under Section 5(a) to perform certain inspection and monitoring functions. A state may also act as DOT's agent to inspect interstate facilities within its boundaries; however, the DOT is responsible for enforcement action. The majority of the states have either 5(a) certifications or 5(b) agreements, while nine states act as interstate agents. In New York, the Public Service Commission acts as the interstate agent.

The DOT pipeline standards are published in Parts 190 to 199 of Title 49 of the CFR. Part 192 of 49 CFR specifically addresses natural gas pipeline safety issues.

Under a Memorandum of Understanding on Natural Gas Transportation Facilities dated January 15, 1993, between the DOT and FERC, DOT has the exclusive authority to promulgate federal safety standards used in the transportation of natural gas. Section 157.14(a)(9)(vi) of the FERC's regulations require that an applicant certify that it will design, install, inspect, test, construct, operate, replace, and maintain the facility for which a certificate is requested in accordance with federal safety standards and plans for maintenance and inspection, or shall certify that it has been granted a waiver of the requirements of the safety standards by the DOT in accordance with Section 3(e) of the Natural Gas Pipeline Safety Act. FERC accepts this certification and does not impose additional safety standards other than DOT standards. If the Commission becomes aware of an existing or potential safety problem, there is a provision in the Memorandum to promptly alert the DOT. The Memorandum of Understanding also provides for referring complaints and inquiries made by state and local governments and the general public involving safety matters related to pipeline under the Commission's jurisdiction.

FERC also participates as a member of the DOT's Technical Pipeline Safety Standards Committee which determines if proposed safety regulations are reasonable, feasible, and practicable.

The pipeline and associated aboveground facilities, such as the pipeline riser on the mooring tower and the gas jumper lines connected to the FSRU, proposed for the Broadwater Project must be designed, constructed, operated, and maintained in accordance with the DOT Minimum Federal Safety Standards in 49 CFR Part 192. The regulations are intended to ensure adequate protection for the public and to prevent natural gas facility accidents and failures. Part 192 specifies material selection and qualification, minimum design requirements, and protection from internal, external, and atmospheric corrosion.

Pipeline Area Classifications

The DOT Minimum Federal Safety Standards in 49 CFR Part 192 also define area classifications based on population density in the vicinity of the pipeline, and specifies rigorous safety requirements for densely populated areas. The class location unit is an area that extends 220 yards on either side of the centerline of any continuous 1-mile length of pipeline. The four area classifications are defined as follows:

Class 1	Location with 10 or fewer buildings intended for human occupancy.
Class 2	Location with more than 10 but less than 46 buildings intended for human occupancy.
Class 3	Location with 46 or more buildings intended for human occupancy or where the pipeline lies within 100 yards of any building, or small well-defined outside area

occupied by 20 or more people on at least 5 days a week for 10 weeks in any 12-month period.

Class 4 Location where buildings with four or more stories aboveground are prevalent.

Class locations representing more populated areas require higher safety factors in pipeline design, testing, and operation. Pipelines constructed on land in Class 1 locations must be installed with a minimum depth of cover of 30 inches in normal soil and 18 inches in consolidated rock. All pipelines installed in navigable rivers, streams, and harbors must have a minimum cover of 48 inches in soil or 24 inches in consolidated rock. Offshore pipelines constructed in less than 12 feet of water, as measured from the mean low tide, must have a minimum cover of 36 inches in soil and 18 inches in consolidated rock. Offshore pipelines constructed in 12 to 200 feet of water, as measured from the mean low tide, must be installed so that the top of the pipe is below the natural bottom unless the pipeline is protected by some other means such as a heavy concrete coating.

Class locations also specify the maximum distance to a sectionalizing block valve (for example, 10.0 miles in Class 1, 7.5 miles in Class 2, 4.0 miles in Class 3, and 2.5 miles in Class 4). Pipe wall thickness and pipeline design pressures, hydrostatic test pressures, maximum allowable operating pressure, inspection and testing of welds, and frequency of pipeline patrols and leak surveys must also conform to higher standards in more populated areas.

Because the entire length of the Broadwater pipeline would be located offshore in Long Island Sound and would have no buildings intended for human occupancy within 220 yards of the proposed centerline, it would be required to meet Class 1 requirements.

Pipeline High Consequence Areas

In 2002, Congress passed an act to strengthen the Nation's pipeline safety laws. The Pipeline Safety Improvement Act of 2002 (HR 3609) was passed by Congress on November 15, 2002, and signed into law by the President in December, 2002. No later than December 17, 2004, gas transmission operators were required to develop and follow a written integrity management program that contains all the elements described in §192.911 and addresses the risks on each covered transmission pipeline segment. Specifically, the law establishes an integrity management program which applies to all high consequence areas (HCAs). The DOT (68 FR 69778, 69 FR 18228, and 69 FR 29903) defines HCAs as they relate to the different class zones, potential impact circles, or areas containing an identified site as defined in §192.903 of the DOT regulations.

OPS published a series of rules from August 6, 2002 to May 26, 2004 (69 FR 29903) that defines HCAs where a gas pipeline accident could do considerable harm to people and their property and requires an integrity management program to minimize the potential for an accident. This definition satisfies, in part, the Congressional mandate in 49 U.S.C. 60109 for OPS to prescribe standards that establish criteria for identifying each gas pipeline facility in a high density population area.

The HCAs may be defined in one of two ways. In the first method an HCA includes

- Current Class 3 and 4 locations;
- Any area in Class 1 or 2 where the potential impact radius is greater than 660 feet and there are 20 or more buildings intended for human occupancy within the potential impact circle; or
- Any area in Class 1 or 2 where the potential impact circle includes an identified site;

In the second method, an HCA includes any area within a potential impact circle which contains:

- 20 or more buildings intended for human occupancy; or
- An identified site.

Once a pipeline operator has determined the HCAs on its pipeline, it must apply the elements of its integrity management program to those segments of the pipeline within HCAs. The DOT regulations specify the requirements for the integrity management plan at § 192.911. The HCAs have been determined based on the relationship of the pipeline centerline to other nearby structures and identified sites.

Due to the offshore location, there are no HCAs in the vicinity of the pipeline proposed for the Broadwater Project.

Pipeline Emergency Planning

Part 192 also prescribes the minimum standards for operating and maintaining pipeline facilities, including the requirement to establish a written plan governing these activities. Under Section 192.615, each pipeline operator must also establish an emergency plan that includes procedures to minimize the hazards in a natural gas pipeline emergency. Key elements of the plan include procedures for:

- Receiving, identifying, and classifying emergency events, gas leakage, fires, explosions, and natural disasters;
- Establishing and maintaining communications with local fire, police, and public officials, and coordinating emergency response;
- Emergency shutdown of system and safe restoration of service;
- Making personnel, equipment, tools, and materials available at the scene of an emergency; and
- Protecting people first and then property, and making them safe from actual or potential hazards.

In addition to the federal safety standards discussed above, Part 192 requires that each operator establish and maintain liaison with appropriate fire, police, and public officials to learn the resources and responsibilities of each organization that may respond to a natural gas pipeline emergency, and to coordinate mutual assistance. The operator must also establish a continuing education program to enable customers, the public, government officials, and those engaged in excavation activities to recognize a gas pipeline emergency and report it to appropriate public officials. Broadwater would be required provide the appropriate training to local emergency service personnel before the pipeline is placed in service. No additional specialized local fire protection equipment would be required to handle pipeline emergencies.

Pipeline Security

Because of the offshore location of the proposed pipeline, there would be minimal security risk. Broadwater would be able to receive security updates and alerts on a regular basis from external agencies, including the Federal Bureau of Investigation (FBI). Broadwater would be able to work with the FBI and other intelligence sources to ensure that appropriate security measures for the pipeline are in place. In addition, the natural gas industry is actively involved with several industry groups to chart how best to address security measures in the current environment. Some companies have formed the Security Task Force for the Interstate Natural Gas Association of America. This task force is addressing ways to improve pipeline security practices, strengthen communications within the industry and interface with government, and extend public outreach efforts.

In September 2002, the OPS issued non-public guidelines to pipeline operators that direct them to develop new security procedures. Operators are required to assess their critical energy infrastructure and to prepare a security plan that responds to the five threat levels of the Office of Homeland Security. Operators are required to develop such plans and report the details to OPS. In deciding how to respond to each security alert level, pipeline operators would take into account a number of factors, including public safety and infrastructure reliability. OPS would subsequently conduct reviews of the security procedures for adequacy. Broadwater would be required to comply with these procedures.

3.10.9.2 Pipeline Accident Data

For the purposes of this EIS, the risks associated with the pipeline transportation of natural gas have been estimated based on historical onshore and offshore pipeline-incident data compiled by OPS. The readily available data include both onshore and offshore pipelines and do not distinguish between onshore and offshore pipelines incidents.

Since February 9, 1970, 49 CFR Part 191 has required all operators of transmission and gathering systems to notify the DOT of any reportable incident and to submit a report on form F7100.2 within 20 days. Reportable incidents were defined as any leaks that:

- Caused a death or personal injury requiring hospitalization;
- Required taking any segment of a transmission line out of service;
- Resulted in gas ignition;
- Caused estimated damage to the property of the operator, or others, or both, of a total of $5,000 or more;
- Required immediate repair on a transmission line;
- Occurred while testing with gas or another medium; or
- In the judgment of the operator was significant, even though the leak did not meet the above criteria.

The DOT changed reporting requirements in June 1984 to reduce the amount of data collected. Since that date, operators must report only incidents that involve property damage of more than $50,000, injury, death, or release of gas, or that are otherwise considered significant by the operator. Table 3.10.9-1 presents a summary of incident data from 1970 through June 1984, as well as the most recent incident data available for the period from 1986 through 2005, recognizing the difference in reporting requirements. The 14.5-year period from 1970 through June 1984, which provides a larger universe of data and more basic report information than subsequent years, has been subject to detailed analysis, as discussed in the following sections.

During the 14.5-year period from 1970 through June 1984, 5,862 service incidents were reported for approximately 300,000 total miles of natural gas transmission and gathering systems in place nationwide. Service incidents, defined as failures that occur during pipeline operation, remained fairly constant over this period with no clear upward or downward trend in annual totals. In addition, 2,013 test failures were reported. Correction of test failures removed defects from the pipeline before operation (American Gas Association 1986).

Table 3.10.9-1 **Natural Gas Service Incidents by Cause**		
	Incidents per 1,000 miles of Pipeline [a]	
Cause	**1970 through June 1984[b]**	**1986 through 2005[c]**
Outside forces	0.70 (53.8%)	0.10 (38.5%)
Corrosion	0.22 (16.9%)	0.06 (23.1%)
Construction or material defect	0.27 (20.8%)	0.04 (15.4%)
Other	0.11 (8.5%)	0.06 (23.1%)
Total	**1.30**	**0.26**

[a] Sources: American Gas Association (1986); U.S. DOT, OPS, http://ops.dot.gov/stats.htm.

[b] Reporting basis: Incidents resulting in property damage of $5,000; or injury, death, or release of gas, or that are otherwise considered significant by the operator.

[c] Reporting basis: Incidents resulting in property damage of $50,000; or injury, death, or release of gas, or than are otherwise considered significant by the operator.

Additional insight into the nature of service incidents may be found by examining the primary factors that caused the failures. Table 3.10.9-2 provides a percentage distribution of the causal factors as well as the annual frequency of each factor per 1,000 miles of pipeline in service (American Gas Association 1986). Data presented for the period extending from mid 1986 through 2003 were gathered from the DOT's OPS.

Table 3.10.9-2 **Outside Forces Incidents by Cause (1970-1984) [a]**	
Cause	**Percent**
Equipment operated by outside party	67.1
Equipment operated by or for operator	7.3
Earth movement	13.3
Weather	10.8
Other	1.5

[a] Source: U.S. DOT, OPS, http://ops.dot.gov/stats.htm.

The dominant incident cause was outside forces, constituting 53.8 percent of all service incidents for the reporting periods 1970 through June 1984. Outside forces incidents result from the encroachment of mechanical equipment, such as bulldozers and backhoes; earth movements due to soil settlement, washouts, or geologic hazards; weather effects such as winds, storms, and thermal strains; and willful damage. Table 3.10.9-2 indicates that human error in equipment usage was responsible for approximately 72 percent of outside forces incidents. Since April 1982, operators have been required to participate in "One Call" public utility programs in populated areas to minimize unauthorized excavation activities in the vicinity of pipelines. The "One Call" program is a service used by public utilities and some private sector companies to provide preconstruction information to contractors or other maintenance workers on the underground location of pipes, cables, and culverts. The 1984 through 2005 data show that the portion of incidents caused by outside forces decreased to 38.5 percent (Table 3.10.9-2).

The pipelines included in the data set in Table 3.10.9-1 vary widely in terms of age, pipe diameter, and level of corrosion control. Each variable influences the incident frequency that may be expected for a specific segment of pipeline.

The frequency of incidents strongly depends on pipeline age. While pipelines installed since 1950 exhibit a fairly constant level of incident frequency, pipelines installed before that time have a significantly higher rate, partially due to corrosion. Older pipelines have a higher frequency of corrosion incidents, since corrosion is a time-dependent process. Further, new pipe generally uses more advanced coatings and cathodic protection to reduce corrosion potential.

Older pipelines have a higher frequency of outside forces incidents partly because their location may be less well known and less well marked than newer pipelines. In addition, the older pipelines contain a disproportionate number of smaller diameter pipelines, which have a greater rate of outside forces incidents. Small diameter pipelines are more easily crushed or broken by mechanical equipment or earth movements.

Table 3.10.9-3 demonstrates the effectiveness of corrosion control in reducing the incidence of failures caused by external corrosion. The use of both an external protective coating and a cathodic protection system, required on all pipelines installed after July 1971, significantly reduces the rate of failure compared to unprotected or partially protected pipe. The data suggest that bare, cathodically protected pipe has a higher corrosion rate than unprotected pipe. This anomaly reflects the retrofitting of cathodic protection to actively corroding spots on pipelines.

Table 3.10.9-3
External Corrosion Incidents by Level of Control[a]

	Incidents per 1,000 Miles per Year
Corrosion Control	**1970 through June 1984**
None – bare pipe	0.42
Cathodic protection only	0.97
Coated only	0.40
Coated and cathodic protection	0.11

[a] Sources: American Gas Association (1986); U.S. DOT, OPS, http://ops.dot.gov/stats.htm.

3.10.9.3 Impact on Public Safety

Historical Data

The service incident data summarized in Table 3.10.9-1 include pipeline failures of all magnitudes with widely varying consequences. Approximately two-thirds of the incidents were classified as leaks, and the remaining third was classified as ruptures, implying a more serious failure.

Table 3.10.9-4 presents the average annual fatalities that occurred on natural gas transmission and gathering lines from 1970 to 2005. Fatalities between 1970 and June 1984 have been separated into employees and non-employees, to better identify a fatality rate experienced by the general public. Of the total 5.0 nationwide average, fatalities among the public averaged 2.6 per year over this period. The simplified reporting requirements in effect after June 1984 do not differentiate between employees and non-employees. However, the data show that the total annual average for the period 1984 through 2005 decreased to 3.6 fatalities per year. Subtracting two major offshore incidents in 1989, which do not reflect the risk to the onshore public, yields a total annual rate of 2.8 fatalities per year for this period.

Table 3.10.9-4
Annual Average Fatalities Associated with Incidents at Natural Gas Transmission and Gathering Systems[a]

Year	Employees	Non-employees	Total
1970 – June 1984	2.4	2.6	5.0
1984 – 2005[b]	-	-	3.6
1984 – 2005	-	-	2.8[c]

[a] Sources: American Gas Association (1986); DOT, Hazardous Materials Information System, http://hazmat.dot.gov.

[b] Employee/non-employee breakdown not available after June 1984.

[c] Without 18 offshore fatalities occurring in 1989 (11 resulting from a fishing vessel striking an offshore pipeline and 7 from an explosion on an offshore production platform).

The nationwide totals of accidental fatalities from various manmade and natural hazards are listed in Table 3.10.9-5 to provide a relative measure of the industry-wide safety of natural gas pipelines. Direct comparisons between accident categories should be made cautiously because individual exposures to hazards are not uniform among all categories. Nevertheless, the average 2.6 public fatalities per year is relatively small considering the more than 300,000 miles of transmission and gathering lines in service nationwide. Furthermore, the fatality rate is approximately two orders of magnitude (100 times) lower than the fatalities from natural hazards such as lightning, tornados, floods, and earthquakes.

Table 3.10.9-5
Nationwide Accidental Deaths [a]

Type of Accident	Fatalities
All accidents[a]	97,900
Motor vehicles	43,649
Falls	14,985
Drowning	3,488
Poisoning	9,510
Fires and burns	3,791
Suffocation by ingested object	3,206
Tornado, flood, earthquake, etc. (1984-93 average)	181
All liquid and gas pipelines (1978-1987 average) [b]	27
Gas transmission and gathering lines, Non-employees only (1970-1984 average) [c]	2.6

[a] All data, unless otherwise noted, reflect 1996 statistics from the U.S. Department of Commerce, Bureau of the Census, "Statistical Abstract of the United States 118th Edition."

[b] U.S. Department of Transportation, "Annual Report on Pipeline Safety - Calendar Year 1987."

[c] American Gas Association (1986).

Potential Broadwater Releases

The available data show that natural gas pipelines continue to be a safe, reliable means of energy transportation. Based on approximately 300,000 miles in service, the rate of public fatalities for the nationwide mix of transmission and gathering lines in service is 0.01 per year per 1,000 miles of pipeline. Because the Broadwater pipeline would be offshore, there actual risk to the public would be substantially less. There are fewer types of activities that could affect the integrity of the offshore pipeline compared to onshore pipelines. However, accidental releases from the pipeline could result from material defects or corrosion, or from third-party strikes from anchors, dropped objects, or trawl gear. In the event of an offshore natural gas release, gas would rise through the water column. Depending upon the water depth, the gas may or may not be within the flammable range upon surfacing, but would be at atmospheric pressure upon reaching the water surface. If the concentration of the gas were within the flammable range and an ignition source were present, a pool fire could occur and burn temporarily at the water surface. An explosion would not occur because the gas would be unconfined. Gas flow through the pipeline would be stopped by automatic flow shutdown valves, but the pressurized gas inventory in the pipeline would continue to vent through the water column until the gas pressure equilibrated with the water pressure at the leak point.

As a result, there would be little or no risk to the public if an incident were to occur with the Broadwater pipeline that resulted in the release of natural gas.

3.11 CUMULATIVE IMPACTS

Cumulative impacts may result when the environmental effects associated with a proposed project are added to either temporary (construction-related) or permanent (operation-related) impacts associated with past, present, or reasonably foreseeable future projects. Although the individual impact of each separate project might not be significant, the additive or synergistic effects of multiple projects could be significant. This cumulative analysis focuses on potential impacts from the proposed Project to resource areas or issues where their incremental contribution would be potentially significant when added to the potential impacts of other actions.

An action must first meet three criteria to be a candidate for inclusion in the cumulative analysis. The action must:

- Affect a resource (e.g., marine biological resources) or resources potentially affected by the proposed Project;
- Cause this impact within all, or part of, the Project area; and
- Cause this impact within all, or part of, the timespan for the potential impact from the proposed Project.

In the previous sections, we have identified resources that could be affected by the proposed Project. Because the Project essentially has no onshore component, the resources affected are associated with the waters of Long Island Sound. Consequently, for the purposes of this cumulative impact analysis, we are considering the Project area to be Long Island Sound, in general, and more specifically, the pelagic regions of the Sound. Further, several commentors have expressed concern that approval of the proposed Project could lead to "industrialization" of the Sound. To assess the potential for this to occur, we evaluated four potential factors that could lead to such development: secondary economic activity, economic clustering (or agglomeration), precedent, and entrepreneurial innovation. After considering each of these factors, we concluded that there is a minimal probability that construction of the Broadwater

Project could lead to industrialization of the Sound. This concept is addressed in greater detail in Section 3.5.2.

The actions considered in the cumulative analysis may vary from the proposed Project in nature, magnitude, and duration. These actions are included based on the likelihood of completion, and only projects either with ongoing impacts or that are "reasonably foreseeable" future actions were evaluated as part of the cumulative impact analysis. Other existing or reasonably foreseeable actions that would be expected to affect similar resources during similar time periods were considered further in the cumulative impact analysis. The anticipated cumulative impacts of the proposed Project and these other actions are discussed, as well as any pertinent mitigation actions. The anticipated cumulative impacts were based on NEPA documentation, agency and public input, and best professional judgment.

A total of 12 projects are either in place, are under construction, or are reasonably foreseeable future projects in the Project area (Table 3.11-1). These projects consist of two existing and one proposed natural gas pipelines, five existing subsea telecommunication or electric transmission cables, two offshore oil transfer platforms, and two proposed offshore dredged material disposal sites. Figure 3.11-1 shows the location of these existing and potential projects.

TABLE 3.11-1
Summary of Potential Cumulative Impacts from Other Projects in the Broadwater Project Area

		Potential for Impacts to Project Area through 2009				
Project	**Construction Date[a]**	**Water Quality?**	**Marine Biological Resources?**	**Visual Resources?**	**Air Quality?**	**Marine Transportation?**
Pipelines						
IGTS	1991	No	No	No	No	No
Eastchester	2004	No	IU	No	No	No
Islander East	(2007)	Yes	Yes	No	Yes	Yes
Cables						
1385 Cable	1969	Yes	Yes	No	No	No
Cross Sound Cable	2002	No	No	No	No	No
AT&T Cable	1993	No	IU	No	No	No
MCI Cable	1996	No	IU	No	No	No
FLAG Atlantic North Cable	2001	No	IU	No	No	No
Other						
KeySpan Northport Platform	1967	No	No	Yes	Yes	Yes
ConocoPhillips Northport Platform	IU	No	No	Yes	Yes	Yes
COE Dredge Disposal Sites (Western and Central Long Island Sound)	IU	Yes	Yes	No	No	No

IU = Quantitative information unavailable.

[a] () = anticipated date.

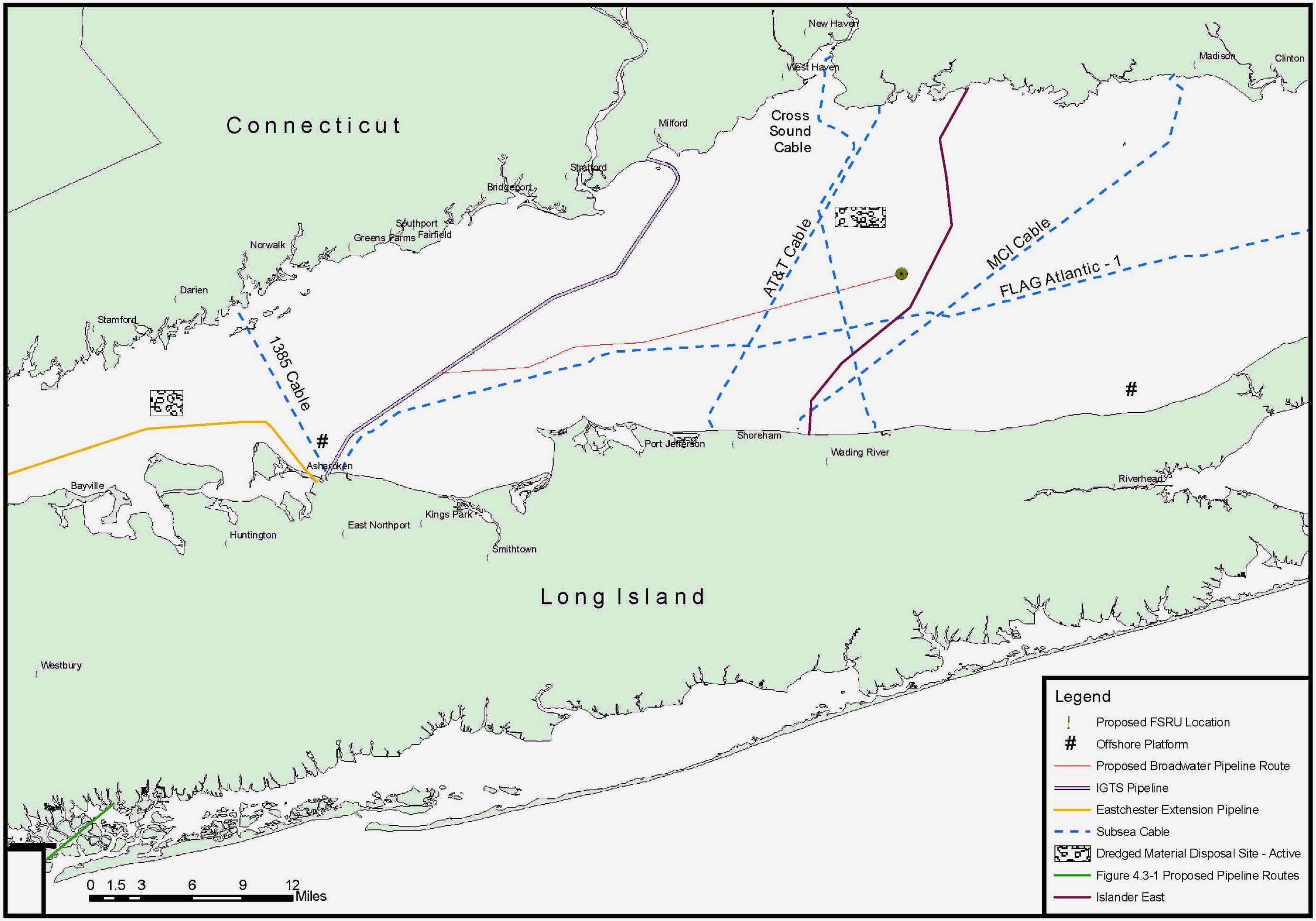


Figure 3.11-1
Broadwater LNG Project
Existing and Proposed Long Island Sound Projects

3.11.1 Pipelines

3.11.1.1 Islander East Pipeline Project

The Islander East Pipeline Company has proposed construction of a 24-inch-diameter gas transmission pipeline system from New Haven, Connecticut, to Shoreham, New York on Long Island (FERC 2002). The Islander East Pipeline Project would include approximately 22.6 miles of subsea pipeline across Long Island Sound and 5 miles of additional lateral pipeline on Long Island. The Islander East pipeline would be constructed approximately 6 miles east of the proposed Broadwater FSRU and subsea pipeline.

The Islander East Pipeline Project is considered here with respect to the potential for cumulative impacts to the offshore habitats of Long Island Sound. The project has been approved by FERC but has been delayed for several years because the State of Connecticut denied issuance of a water quality certificate for the project. On October 5, 2006, the U.S. Second Circuit Court of Appeals ruled that the State of Connecticut did not sufficiently support its decision to deny a water quality certificate to the Islander East Pipeline Company, LLC, and that reconsideration of the application must be completed within 75 days of the date of the ruling, that is, by December 19, 2006. While it is not certain if or when this project will be constructed, its similarity and proximity to the proposed Broadwater subsea pipeline require further consideration. Table 3.11-2 presents a comparison of the two projects and the cumulative total impact.

TABLE 3.11-2
Cumulative Impacts of Broadwater LNG and Islander East Pipeline Projects

	Broadwater	Islander East	Cumulative Total
Offshore project length (miles)	21.7	22.6	44.3
Construction method			
Dredge (miles)	0.0	1.1	1.1
Plow (miles)	21.7	20.1	41.8
Horizontal directional drilling (miles)	0.0	1.4	1.4
Construction right-of-way width (feet)	50–300	80–150	130–450
Number of equipment passes (with anchors)	3	4	7
Offshore seafloor affected (acres)	215.5[a]	3,106	3,320.3

[a] Includes incorporation of our recommendations.

3.11.1.2 IGTS

IGTS is a 411-mile pipeline system from Waddington, New York to Northport, New York. The portion of the IGTS that crosses Long Island Sound was constructed in 1991; it extends from Devon, Connecticut to Northport, Long Island. The proposed Broadwater pipeline would terminate at the IGTS pipeline in Long Island Sound. The IGTS pipeline was buried beneath the seafloor, using a combination of dredging, plowing, and excavation, depending on water depth; dredging was limited to shallow nearshore waters and therefore did not occur within the Project area.

The IGTS pipeline route was resurveyed in 1993 and 1999 to determine the extent to which topography differed from pre-construction conditions (TFOLIS 2003). Along much of the offshore pipeline route, natural sediment transport had refilled the construction trench; however, shallow linear depressions were observed along portions of the pipeline centerline (TFOLIS 2003). The available survey results do not quantify the area of the benthic habitat that is continuing to recover. Post-construction surveys identified some more substantial impacts to nearshore oyster beds where dredging and drag beam operation occurred; however, these impacts did not occur within the Project area and are not considered further in this cumulative impact analysis.

3.11.1.3 IGTS Eastchester Extension

The IGTS Eastchester Extension, constructed in 2004, is a 32-mile, 24-inch natural gas pipeline running from Northport, Long Island to Bronx, New York. The Eastchester Extension pipeline was buried beneath the seafloor, using a combination of horizontal directional drilling (in nearshore shallow water areas outside the Project area) and subsea plowing.

Construction activities included attempts to mechanically backfill the pipeline trench; however, post-construction monitoring has indicated that the mechanical backfilling efforts were unsuccessful in replacing the excavated spoil material back into the trench along much of the pipeline route. Subsequent monitoring a year later indicated that most of the trench had not backfilled naturally. In addition, construction of the Eastchester Extension pipeline resulted in some inadvertent damage to electric transmission cables in the western portion of Long Island Sound; the damage was subsequently repaired.

3.11.2 Telecommunication and Electric Transmission Cables

Five subsea telecommunication and electric transmission cables occur in the Project area (see Figure 3.11-1). The most recently constructed cable, the Cross Sound Cable, was installed in 2004; the remaining cables have been in place for 5 years or more. Each of these projects was constructed in accordance with applicable permits, including mitigation to avoid and minimize impacts, as deemed appropriate. Except as otherwise noted below, we are not aware of any long-term and ongoing environmental impacts associated with the construction of these cables. Regular operation of the cables does not result in any environmental impacts to the Project area.

3.11.2.1 1385 Cable Line

The 1385 Cable Line system, constructed in 1969 by Connecticut Light and Power (CL&P), traverses Long Island Sound approximately 11 miles from Norwalk, Connecticut to Northport, New York on Long Island. The cable is located more than 25 miles southwest of the proposed Broadwater Project. The cable system consists of seven 3-inch-diameter cables, each filled with a dielectric fluid (alkylbenzene). The 1385 Cable Line system initially was installed using two construction methods. In shallow nearshore waters (outside the Project area), the cables were installed in a dredged trench that subsequently was backfilled with concrete, rock, or other fill. Within the Project area, the cables were laid directly on the seafloor and later were covered with fill material. These fill activities did not completely cover the cable; consequently, the 1385 Cable is exposed in many places (TFOLIS 2003). Further, anecdotal information suggests that evidence of the cable trenches in nearshore waters (outside the Project area) were still apparent in 2002 (TFOLIS 2003).

Since 1970, third-party damage to exposed portions of the 1385 Cable has resulted in release of alkylbenzene on 55 separate occasions (TFOLIS 2003). Although these releases have been small, localized, and temporary, CL&P has proposed replacing the 1385 Cable Line system with a system of solid dielectric cables that do not contain alkylbenzene.

3.11.2.2 Cross Sound Cable

The Cross Sound Cable, constructed in 2002, traverses approximately 24 miles from New Haven, Connecticut to Brookhaven, New York on Long Island. The Cross Sound Cable was installed using horizontal directional drilling in shallow nearshore waters outside of the Project area. Within the Project area, the cable was installed using a remotely operated jet sled (TFOLIS 2003). The proposed pipeline would traverse the Cross Sound Cable at MP 3.0, and no impacts to the cable are anticipated.

Although some difficulties were encountered in burying the cable to permitted depth in nearshore waters, the cable was installed as permitted within the Project area. Six months after the Cross Sound Cable was installed, the construction corridor was surveyed for evidence of continuing impacts to bottom topography, sediment composition, and benthic marine communities. Within the Project area, there were some shallow depressions along the cable construction corridor. Where these scars were present, their dimensions ranged from 2 to 8 feet wide and from 0.5 to 2 feet deep. Sediment composition and marine benthic community composition and diversity did not appear to differ from pre-construction conditions within the Project area (OSI 2003).

3.11.2.3 AT&T Cable

The AT&T Cable traverses Long Island Sound approximately 22 miles from Connecticut to Long Island. The AT&T Cable was installed using horizontal directional drilling in shallow nearshore waters outside of the Project area. Within the Project area, the cable was installed using a jet plow (TFOLIS 2003). The proposed Broadwater pipeline would cross the AT&T cable at MP 6.4, and no impacts to the cable are anticipated.

No known information indicates that environmental impacts are continuing in association with construction of the AT&T Cable.

3.11.2.4 MCI Cable

The MCI Cable, constructed in 1996, traverses approximately 27 miles from Connecticut to Long Island, approximately 5 miles east of the proposed Broadwater Project. Like the AT&T Cable, the MCI Cable was installed using horizontal directional drilling in shallow nearshore waters outside of the Project area. Within the Project area, the cable was installed using a jet plow (TFOLIS 2003).

No known information indicates that environmental impacts are continuing in association with construction of the MCI Cable.

3.11.2.5 FLAG Atlantic 1 North Fiber Optic Cable

The FLAG Atlantic 1 North Fiber Optic Cable, constructed in 2001, is a trans-Atlantic cable connecting the north shore of Long Island to London, England along a corridor approximately 1 mile south of the proposed Broadwater Project. Like the AT&T and MCI Cables, the FLAG Cable was installed using horizontal directional drilling in shallow nearshore waters outside of the Project area. Within the Project area, the cable was installed using a jet plow (TFOLIS 2003).

No known information indicates that environmental impacts are continuing in association with construction of the FLAG Atlantic 1 North Fiber Optic Cable.

3.11.3 Other Projects

3.11.3.1 Dredged Material Disposal Sites

The COE and EPA completed an EIS to evaluate potential sites in central and western Long Island Sound suitable for receiving spoil material from regional navigational dredging projects (EPA 2004). Two disposal sites were selected, the Western Long Island Sound site and the Central Long Island Sound site. The Western Long Island Sound site is located over 10 miles west of the western terminus of the proposed Broadwater Project. The Central Long Island Sound site, a formerly active EPA-designated dump site, is located in Connecticut waters approximately 3 miles northwest of the proposed Broadwater FSRU location.

Both proposed disposal sites either currently receive or did receive dredged disposal material from a variety of harbor and waterway maintenance dredging and deepening projects throughout the Long Island Sound area. The EIS for those sites identified appropriate mitigation measures to avoid and minimize potential impacts, and concluded that the effects of dredged material disposal on sediment and water quality at these two locations were minor and effectively limited to the dumpsite areas themselves.

3.11.3.2 Nearshore Oil Transfer Platforms

KeySpan operates a petroleum delivery platform on Long Island Sound approximately 1 mile offshore of Northport Harbor, New York. This platform, which has been in operation since 1967, consists of an unloading platform, two mooring platforms (each measuring about 50 feet by 50 feet and extending 17 feet above the sea surface), and mooring buoys. In 2005, 82 vessels (barges and tankers) made deliveries to this facility, with oil transported by pipeline to onshore facilities (Fisher 2006).

ConocoPhillips operates a similar oil receiving platform approximately 1.5 miles offshore of Northport, New York. This single platform facility is 100 by 45 feet and 24 feet above mean low water. Approximately 50 tankers visit each year (Gianfalla 2006).

Although both the KeySpan and ConocoPhillips platforms are located in shallow, nearshore waters outside of the Project area, tanker activity at these locations has the potential to result in a cumulative impact on air quality and marine transportation within the Project area. The presence of tankers at these facilities also has the potential to result in a cumulative impact on visual resources for residents in the platform vicinity.

3.11.4 Commercial Shipping

As described in Section 3.7.1, water-dependent activities are important to the economies of New York and Connecticut. Commercial navigation includes vessels involved in domestic and foreign trade, ferries providing local transportation service, and commercial fishing boats. Because of the greater depths through the central portion of Long Island Sound (greater than 66 feet), maintained navigation channels are restricted to nearshore areas and within the rivers and harbors along the Sound. The locations of ports within the Sound and the presence of Stratford Shoal, which is centrally located in the Sound, largely dictate the paths followed by large vessels on the Sound.

The main shipping route in Long Island Sound extends in a generally east-west direction through the center of the Sound, on a straight course from deepwater areas in the eastern Sound inside the Race through to the Stratford Shoal area. From this main route, vessel traffic branches to the north and south to enter ports throughout the Sound. Due to the greater port development in Connecticut, more routes branch toward Connecticut than New York.

There is a predominance of east-west traffic transits south of the proposed FSRU location. Much of this east-west traffic is either through-traffic (using Long Island Sound as a thoroughfare to or from the Port of New York/New Jersey) or is heading toward Bridgeport, Connecticut or Port Jefferson, New York. In addition, there is a concentration of north-south traffic east of the proposed FSRU site. The majority of this traffic is tug and barge traffic transiting to or from the Riverhead Offshore Platform.

Most of the vessel traffic approaching the Race transits Block Island Sound. Most commercial vessel traffic entering the Race from the Atlantic Ocean through Block Island Sound and Rhode Island Sound uses the formal north/south shipping lanes (with a separation lane) that are established east of Block Island, and are therefore within the established vessel traffic control scheme. From the north end of the shipping lanes, vessels diverge to various ports in Massachusetts or Rhode Island, or they pass through the Race to approach ports in Connecticut and New York.

Commercial vessel traffic in Long Island Sound could increase in the future. For example, the Port of New York/New Jersey is working on a plan to decrease truck traffic in the area by increasing use of barge and rail transport of cargo, including barging cargo to ports at Bridgeport, Connecticut, Providence, Rhode Island, and Boston, Massachusetts. If implemented, this project (Port Inland Distribution Network) would increase vessel traffic to Bridgeport and through traffic in Long Island Sound. In addition, it is possible that commercial shipping in Long Island Sound would increase for other reasons. We anticipate that any increased vessel traffic would use the shipping routes that are currently in use throughout the Sound.

3.11.5 Potential Cumulative Impacts of the Proposed Action

Potential cumulative impacts are grouped by resource area in this section. The potential impacts that theoretically are most likely to be cumulatively significant are related to water quality, marine biological resources, visual resources, air quality, and marine transportation.

3.11.5.1 Water Quality

As indicated in the previous sections of this document, Long Island Sound suffers from water quality impairments primarily attributable to anthropogenic inputs. Specifically, nitrogen discharged from sewage treatment plants facilitates eutrophication and hypoxia in the western portion of the Sound. Treatment plant upgrades targeting better nitrogen removal techniques have reduced the nitrogen concentration of effluent from these plants. Over time, water quality improvements should occur because of these efforts. More recently, concerns over rising water temperatures have been raised by researchers. Varekamp et al. (2004) indicated that a rising temperature trend correlates with the occurrence of common summer hypoxia, and that temperature may have played a subsidiary role in its development.

During construction, surface water quality primarily would be affected by turbidity caused by pipeline installation as part of the Broadwater Project. These impacts would dissipate within approximately a day of construction activities. The primary impacts to water quality during operation of the Broadwater Project would be associated with biocides or other additives in water discharges. These discharges would be treated prior to discharge and would comply with the recommended mitigation measures in this EIS and SPDES requirements, but they would continue throughout the life of the proposed Project.

The Islander East Pipeline Project has the potential to adversely affect water quality as a result of sediment resuspension and turbidity during pipeline installation; no impacts to water quality are expected during operation of the Islander East pipeline. Operation of the proposed EPA dredged material disposal sites potentially affect water quality in the Project area; however, these impacts are expected to be localized (EPA 2004a). Finally, the 1385 Cable has the potential to affect water quality in the Project area, either through continued release of alkylbenzene in the event of anchor damage to exposed portions of the cable or through temporary, localized increases in turbidity during construction of a replacement cable system.

Turbidity impacts associated with the projects discussed in this section would be of a short duration and would not overlap spatially or temporally with the Broadwater Project. Consequently, turbidity impacts are cumulative only in the sense that a single body of water would incur these impacts. Given the volume and dynamic nature of the Sound (for example, its tidal currents and tidal flushing), we would not expect water quality impacts to be cumulatively significant. Elements of the proposed Broadwater Project, the Islander East Pipeline Project, the dredged material disposal sites, and the replacement 1385 Cable with potential to affect water quality would be subject to review and approval under Section 404 of the CWA, as administered by COE; any adverse impacts to water quality would require appropriate mitigation. Further, discharges to surface waters associated with operation of any of these projects would require review, approval, and mitigation (if necessary) under New York's SPDES program.

3.11.5.2 Water Temperature

Water temperature would be affected during operation of the Project but on a very limited basis, as described below. The pipeline would be coated with 3 inches of concrete except along the descent alongside of the mooring tower (riser pipeline). Natural gas is expected to enter the pipeline roughly between 100º and 130ºF at the top of the mooring tower and to fall to a temperature between 100º and 120ºF at the bottom of the mooring tower, or at the sediment surface. The heat loss experienced in the pipeline from the surface to the seafloor would be transferred to the surrounding water column. Based on the volume of water flowing by the pipeline, any increases in temperature would be readily dissipated in the water column, with no significant thermal plume expected. In winter, the temperature differential between the pipeline and the surrounding water column could reach from 80º to 90ºF. The remainder of the pipeline would be coated with 3 inches of concrete and installed to a depth of 3 feet below the sediment surface, or otherwise protected with armor rock or concrete mats. The transmission of higher temperature gas through the pipeline could result in some minimal temperature transfer into the surrounding sediments, but the impact would be highly localized and would not result in significant impacts on marine or benthic habitat. Increased sediment temperature associated with the heated gas flowing through the pipeline would be largely restricted to within the disturbed trench line.

Broadwater estimates that the discharged cooling water from the steam-powered LNG carrier would be 3.6°F higher than ambient water temperatures. Based on the current available information, the discharge of cooling water from LNG carriers is not expected to exceed New York's water quality criteria for thermal discharges

Other sources of thermal impacts to Long Island Sound include KeySpan's power generation facilities at Northport and Ravenswood as well as the nuclear power facility known as Millstone in Connecticut. The thermal impacts of the Broadwater Project when considered cumulatively with other projects are not significant.

3.11.5.3 Water intake

The annual average daily intake of the FSRU would be 5.5 mgd. On days when LNG carriers are not transferring cargo to the FSRU, the average daily intake would be 6.6. mgd. Because ballast water would be discharged during loading of LNG from the carrier to the FSRU, the minimal intake volume of 0.9 mgd for contingency operations (non-ballast water purposes) would be in effect during this operation.

At a maximum gas sendout rate of 1.25 bcfd, the intake volume would increase to 8.2 mgd. All water intakes to the FSRU would be conducted in accordance with SPDES Permit requirements. For these reasons, any impacts to water quality and volume associated with water intakes are considered minor but long term because they would continue for the life of the proposed Project. Similarly, entrainment and impacts to ichthyoplankton would affect a very small percentage of the standing crop of EFH-managed species of central Long Island Sound; these losses are not expected to affect the finfish population within Long Island Sound. Additional discussion on potential water intake impacts to EFH-managed species is provided in Section 6.2.2.1 of Appendix E.

Other sources of water intake impacts to Long Island Sound include KeySpan's power generation facilities at Northport, Port Jefferson, and Wading River. Daily seawater intake at these facilities is much greater than the proposed Project. For example, the KeySpan Northport facility is designed to intake approximately 1,867 mgd of cooling water from the Sound (EPA 2004b). The water intake impacts of the Broadwater Project when considered cumulatively with other projects are not significant.

3.11.5.4 Marine Biological Resources

Based on the available post-construction monitoring information for the Eastchester Extension, there is the persistence of a trench along the pipeline route. While benthic community surveys have not been conducted, it is expected that some recolonization of the benthic habitat has occurred. However, the potential alteration in the surface sediment could affect the suitability of the substrate for some species. In addition, the persistence of a trench could impede migration of benthic or demersal organisms.

If the Islander East pipeline were constructed during the same season as the proposed Project, it is possible that benthic and demersal marine biological resources would be cumulatively affected by physical disturbance and increased levels of turbidity and sedimentation. These impacts largely would be limited to the immediate vicinity of the two projects, and the magnitude of the cumulative impacts would depend on the timing of the construction phases. Benthic habitat disruption would result in mortality of sessile organisms, and mortality and displacement of some mobile invertebrates and fish. Further, seabottom disturbance associated with pipeline trenching and anchor placement could reduce the capacity of the affected area to provide epibenthic and infaunal recruits to a nearby disturbed site or provide adequate habitat to fish relocating from a nearby disturbed area. The overall effect could be greater loss of benthic prey species, EFH, and/or EFH-managed species for a longer period than if each project occurred separately. Further, operation of the dredged material disposal sites could affect benthic marine resources within the permitted disposal areas.

Recovery of the benthic communities disturbed by trenching and anchor placement would occur at varying rates, dependent on a variety of environmental parameters and the severity of the impact. Future construction of the Islander East Project and the Broadwater Project (as described in Section 3.1) would incorporate active backfilling of the excavated trench, and impacts to the benthic habitat are expected to be short term. Except for the 1385 Cable Project built in 1969, the available information on these completed pipeline and cable projects indicates that the benthic habitat in offshore areas recovers within 1 to 2 years. While each of these projects either has resulted in or could result in disturbance of benthic habitat, we do not believe that a significant cumulative impact to benthic habitat in Long Island Sound would result, based on the expansive softbottom habitat in Long Island Sound, the relatively small size of the individual project footprints, and the geographic and temporal separation of the projects.

3.11.5.5 Visual Resources

The visual resources of the existing landscape are defined by historical and current land uses such as agriculture, recreation, conservation, and development. The visual qualities of the landscape are further influenced by the volume and type of marine vessel traffic already present in Long Island Sound.

The FSRU would be visible from land most of the time. It generally would appear as a relatively small, faint object on the horizon that would be similar in appearance to other vessels. This would represent a minor visual impact that would persist for the life of the Project. Construction activity at the FSRU and along the proposed pipeline route would be visible to recreational boaters, fishermen, and individuals along the Sound's shorelines on clear days. Construction activity would be observable for a short period and would appear generally similar to existing commercial marine traffic, which currently stands at more than 50,000 vessel trips per year in Long Island Sound. In the event that construction of the Islander East pipeline were to occur concurrently with construction of the proposed Project, additional pipeline construction vessels would contribute incrementally but temporarily to visual impacts.

Except for the KeySpan and ConocoPhillips oil platforms, none of the other projects discussed herein have the potential to affect visual resources in the Project area during operations. The KeySpan platform extends approximately 17 feet above the sea surface and receives deliveries from large oil tankers on a regular basis. The presence of these tankers could contribute to cumulative impacts to visual resources in the vicinity of the platform. Similarly, the ConocoPhillips Platform extends 23 feet above mean low water and receives about one tanker per week.

3.11.5.6 Air Quality

If the Islander East pipeline were constructed during the same season as the proposed Project, it is possible that construction vessels associated with both projects could adversely affect air quality in the Project area. Operation of the KeySpan and ConocoPhillips nearshore oil transfer platforms also may contribute to air quality degradation in the Project area; however, these impacts are considered as part of existing air quality conditions for the Project area (see Section 3.9).

As discussed in Section 3.9, neither construction nor operation of the Broadwater FSRU and pipeline is expected to exceed federal or state air quality standards.

Elements of the proposed Broadwater Project and the Islander East Pipeline Project with potential to affect air quality would be subject to review and approval under the NSR/PSD permitting process, as administered by NYSDEC; any adverse impacts to air quality would require appropriate mitigation, in part, to avoid potential cumulative impacts.

3.11.5.7 Marine Transportation and Traffic

Construction of the proposed Broadwater and Islander East pipelines would result in a temporary increase in ship traffic in Long Island Sound. Operation of the Broadwater Project would result in a slight but permanent increase in vessel traffic in Long Island Sound, and safety zones established around the proposed Broadwater FSRU and LNG carrier vessels could temporarily impede or slow ship movements for a brief period of time (up to 30 minutes) in Long Island Sound—particularly in the vicinity of the Race. Operation of the KeySpan and ConocoPhillips nearshore oil transfer platforms also may contribute to marine traffic in the Project area; however, these impacts are considered as part of existing marine transportation conditions for the Project area (see Section 3.7.1).

In the event that construction of the Islander East pipeline is concurrent with construction of the proposed Broadwater Project, the two projects could result in temporary and minor cumulative impacts on recreational and commercial boaters, and could cause temporary delays for the Bridgeport ferry. However, the recent and successful installation of several subsea utilities across Long Island Sound within the general Project area strongly suggests that vessel-to-vessel communication and scheduling can successfully mitigate potential impacts to marine traffic during construction of pipelines and other linear subsea utilities. Limiting construction to winter months, when boating activity in Long Island Sound is greatly decreased, would further mitigate impacts to marine transportation and traffic. In the event that construction of the Islander East pipeline is concurrent with operation of the proposed Broadwater FSRU, the two projects could result in temporary and minor cumulative impacts on marine traffic.

Because the FSRU and its safety and security zone would be in an area outside of the generally used transit lanes for commercial shipping and would be in the widest portion of the Sound (about 20 miles wide in that area), there would be sufficient room to accommodate future increases in commercial vessel traffic without conflict with the FSRU and its safety and security zone. As noted in the WSR, operation of the Project would increase commercial shipping traffic in Long Island Sound by about 1 percent. If commercial shipping in the Sound increases in the future, there would still be a low incidence of commercial vessels needing to alter routes or travel speeds, and the impact of LNG carrier operation on commercial shipping would remain minor. Effective scheduling of construction vessel and LNG carrier transits could mitigate the impact of vessel traffic related to these projects on marine transportation and traffic.

3.11.6 Conclusions

We conclude that only the Islander East Pipeline Project has the potential to contribute any cumulative impacts to the Project area. Both the proposed Broadwater Project and the Islander East Pipeline Project would be within the same general offshore area. While the actual schedule for construction of the Islander East Project is not known, the proposed schedule is 2007. Therefore, construction of the two projects would not overlap unless Islander East was delayed for 2 or 3 years. Additionally, the type of project, construction methods, and impacts would be similar for the two projects. Each of these projects would result in temporary and minor effects during construction, but each project would be designed to avoid or minimize impacts to water quality, marine resources, and marine transportation. Additionally, significant impacts to sensitive resources resulting from these projects would be mitigated, and mitigation generally leads to the avoidance or minimization of cumulative impacts.

We believe that impacts associated with the proposed Broadwater Project would be relatively minor, and we have included various recommendations in this EIS to further reduce the environmental impacts associated with the Project. We recognize that unanticipated accidents during construction or operation of either the Broadwater or Islander East Pipeline Projects could result in potential undefined impacts. However, a meaningful evaluation of those potential impacts is impossible, as quantification of potential impacts would be speculative at best. Accordingly, we consider project monitoring and mitigation programs to be critical in addressing unanticipated impacts, should they occur.

The environmental impacts associated with the proposed Broadwater Project and the Islander East Pipeline Project would be minimized by use of specialized construction techniques, effective vessel scheduling and communication, and appropriate mitigation measures. Consequently, only a small cumulative effect is anticipated when the impacts of the proposed Project are added to past, present, or reasonably foreseeable future projects in the area.