APPENDIX J

ESSENTIAL FISH HABITAT (EFH) ASSESSMENT

Appendix J

Essential Fish Habitat Assessment for the Broadwater LNG Project

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Acronyms and Abbreviatons

bcf	billions cubic feet
bcfd	billions cubic feet per day
CFR	Code of Federal Regulations
CL&P	Connecticut Light & Power
CO	carbon monoxide
CO_2	carbon dioxide
COE	U.S. Army Corps of Engineers
dB	decibel
dB_{rms}	decibel root mean square
EEZ	Economic Exclusion Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
FMC	Fishery Management Council
FSRU	Floating Storage and Regasification Unit
DOT	Department of Transportation
GBS	gravity-based structures
HAPC	Habitat Areas of Particular Concern
IGTS	Iroquois Gas Transmission System
LNG	liquefied natural gas
m^3	$meters^3$
MAFMC	Mid-Atlantic Fishery Management Council
MSA	Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006
NEFMC	New England Fishery Management Council
NEPA	National Environmental Protection Act
NMFS	National Marine Fisheries Service
NO_x	nitrogen oxides
NOAA	National Oceanic and Atmospheric Administration
NYSDEC	New York State Department of Environmental Conservation
SPDES	New York State Pollutant Discharge Elimination System
ORV	Open rack vaporization
ppb	part per billion
ppm	part per million
psig	pounds per square inch gauge
SCADA	supervisory control and data acquisition
SCV	submerged combustion vaporization
SPCC	Spill Prevention, Containment, and Countermeasures
SRV	shuttle regasification vessels
STV	shell and tube vaporization

Acronyms and Abbreviatons
(continued)

μPa ..... microPascal
μPa/Hertz ..... microPascal/Hertz
USGS ..... United States Geological Survey
YMS ..... yoke mooring system

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ESSENTIAL FISH HABITAT ASSESSMENT

1.0 INTRODUCTION

The purpose of this document is to present the findings of the Essential Fish Habitat (EFH) assessment conducted for the proposed Broadwater Project (Project) as required by the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 (MSA) (amended in 1976 and 1998). This EFH assessment is based on the regulations implemented in the United States Department of Commerce, National Oceanic and Atmospheric Administration (NOAA) EFH Final Rule, 50 Code of Federal Regulations (CFR) Part 600 (NOAA 2002). The objective of this EFH assessment is to describe how the actions as part of the proposed Broadwater Project may affect EFH and EFH-managed species within the area influenced by the proposed Project. According to NOAA National Marine Fisheries Service (NMFS), EFH within Long Island Sound, Block Island Sound, Montauk Channel, Rhode Island Sound, and portions of the Atlantic Ocean (the Project Waterway) includes those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. During construction, the area of influence would primarily be associated with YMS and pipeline installation in the offshore waters of Long Island Sound. During operations, the area of influence would primarily be the waters of central Long Island Sound and secondarily along the transit route of the LNG carriers between the boundary of the U.S. territorial sea and the proposed FSRU location in Long Island Sound. In addition to the open waters of the Atlantic Ocean and Long Island Sound, the LNG carrier transit routes would traverse Rhode Island Sound, Block Island Sound, and Montauk Channel, which together comprise the Project Waterway for the proposed Broadwater Project.

This report was prepared to meet the requirements described by the NMFS to comply with the MSFCMRA. The EFH assessment includes a description of the proposed action; an analysis of the direct, indirect, and cumulative effects on EFH, EFH-managed species, and their major food sources; our evaluation of the effects of the proposed action on EFH and EFH-managed species; and proposed mitigation measures selected to minimize expected project effects if applicable.

2.0 PROJECT DESCRIPTION

Section 2.0 provides a brief overview of the project description, construction methods, and operations of the proposed Project. These topics are more fully described in Section 2.0 of the Environmental Impact Statement (EIS).

Broadwater proposes to construct and operate a marine liquefied natural gas (LNG) floating storage and regasification unit (FSRU) and subsea pipeline for the importation, storage, regasification, and transportation of natural gas. The proposed Broadwater LNG FSRU would be located in Long Island Sound, in New York state waters, approximately nine miles from the nearest coast located on Long Island (Figure 2-1).

The proposed FSRU would be designed to receive, store, and regasify LNG at an average throughput of 1.0 billion cubic feet per day (bcfd). The proposed FSRU would be capable of a peak day throughput of 1.25 bcfd into the existing Iroquois Gas Transmission System (IGTS) pipeline via a proposed subsea pipeline.

LNG would be delivered to the proposed FSRU via LNG carriers with capacities ranging from 125,000 meters^3 (m^3) to 250,000 m^3. Broadwater anticipates that LNG carriers would deliver approximately two to three times per week (an average of 118 carriers per year). The proposed FSRU would be approximately 1,215 feet in length, 200 feet in width, and rise approximately 80 feet above the water line with some above-deck structures extending up to approximately 140 feet. The proposed FSRU would be capable of storing approximately 8 billion cubic feet (bcf) of LNG and vaporizing LNG using a closed-loop shell and tube vaporization (STV) system.

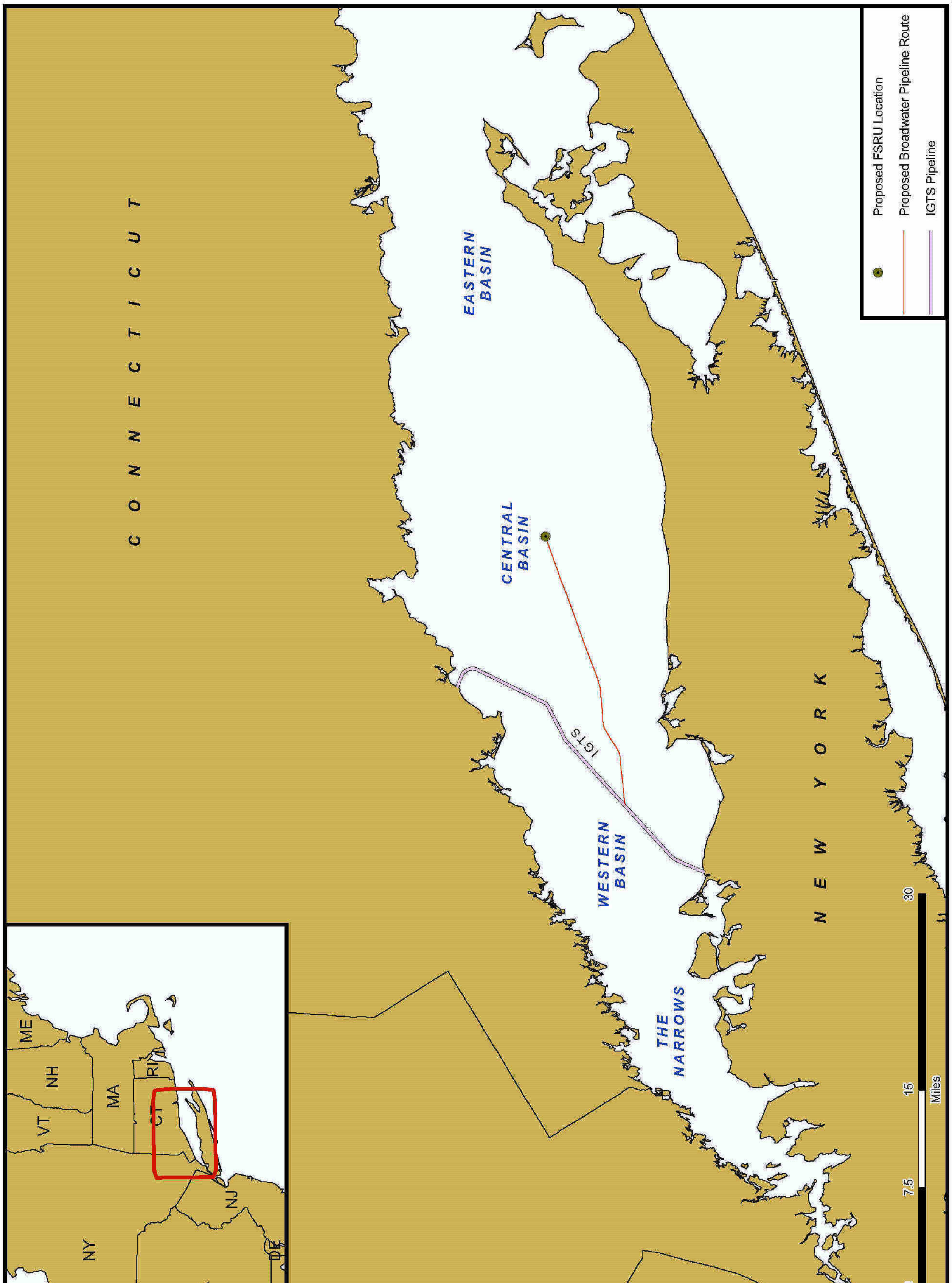

Figure 2-1
Broadwater LNG Project
Proposed FSRU Location and Pipeline Route

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The proposed FSRU would be moored to the seafloor of Long Island Sound via four legs attached to a yoke mooring system (YMS). The YMS would allow the FSRU to pivot around the mooring tower base. The mooring tower base would feature an open design construction. The total area under the proposed YMS would be approximately 0.3 acre. The proposed YMS would house the connection between the proposed FSRU and the proposed 21.7-mile subsea pipeline that would transport LNG from the proposed FSRU to the existing IGTS pipeline (Figure 2-1).

2.1 PROPOSED CONSTRUCTION METHODS

A brief discussion of the proposed construction methods for the proposed FSRU and pipeline are discussed below. A more detailed discussion of proposed construction methods can be found in Section 2.3 of the EIS.

2.1.1 Proposed FSRU

The proposed FSRU would be constructed in a certified shipyard outside of the United States. The proposed FSRU would then be towed into Long Island Sound to the YMS, which is described further below.

2.1.2 Proposed YMS

Prior to delivery of the proposed FSRU, the proposed YMS would be installed in the seafloor of Long Island Sound. The four legs of the proposed YMS tower would be driven into the seafloor (at a water depth of approximately 95 feet). According to Broadwater, either a vibratory hammer or a conventional pile-driver would be used to install the four legs of the YMS into the seafloor. Deep exploratory borings would be conducted in the later part of 2008 to assess the existing conditions underlying Long Island Sound and to determine the actual depth to which the piles would be installed. However, the geological information available from the United States Geological Survey (USGS) shows bedrock is likely to be too deep (approximately 427 feet) for piles to be directly drilled into bedrock (Lewis and Stone 1991), therefore they would likely terminate in the lower glacial lake deposits. The legs would be installed one by one, and installation would be expected to be conducted in October 2010 allowing approximately 1 week for each leg. We have included a recommendation (Section 3.3.2.2 of the EIS), at the request of the NMFS - Protected Resources Division, that Broadwater conduct pile driving activities associated with installation of the proposed YMS between December and March to avoid impacts to federally listed threatened and endangered species, specifically sea turtles. The YMS would allow the proposed FSRU to pivot or "weathervane" around the YMS, enabling the vessel to orient in response to the prevailing wind, tide, and current conditions. About 0.3 acre of the seafloor would be between the four legs of the tower, and anchors from the support barge would impact less than 0.5 acre of seafloor. To maintain the stability of the mooring tower during lowering to the sea floor, a wooden frame (termed a "mud mat") constructed of untreated lumber would be installed between the legs of the tower, driven into the seafloor, and remain in place for the life of the Project or until it degrades.

2.1.3 Proposed Pipeline

Broadwater proposes to install the proposed subsea pipeline during the fall, winter, and early spring of 2009-2010, construction would commence in October 2009 and continue through the end of April 2010. Broadwater anticipates that construction associated with sediment disturbance would be virtually completed prior to mid-March 2010 until YMS installation resumes in October 2010. As proposed by Broadwater, the direct impacts to sediment during pipeline installation would affect a total of 2,234.7 acres of sediment. Over 90 percent of this acreage would be affected by anchor cable sweep (2,020 acres) from construction vessels.

An expert assessment (Jaap and Watkins 2007 [Appendix G]) of Broadwater's proposed anchoring impact estimates based on post-construction monitoring surveys conducted using divers, side-scan, and remotely operated vehicles following marine pipeline installation for the Gulfstream pipeline off Florida. The assessment concluded that the use of mid-line buoys on all anchor cables would reduce anchor impacts by 88 percent relative to the anchoring methods currently proposed by Broadwater, specifically from 2,234.7 acres to 262.8 acres. Therefore, our recommendation that Broadwater use mid-line buoys on all anchor cables should virtually eliminate impacts to sediment associated with anchor cable sweep (Section 3.1.2.3 of the EIS). 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. Therefore, we recommend that Broadwater either use mid-line buoys on the anchor cables of all construction vessels or they avoid the use of anchors completely by using a dynamically positioned vessel for pipelaying and plowing (Section 3.1.2.3 of the EIS).

From mid-March to the end of April 2010, construction activities would primarily consist of connecting the proposed pipeline to the IGTS pipeline and cleaning and testing of the proposed pipeline. The majority of the proposed pipeline (approximately 21.5 miles) would be installed via a subsea plow. 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 all of the 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 recommend that Broadwater develop methods, in collaboration with the appropriate agencies, to successfully mechanically backfill the trench with the excavated spoil material following installation of the proposed pipeline. The backfilling methods, as determined with interagency coordination, may require detailed post-construction monitoring criteria to assess success (Section 3.1.2.2 of the EIS). Manual excavation by divers and/or the use of submersible pumps would be used to install the proposed pipeline at the IGTS tie-in, proposed FSRU tie-in, AT&T cable crossing, and the Cross Sound Cable crossing. A scaled-down subsea plowing has been proposed by Broadwater to address trenching through the coarser substrate along Stratford Shoal. This test plow investigation would be completed in less than 2 days during the period between October 2008 and April 2009. The vessel used to tow the test plow would not be expected to create cable sweep or anchor footprints. 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. As described in the EIS (Section 3.1.2.3), we recommend that Broadwater provide a contingency plan 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.

The proposed pipeline would be buried beneath the seafloor to a minimum depth of three feet where practicable. The proposed pipeline would be covered with armor in areas where it could not be buried. The entire subsea pipeline would also be coated with three inches of concrete.

2.2 PROPOSED OPERATIONS

A brief discussion of the proposed operations for the proposed FSRU and pipeline are discussed below. A more detailed discussion of proposed operations can be found in Section 2.4 of the EIS.

Operation of the proposed Project would involve importation and transfer of LNG to the proposed FSRU from LNG carriers, regasification of LNG on the proposed FSRU, and transfer of regasified LNG (natural gas) into the proposed 21.7-mile subsea pipeline and ultimately into the existing IGTS pipeline system.

2.2.1 Proposed FSRU

Imported LNG would be obtained from liquefaction plants throughout the world and delivered by LNG carriers to the proposed FSRU. Upon arrival at the proposed FSRU, each LNG carrier would dock at the berthing area along the starboard side of the FSRU, attach to the FSRU's unloading arms, and transfer LNG to the FSRU's storage tanks. LNG would be transferred at a maximum rate of 5,000 m^3 per hour per arm. As the LNG is offloaded, the LNG carrier would take on ballast water to compensate for the weight of the offloaded cargo. After completion of cargo transfer, the unloading arms and umbilicals would be detached, and the LNG carrier would depart with tug assistance. The entire unloading process from ship arrival at the pilot station and return to the pilot station would take approximately 35 to 40 hours (See Table 2.4-1 of the EIS).

From the storage tanks on the proposed FSRU, LNG would be transferred by in-tank submersible pumps to a series of vaporizers, and then through the sendout lines and riser pipeline and into the proposed subsea pipeline. As described in Section 2.4.1 of the EIS, LNG must be warmed from a liquid to a gaseous state (vaporized) before it can be transported as natural gas in the sendout pipeline. Broadwater has proposed to accomplish this using closed-loop STV technology. Under this approach, LNG would be regasified by passing through a series of heated coils, which are heated using a glycol/water mixture contained in a closed loop system. The closed loop system is recommended by NOAA because this system requires no intake or discharge of seawater compared to an open loop system (NOAA 2005a) thereby, minimizing impacts to marine organisms from impingement/entrainment and heated discharge from open loop systems.

Seawater intakes for the proposed FSRU would be taken in through the FSRU's four seawater intakes - all of which would be on the bottom of the hull, approximately 40 feet below the water line. Two of these intakes would supply the sea chests to provide water for ballast, desalinization, and the side-shell water curtain between the LNG carrier and proposed FSRU during LNG transfer. The sea chests would have two main intakes, one on the port side and one on the starboard side and only one of these intakes would operate at a time. 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. Between the coarse grate and the mesh screen, sodium hypochlorite would be continuously injected into the seawater, resulting in an initial sodium hypochlorite concentration in the seawater between 10 and 50 part per billion (ppb).

In addition to the main seawater intakes, there would be two firewater pump intakes, one on the forward end and the other on the aft end. The intake portals would have coarse grates, with openings approximately 4 inches by 2 inches.

All water intakes would be discharged 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 chlorine concentrations would be monitored via a colorimetric assay. All discharges would be in accordance with New York State Pollutant Discharge Elimination System (SPDES) Permits. Broadwater submitted their SPDES Permit application on March 24, 2006 to the New York State Department of Environmental Conservation (NYSDEC).

Broadwater anticipates that the maintenance program of the proposed FSRU would include visual inspections, operational checks and tests, routine onboard mechanical and electrical maintenance activities, lubrication schedules and regular steelwork examinations, and surveys above and below the water line. Underwater maintenance may include surface cleaning of the hull, intake grates, and other parts to remove localized accumulations of slime and weeds. The cleaning would be accomplished by divers and would consist of light brushings conducted no more than once per year. If mechanical repairs to underwater parts of the proposed FSRU or YMS are necessary, the area to be repaired would be segregated from seawater by a cofferdam installed by divers.

2.2.2 Proposed Pipeline

The proposed pipeline facilities would be operated and maintained in accordance with 49 CFR 192. The pipeline would be operated at a maximum allowable operating pressure of about 1,400 pounds per square inch gauge (psig). This pressure would be compatible with the pressures in the IGTS pipeline. The average flow would be approximately 1.0 bcfd, with a maximum flow of 1.25 bcfd.

Operation of the proposed pipeline, including maintenance of gas quality and volumetric control, would be handled from the Broadwater FSRU command and control center. IGTS would also construct minor gas quality monitoring and control facilities at existing IGTS locations using blanket construction authorizations. This equipment would include gas chromatographs and other monitoring equipment and heating equipment. The Broadwater FSRU command and control facility and the IGTS control facilities would be staffed 24 hours per day for monitoring the operations and facilities, using supervisory control and data acquisition (SCADA) systems. Operation and maintenance records would be maintained in accordance with the requirements of 49 CFR 192.

Regular pipeline maintenance would include maintenance and pigging at intervals specified in Broadwater's Project-specific pipeline maintenance plan that would be based on regulatory requirements of the U.S. Department of Transportation (DOT) and NYSDEC regulations for pipelines, and as conditions warrant. Pigging procedures would typically be completed in 10 to 14 days, depending on weather and the type of inspection required. Where necessary, concrete mats or other protective barriers covering the receiver flange at the IGTS pipeline tie-in would be temporarily removed prior to pigging and later replaced, using a dive support vessel.

The proposed Broadwater pipeline would be equipped with an automatic and manual shutdown system that would be implemented if a pipeline leak, equipment failure, or system failure occurred.

2.2.3 LNG Carriers

LNG carriers must comply with all federal and international standards regarding LNG shipping and would be subject to all rules, regulations, and requirements of the United States Coast Guard (Coast Guard). The proposed Project would be designed to accommodate LNG carriers with capacities ranging from 125,000 m^3 to 250,000 m^3. LNG carriers would be of double-hulled design. LNG carriers would transport LNG to the proposed FSRU from various countries with natural gas liquefaction plants. Carriers would approach Long Island Sound, Block Island Sound, Montauk Channel, and Rhode Island Sound from the Atlantic Ocean. After crossing the offshore boundary of the Economic Exclusion Zone (EEZ), the LNG carriers would continue towards Long Island Sound through either Rhode Island Sound and Block Island Sound via the Point Judith pilot station (the northern or Block Island route), or Montauk Channel southwest of Block Island via the Montauk Channel pilot station (the southern or Montauk route) (see Appendix C of the EIS for maps of these routes). LNG carriers would berth along the starboard side of the proposed FSRU, and only one LNG carrier would be allowed to berth at a time. Each LNG carrier would be secured to the FSRU using mooring lines equipped with quick-release hooks that would be permanently attached to the FSRU. Floating pneumatic fenders would be used to separate the hulls of the two vessels while berthed and to prevent contact. In addition, a side-shell water curtain would be directed overboard between the FSRU and the LNG carrier during off-loading. The side-shell water curtain would help the FSRU and the LNG carrier maintain hull integrity.

Carriers that transport LNG to the proposed Project would be fitted with an array of cargo monitoring and control systems that would automatically monitor and control cargo pressure, temperature of the cargo tanks and surrounding ballast tanks, emergency shutdown of cargo pumps and closing of critical valves, the level of cargo in the tanks, and gas and fire detection. These systems would be active while the carrier is at sea and during the remote-control phase of cargo operations at the proposed FSRU.

2.2.4 Onshore Facilities

Onshore support facilities would be required for operation of the proposed FSRU and the pipeline. Permanent onshore support facilities would be established within an existing waterfront industrial site in either Greenport or Port Jefferson, New York (Figure 2.4-2 and Figure 2.4-3 of the EIS). These facilities would include office space for 6 to 10 staff; a warehouse for storage and handling of spare parts, tools, and equipment; dock space for berthing four tugs; a workshop for tug maintenance; and a waterfront staging area capable of supporting container transfer cranes, large trucks, and a personnel transfer and boarding area. Apart from the installation of a perimeter security fence and guardpost, Broadwater does not anticipate modifying the existing onshore facilities.

3.0 ALTERNATIVES

In accordance with the National Environmental Protection Act (NEPA) and the Federal Energy Regulatory Commission (FERC) policy, a range of alternatives to the Broadwater LNG Project were evaluated. The purpose of this evaluation was to determine if there are reasonable alternatives that would be environmentally preferable to the Project as proposed. A more detailed discussion of alternatives can be found in Section 4.0 of the EIS.

Each alternative was considered until it was clear whether the alternative was reasonable or not, and if reasonable, whether it would result in environmental impacts that would be greater than those of the proposed Project as described in Section 3.0 of the EIS.

In addition, the proposed Project and alternatives to the proposed Project were compared with NOAA's *Recommended Best Practices for Liquefied Natural Gas Terminals* (NOAA 2005a). This document was developed by NOAA to provide guidance to NOAA staff to ensure consistent reviews of applications and environmental impact analyses for proposed LNG terminals. The document presents NOAA's recommendations regarding design, siting, construction, and operation of proposed LNG terminals so as to minimize impacts to marine and coastal resources.

3.1 ALTERNATIVE LNG TERMINAL DESIGNS

We identified three alternative types of LNG terminals that could be used to receive natural gas from international sources, and then store, regasify, and distribute natural gas via the existing natural gas pipeline infrastructure. Therefore, our assessment of general LNG terminal designs included:

- Onshore terminals
- Offshore gravity-based structures[1] (GBS); and
- Offshore terminals using shuttle regasification vessels (SRVs)[2].

Assessment of these alternative designs focused on the potential impacts of the terminal designs themselves as well as additional impacts associated with siting requirements such as buffer areas and the need to interconnect with the existing infrastructure. Additional discussion of terminal location alternatives is provided in Section 3.2. The Safe Harbor Project is discussed in Section 4.3.2.1 of the EIS.

3.1.1 Onshore LNG Terminal

To meet the Project objectives, federal LNG siting and safety criteria, and other federal requirements, an onshore LNG facility would require access to a deepwater port or other waterways where the water depth is approximately 50 feet or more, and a site with sufficient applicant-controlled land to accommodate a site-specific onshore exclusion zone. A minimum water depth of 50 feet would be required to safely accommodate transit, maneuvering and berthing of existing and future LNG carriers with drafts as deep as 40 feet.

We identified general areas in the Long Island Sound area where an onshore LNG terminal could be sited, all of which are on or near shorelines to provide marine berthing and transfer facilities for the LNG carriers. The onshore LNG storage facilities would need to be no more than about 2 miles from the berthing facility, based on the current technology for offshore, subsea cryogenic pipelines (Trammel 2006, Kitzel 2006). Rankin and Mick (2005) have suggested that longer subsea and onshore LNG pipelines may be feasible using a triple-walled pipe-in-pipe design. This technology is still being tested for LNG application and may be feasible, depending on advances in material availability and operational techniques that would maintain the required low temperature of the pipe when a carrier is not unloading LNG. At the present time, however, we do not consider it a feasible alternative.

Existing developed ports in Long Island Sound where water depth exceeds 50 feet were initially examined. These sites included Northport and Port Jefferson on Long Island and in Bridgeport, New Haven, and New London in Connecticut. With the exception of New Haven, none of the deepwater ports evaluated appear to have sufficient land available for construction and operation of an onshore LNG terminal. Additionally, each of these ports experiences a high volume of commercial marine traffic, which could be adversely affected by construction, and operation of an onshore LNG terminal. Finally, residential neighborhoods occur within 0.5 miles of port areas at Northport, Port Jefferson and New Haven. Therefore, none of the existing deepwater port sites are considered suitable for development of an onshore LNG terminal.

In Long Island Sound, there are not any potential onshore LNG terminal sites that are near areas where water depth exceeds 50 feet. As a result, access for LNG carriers would require either shoreline modifications and nearshore dredging, or construction of a long dock or mooring jetty. A dock or mooring jetty would generally need to extend 1 mile or more into Long Island Sound to provide sufficient water depth. Both the FWS (1991) and NYSDOS (2005) have designated much of the coastline of central

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[1] Gravity-based structures are essentially concrete boxes that house LNG storage tanks and are placed on the seafloor.

[2] SRVs are marine vessels that transport LNG and have onboard vaporization equipment. Vaporized LNG is transferred from the SRV to a pipeline riser attached to an offshore buoy.

Long Island Sound as significant natural areas due to the presence of shallow nearshore marine resources and coastal features. Dredging or pier or jetty construction could significantly impact these areas and would have an adverse impact on shellfish beds and other sensitive marine resources in excess of the impacts associated with the currently proposed Project.

Much of the shoreline of the region is relatively densely populated. Although LNG terminals have operated safely within populated areas, such as the Everett LNG facility in Boston, Massachusetts, increased distance between an LNG facility and populated areas enhances safety, reduces potential impacts of air emissions, and lessens visual impacts. Thus, an onshore LNG terminal anywhere in the region would be closer to populated areas than the proposed offshore FSRU location increasing concerns about potential risks to human health and safety.

In addition, NOAA recommends all LNG terminals be sited as far offshore as possible, in areas of lower biological productivity, and away from sensitive habitats and migration routes of economically important fish species and their forage, marine mammals, or listed species (NOAA 2005a). Therefore, the proposed offshore location is intended to address NOAA's recommendation (NOAA 2005a).

3.1.2 GBS Alternative

A GBS terminal could be constructed offshore, either in Long Island Sound or in the Atlantic Ocean. Under this alternative, LNG storage tanks would be contained in a concrete structure or structures placed directly on the seafloor and extending above the water surface. Vaporization equipment would be installed above the water likely using the concrete structures as a platform. LNG carriers would moor at the GBS and offload LNG into storage tanks in the GBS. The LNG would be regasified at the terminal and transported as natural gas through a sendout pipeline connected to an existing interstate natural gas distribution system.

GBSs would be constructed at a specialized onshore construction facility called a graving dock. Existing graving docks in the general area, including facilities in Brooklyn, New York and Bayonne, New Jersey, are too small to accommodate construction of a GBS. Therefore, a new graving dock would need to be constructed for a Project-specific GBS. Environmental impacts associated with the construction of a graving dock would vary from site to site, although we anticipate that for any potential graving dock sites in the region, the onshore impacts associated with construction of the GBS could be greater than those for the entire proposed Broadwater Project.

To accommodate LNG carriers, a GBS-based LNG terminal would need to be installed where water depth is at least 50 feet (Pepper and Shah 2004). Because the GBS must extend above the water, the maximum practicable water depth for a facility of this type would be approximately 100 feet. A GBS could be installed at the proposed site of the FSRU or at locations closer to shore with water depths of 100 feet or less. As the distance to the shoreline decreases, the visual impacts would increase. Broadwater estimated that a GBS capable of meeting the purpose of the Project would permanently impact approximately 16.9 acres of the seafloor, converting the substrate from softbottom sediments to concrete. As a result, a GBS (regardless of installation location) would result in a permanent seafloor conversion that would be greater than those of the proposed Project (about 16.9 acres for the GBS compared to about 0.3 acre for the FSRU's mooring system).

As described in Section 3.2, a GBS in the Atlantic Ocean would require a pipeline to the south shore of Long Island, with the impacts dependent on the distance to shore and the construction methods used through the nearshore area. However, construction through nearshore areas could affect sensitive marine species. In addition, a new onshore pipeline would be required to connect to the existing natural gas transmission system that transports gas to markets on Long Island and in New York City and

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Connecticut. A new compressor station would likely be required to maintain the appropriate pressure in the pipeline prior to connecting to the existing transmission system and would result in onshore air emissions and visual impacts that would not occur with the proposed Project. The adverse environmental impacts associated with a GBS, installation of the offshore and nearshore pipeline, installation of the onshore pipeline, and adding compression would be substantially greater than those of the proposed Project.

3.1.3 SRV Alternative

With this alternative, two or more permanently moored LNG unloading buoys would be constructed and attached to the seafloor using a 6- or 8-point mooring (anchoring) system. Each unloading buoy would contain a natural gas pipeline riser connected to a subsea pipeline that would extend to shore. The unloading buoy would be suspended within the water column below the sea surface.

SRV designs do not have the capacity to store LNG. To ensure that a continuous supply of gas would be provided to the region, use of an SRV LNG terminal would require two or three unloading buoys to allow for the departure/arrival of an SRV while another SRV is unloading, or additional storage capacity such as an FSRU or GBS.

An SRV with a draft of 45 to 52 feet would moor over the buoy, draw the buoy up through a port in the LNG vessel, vaporize LNG in its storage tanks, and transmit natural gas into the riser in the buoy. When unloading activities are complete, the unloading buoy would be disconnected from the LNG vessel and released. When not in use, the submerged unloading buoy and flexible riser are typically held suspended within the water column using a system of anchor chains. To accommodate the deep-draft SRVs and to prevent the subsea riser from contacting the bottom, the unloading buoys would need to be constructed where water depth is 100 feet or deeper.

If an SRV system were to be installed in Long Island Sound or the Atlantic Ocean, the adverse environmental impacts associated with the anchors and mooring lines, installation of the offshore and nearshore pipeline, and installation of the onshore pipeline would be substantially greater than those of the proposed Project. In addition, this alternative would not satisfy the Project purpose of providing adequate storage to better serve energy needs.

3.2 ALTERNATIVE LNG TERMINAL LOCATIONS

We evaluated alternative offshore locations for siting an LNG terminal. Our initial screening considered areas in the Atlantic Ocean south of Long Island, Block Island Sound, and throughout Long Island Sound as potential sites for the FSRU.

3.2.1 Block Island Sound and the Atlantic Ocean

With an FSRU in either Block Island Sound or the Atlantic Ocean, a sendout pipeline would extend from the offshore location through the nearshore area and onto Long Island or Connecticut. From that point, a pipeline would have to be installed to connect to the existing interstate natural gas transmission line that transports gas to New York City and Long Island. The impacts of pipeline construction would be dependent on the distance to shore and the construction methods used through the nearshore area. However, construction through nearshore areas could affect sensitive marine species, as much of the southern shoreline of Long Island is protected either as federal recreational land or listed as Significant Coastal Fish and Wildlife Habitat (NYSDOS 2006). These resources could include Jones Beach State Park, Hempstead Bay, Cupsogue Beach County Park, Shinnecocke County Park, Fire Island National Seashore, and Amagansett National Wildlife Refuge. As stated previously, NOAA (2005a) has recommended avoidance of nearshore areas due to the higher concentration of fish eggs and larvae and sensitive nursery habitats (NOAA 2005a). In addition, the new pipeline would need to extend onshore to the existing pipeline infrastructure, and all onshore impacts (such as shorelines, residences, forests) would be greater than the proposed subsea pipeline since the proposed Broadwater pipeline would not extend onshore.

The environmental impacts associated with an offshore LNG terminal sited in either Block Island Sound or the Atlantic Ocean would be substantially greater than those of the proposed Project, irrespective of whether the terminal was an FSRU, GBS, or SRV.

3.2.2 Central and Eastern Long Island Sound

Our evaluation of alternatives to the proposed Broadwater FSRU location within the central and eastern portions of Long Island Sound included the assumption that the Project's sendout pipeline would be an offshore pipeline as proposed and would connect to the IGTS pipeline. This would avoid all onshore and nearshore impacts by interconnecting to the IGTS pipeline in Long Island Sound. With this as a basic assumption, a primary criterion in the evaluation was proximity to the IGTS pipeline to minimize the length of the sendout pipeline to the extent possible to minimize overall environmental impacts.

Another critical criterion was a water depth of at least 50 feet to accommodate both the FSRU and the LNG carriers. The distance from shore was also considered in the evaluation since greater distances would decrease the visibility of the FSRU for viewers in New York and Connecticut, and greater distances from shore would avoid impacts to sensitive nearshore resources due to construction of the sendout pipeline.

The FSRU location proposed by Broadwater is approximately 9 miles from the nearest shoreline. Because increased distance from the shoreline and the associated reduction in visual impacts and marine traffic conflicts was a key screening criterion for this analysis, we only considered alternative locations that were at least that approximate distance from the nearest shoreline. Rather than limit the distance to just 9 miles and farther, we considered that locations that are at least 7 miles from the nearest shoreline would greatly reduce visual impacts to shoreline residents while still meeting the 50-foot minimum water depth criteria. Figure 4.4-1 in the EIS illustrates the portion of Central and Eastern Long Island Sound that is at least 7 miles from the nearest shoreline. Locating the FSRU further to the east than the proposed location and more than 7 miles from the shoreline would further lengthen the connecting pipeline, and does not appear to offer any environmental advantages. Therefore, we eliminated any alternative FSRU locations east of the proposed site from further consideration.

The length of the subsea pipeline could be shortened and benthic impacts reduced by locating the FSRU west of the proposed location within the area that is at least 7 miles from shore. However, the commercial vessel traffic analysis (described in Section 3.7.1 of the EIS) indicated that north-south vessel movement increases from a relatively low density at the proposed location to higher densities west of the site. We considered the potential long-term impact to marine transportation to be more important than the small decrease in temporary to short-term bottom impacts (which are already minor with the proposed site) due to a somewhat shorter pipeline (up to several miles shorter). Therefore, we eliminated areas west of the proposed site and at least 7 miles from the shore from further consideration.

Similarly, there is a substantial increase in commercial vessel traffic south of the proposed location. In addition, visual impacts would increase with closer proximity to shore without achieving other environmental advantages. Consequently, we eliminated areas south of the proposed location from further consideration.

Although not as substantial a difference, the vessel traffic to the north of the site within the area at least 7 miles from shore is greater than in the vicinity of the proposed site. In addition, a commercial trawl lane has been established north of the proposed site, and although the safety and security zone around the proposed FSRU site would interfere with part of the lane, the conflict would be greater with a more northerly location. Therefore, we also eliminated areas north of the proposed location and at least 7 miles from the shoreline.

3.2.3 Western Long Island Sound

Western Long Island Sound is narrower than the central and eastern portions of the Sound. As a result there is a higher density of recreational use and fewer route options for commercial shipping than areas of Long Island Sound to the east. There would be a greater potential for impacts to marine transportation and recreation in this area than elsewhere in Long Island Sound. In addition, the water is typically more shallow in this area than in more easterly areas of the Sound, and many potential sites for the FSRU would likely require extensive dredging to provide the 50 feet of minimum water depth required for LNG carrier operation. In addition, since the western basin of Long Island Sound is narrower than the central basin, the FSRU and the berthed LNG carriers would be closer to the shoreline and densely populated areas.

In western Long Island Sound, the sendout pipeline from the FSRU to an interconnection with the IGTS Eastchester Extension pipeline instead of the IGTS mainline would likely extend through more sensitive nearshore benthic environments, resulting in impacts greater than those of the proposed Project.

NOAA recommends avoiding shallow water areas due to increased concentrations of eggs and larvae (NOAA 2005a). NOAA's recommendation to site LNG terminals as far offshore as possible also minimizes the need for and impacts from additional dredging to support LNG carriers and support vessels. Recreational use areas should also be considered and avoided if possible (NOAA 2005a).

3.3 PIPELINE ROUTE ALTERNATIVES

Section 4.5.2 of the EIS evaluates five route alternatives between the FSRU location and the existing IGTS pipeline. We do not recommend any of these alternatives since they would not be environmentally superior to the proposed route. Four of these route alternatives would be located in the offshore waters of Long Island Sound, and one alternative would be located both onshore and offshore (Scott's Beach Route Alternative).

3.3.1 Pipeline Route Alternatives

There were a total of five pipeline route alternatives including three offshore route alternatives between the FSRU and an offshore interconnect with the existing IGTS pipeline, and two route alternatives that would connect the offshore FSRU with an onshore interconnect with the existing IGTS pipeline. The offshore route alternatives include a North Route, Middle Route, South Route, and Stratford Shoal Reroute. The proposed route (in central Long Island Sound) minimizes potential impacts to various resources by limiting the pipeline length while optimizing other screening criteria, such as human populations, marine transportation, or sensitive biological resources. It avoids the need for construction in areas of shallow bedrock, minimizes the number of utility crossings, and avoids or minimizes impacts to marine hazards and restricted areas. The proposed pipeline route addresses NOAA's suggestions to avoid wetlands and associated sensitive communities, eelgrass beds, and shellfish beds (2005a). The seafloor along the proposed pipeline route is made up of soft-bottom sediments and habitats with the exception of the hard-bottom substrate of Stratford Shoal. Each of these offshore alternative routes would impact more sensitive nearshore resources, have more utility crossings, disturb contaminated sediments, and/or result in a longer overall subsea pipeline or longer crossing of Stratford Shoal. Therefore, these three offshore alternative routes were not considered environmentally preferable to the proposed route.

The two alternative routes that would extend onshore include the Shoreham Route Alternative and the Scott's Beach Route Alternative. These route alternatives were developed in response to a request by NMFS to reduce the total length of pipeline construction within Long Island Sound. These two pipeline routes would be at least 12 miles longer than the proposed Broadwater pipeline. The Shoreham Route Alternative would include a 9.9-mile offshore pipeline that would proceed due south from the proposed FSRU location, then follow the proposed Islander East Pipeline Route to a landfall location near Shoreham. From there, an approximately 32-mile onshore pipeline would parallel the proposed Islander East Pipeline Route then travel westward to a tie-in with the IGTS Pipeline near Smithtown, New York. The Scott's Beach Route Alternative would include a 10.7-mile offshore pipeline that would extend southwesterly from the proposed FSRU to a landfall location at Scott's Beach near Miller Place, New York. From there, an approximately 23.3-mile onshore pipeline would be constructed primarily along existing roadways to tie-in with the IGTS Pipeline near Smithtown, New York.

Both the Shoreham Route and Scott's Beach Route Alternatives would result in the construction of a shorter pipeline within Long Island Sound relative to the proposed Project. However, both would require pipeline construction through sensitive nearshore, coastal, and onshore resources. These alternative routes would require extensive construction through residential and recreational areas and would have the potential to impact dozens of existing homes. These alternative routes would also cross approximately 8 to 9 miles of forested uplands, including portions of the Central Pine Barrens. Finally, an intermediate compressor station would likely be required if the pipeline were constructed along either the Shoreham Route or the Scott's Beach Route Alternatives.

Based on the potential for greater environmental impacts, we do not consider either the Shoreham Route or Scott's Beach Route Alternative environmentally preferable to the proposed route.

3.4 PIPELINE CONSTRUCTION ALTERNATIVES

In addition to pipeline route alternatives, we evaluated alternative pipeline construction methods to determine whether or not they could minimize the impacts of pipeline installation including the types of construction vessels used, and the methods used to physically install the pipeline in the seabed.

The proposed pipe lay approach would involve the use of a traditional lay barge that would be held in place and moved forward along the pipeline centerline using a system of anchors and anchoring cables. In Section 3.1.2.3 of the EIS, we recommend that Broadwater use mid-line buoys on all anchor cables (or a dynamically positioned lay barge if Broadwater considered it more feasible) to virtually eliminate the impacts of cable sweep. After lowering the pipeline to the seabed, the proposed pipeline installation approach would involve the use of the same lay barge to pull a subsea plow that would excavate a furrow beneath the pipeline. In Section 3.1.2.2 of the EIS, we recommend that Broadwater actively backfill the proposed pipeline trench with excavated spoil material following pipeline installation, and conduct post-construction monitoring to document success. NOAA suggests subsea plows be used for pipeline installation because they greatly reduce the collateral damage to the seafloor and recovery time (NOAA 2005a). In addition, the proposed pipeline would be installed from October to April, thus avoiding the more biologically sensitive spring and summer months of the year.

For pipe lay activities, we evaluated the use of a non-anchored, dynamically positioned lay barge as an alternative to an anchored lay barge. We also evaluated two alternative techniques for installing and covering the pipeline: post-lay jetting and pre-lay trenching.

3.4.1 Dynamically Positioned Lay Barge Alternative

With this alternative, the barge used to lay the pipeline on the bottom and to pull the subsea plow for pipeline installation would not require anchors and anchor lines to maintain position and move forward during pipe lay activities. Instead, station keeping and forward movement would be accomplished using thrusters, thus avoiding the impacts associated with anchor placement and anchor cable sweep on the seafloor.

If a dynamically positioned lay barge were used for installing the pipeline, impacts associated with anchor placement and anchor cable sweep as proposed by Broadwater (approximately 16 acres and 2,020 acres) would not occur. However, thrusters on a dynamically positioned lay barge could disturb sediments beneath and adjacent to the barge in some locations, resulting in an increase in turbidity. By incorporating the recommendation for mid-line buoys into the Project, Broadwater would substantially reduce the impacts of anchor cable sweep (Section 3.1.2.3 of the EIS) and much of the potential environmental advantage to using a dynamically positioned lay barge for the Project would no longer apply. As part of our recommendation for the use of mid-line buoys, we have given Broadwater the option to use a dynamically positioned lay barge in the event that it would be more feasible than mid-line buoys on all anchor cables of a standard lay barge.

3.4.2 Alternative Pipeline Installation Methods

To meet federal pipeline integrity protection requirements, the pipeline must be buried to a minimum depth of 3 feet or covered with armored mats or rocks that provide an equivalent level of protection. Since covering the entire 21.7-mile subsea pipeline with armored mats or rocks would increase permanent sediment conversion by approximately an order of magnitude relative to the proposed Project, these alternatives protection methods are not considered further. We evaluated two alternative methods for burying the pipeline with natural substrate: the use of a subsea jetting sled to bury the pipe and construction of a dredged trench.

3.4.2.1 Subsea Jetting Sled

With this alternative, a jet sled would be used to excavate the pipeline trench after the pipe is place on the sea floor. Similar to the proposed plow method of excavation, the subsea jet sled would be positioned around the pipeline on rollers and would be pulled forward by the lay barge. High-pressure water jets on the jet sled would liquefy sediments in front of the sled and force the sediments upward, creating a trench beneath the pipeline.

The width of the trench created by a jetting sled would vary depending upon the particle size and cohesiveness of the sediments. Because much of the proposed pipeline route traverses areas dominated by clays and other cohesive sediments, Broadwater estimated that a jetted trench would be approximately 40 feet wide; FERC estimated a similar jetted trench width in the Islander East EIS. The trench width would likely increase in areas with less cohesive sandy and silty sediments. Unlike the proposed subsea plow, sediments displaced by a jet sled would not fall immediately adjacent to the trench but would be broadcast over a larger area. Under this alternative, we anticipate increased sediment deposition in the general vicinity of the trench, and the total area of seabottom impacts would increase to more than double (approximately 526 acres for jetting and about 197 acres for the proposed plowing method). Because a jet sled would disperse sediment over a wider area than the proposed plowing method, we anticipate that turbidity and redeposition of sediment would be of greater magnitude and longer duration than would occur with the proposed pipeline installation approach. Therefore this alternative does not appear to be environmentally superior to the proposed plow method of trenching.

3.4.2.2 Pre-Lay Dredge

With this alternative, the trench would be excavated using a barge-mounted excavator or clamshell dredge prior to lowering the pipe to the seafloor. Sediment removed from the trench would be placed on one or both sides of the trench, and after the trench is excavated, the pipeline would be laid directly into the trench.

Although the design width of a pre-lay trench would be 40 feet, slumping of sediments at a 2:1 slope would require that the pre-lay trench width be approximately 54 feet. We anticipate that sidecast dredged material would affect a 100- to 200-foot-wide area beyond the trench, and the total area of seabottom affected would be approximately double that of the proposed method (395 acres as compared to approximately 197 acres). In addition, we anticipate that movement of the excavated material vertically through the water column (in the excavator bucket or clamshell) coupled with the large volume of sidecast material left adjacent to the trench would result in greater turbidity and redeposition of sediment than would occur with the proposed pipeline installation approach. We do not consider this construction alternative environmentally preferable to the methods proposed for the Project.

3.5 ALTERNATIVE VAPORIZATION METHODS

LNG must be warmed from a liquid to a gaseous state (vaporized) before it can be transported as natural gas in the sendout pipeline. Broadwater has proposed to accomplish this using STV technology. Under this approach, LNG is regasified by passing through a series of heated coils, which are heated using a glycol/water mixture contained in a closed loop (Section 2.1.1.4 of the EIS). We evaluated three alternative vaporization technologies and their potential environmental impacts:

- Ambient-air-heated vaporization;
- Open rack vaporization; and
- Submerged combustion vaporization.

3.5.1 Ambient-Air-Heated Vaporization

Ambient-air-heated vaporizers use heat from the surrounding air to warm LNG as it is distributed through a series of heat exchanger tubes. Because heat would be derived solely from ambient air with no supplemental heating, no air emissions or water discharges would directly occur with this vaporization technology.

Because ambient air must be warm enough to vaporize LNG year round, this vaporization approach is only feasible for LNG terminals in warm climates, such as the Petronet LNG Terminal in Dahej, India (Yang and Huang 2004). LNG terminals in temperate climates would require supplemental heat from submerged combustion vaporization (SCVs) or STVs during cooler weather. Therefore, this technology is not preferred.

3.5.2 Open Rack Vaporization

Open rack vaporization (ORV) systems are widely used for LNG vaporization at LNG terminals in Japan, Korea, and portions of Europe (Yang and Huang 2004). In the Gulf of Mexico, the ORV system is in use at the Gulf Gateway Energy Bridge terminal and was approved for use at the Port Pelican and Gulf Landing LNG terminal projects (Exponent 2005). ORV systems use seawater as the LNG warming medium, with the LNG pumped through a series of aluminum heat transfer tubes arranged in a rack. Seawater is drawn in through screened water intakes, treated with sodium hypochlorite to prevent marine growth, passed over the heat transfer rack to warm the LNG, and then discharged back to the water body. Discharged seawater is typically 13 to 22°F cooler than the ambient seawater (Exponent 2005). A typical ORV system requires approximately 136 million gallons of seawater per day (Exponent 2005).

ORV systems are effective only when the ambient seawater temperature is at least 50 to 63°F. When seawater temperatures drop below this range, supplemental methods of LNG warming would need to be implemented. Typically, supplemental heating would be provided using submerged heaters similar to those used for submerged combustion vaporization systems or using an STV system. Both methods of supplemental heating would result in air emissions. Because the water temperature in Long Island Sound is often below 50°F, use of an ORV system for the Broadwater Project would also require a supplemental heating system.

The intake of seawater associated with ORV systems affects marine life through impingement and entrainment fish eggs and larvae (ichthyoplankton), shellfish eggs and larvae, and zooplankton that are unable to escape from the intake area. The discharge of cooled and chemically treated warming water would also affect marine life and water quality, although the effects would be localized. NMFS has opposed the use of ORV technology in new LNG terminal projects due to concerns about the magnitude of these impacts on fish and shellfish populations. Therefore, this technology is not preferred.

3.5.3 Submerged Combustion Vaporization

The SCV method is currently in use at LNG terminal facilities at Elba Island, Georgia, and Lake Charles, Louisiana, and was approved by FERC for use at the Cameron LNG project located near Hackberry, Louisiana. This type of system uses water heated by combustion exhaust to warm and vaporize LNG and includes a water bath containing stainless steel tubes (vaporization coils). LNG is warmed and vaporized by pumping it through tubes submerged in the heated water bath. As heat is transferred from the water bath to the LNG, the water bath cools and requires constant reheating. That is accomplished using a combustion chamber that is submerged in the water bath. Water in the water bath is periodically discharged and replaced with fresh water.

The submerged combustion units use vaporized LNG (natural gas) for fuel and produces carbon dioxide (CO_2) and water. The CO_2 is absorbed into the water bath, resulting in a low (acidic) pH that requires chemical treatment to neutralize the water bath prior to discharge. An SCV system with an average sendout rate of 1.0 bcfd of natural gas discharges approximately 173,000 gallons of treated freshwater per day.

Air emissions from SCVs include CO_2, carbon monoxide (CO), and nitrogen oxides (NO_x). Without emissions control systems being applied, NO_x and CO concentrations in the exhaust are typically 40 ppm and 80 ppm, respectively. With emission control systems, NO_x emissions are reduced by about 90 percent. Even with these controls, emissions would be greater than those compared to the proposed STV method, and, thus, this vaporization technology is not considered environmentally preferable to the proposed method.

3.5.4 Conclusions Regarding LNG Vaporization Technology Alternatives

Ambient-air-heated vaporization is not a feasible vaporization alternative for the Broadwater Project because air temperatures would be too cold during much of the year for this system to function properly. Similarly, water temperatures in Long Island Sound are often too low for an ORV system to be able to vaporize LNG. In addition, an ORV system would result in greater impacts to marine resources than the proposed STV system due to the large seawater intakes and discharges required for the ORV system. Use of an SCV system would result in higher levels of air emissions than those that associated with the proposed STV system and would also require the discharge of treated freshwater to Long Island Sound.

In summary, none of the alternative LNG vaporization methods considered in our evaluation would have fewer environmental impacts or would be environmentally preferable to the proposed STV system. We have therefore eliminated these vaporization alternatives from further consideration.

4.0 ESSENTIAL FISH HABITAT

The MSA set forth a mandate for NMFS, regional Fishery Management Councils (FMC), 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-designated species and life history stages in the proposed Project Waterway were identified based on a list in the NOAA Guide to Essential Fish Habitat Designations in the Northeastern United States (NOAA 2005b). The guide identifies the managed species and their life stages that have EFH in selected 10-minute by 10-minute squares of latitude and longitude (referred to as "blocks"). These designations were completed by the New England Fishery Management Council (NEFMC), Mid-Atlantic Fishery Management Council (MAFMC), and the NMFS pursuant to the MSA (Tables 4-1 and 4-2 and Figure 4-1).

TABLE 4-1
Ten-Minute Square Coordinate Designations within the Project Waterway

Block Number	North	East	South	West
41207130*	41° 30.0' N	71° 30.0 W	41° 20.0' N	71° 40.0' W
41207120*	41° 30.0' N	71° 20.0 W	41° 20.0' N	71° 30.0' W
41107250*	41° 20.0' N	72° 50.0 W	41° 10.0' N	73° 00.0' W
41107240*	41° 20.0' N	72° 40.0' W	41° 10.0' N	72° 50.0' W
41107230*	41° 20.0' N	72° 30.0' W	41° 10.0' N	72° 40.0' W
41007220*	41° 20.0' N	72° 20.0' W	41° 10.0' N	72° 30.0' W
41107210*	41° 20.0' N	72° 10.0' W	41° 10.0' N	72° 20.0' W
41107200*	41° 20.0' N	72° 00.0' W	41° 10.0' N	72° 10.0' W
41107150*	41° 20.0' N	71° 50.0' W	41° 10.0' N	72° 00.0' W

TABLE 4-1 (continued)
Ten-Minute Square Coordinate Designations within the Project Waterway

Block Number	North	East	South	West
41107140*	41° 20.0' N	71° 40.0' W	41° 10.0' N	71° 50.0' W
41107130*	41° 20.0' N	71° 30.0' W	41° 10.0' N	71° 40.0' W
41107120*	41° 20.0' N	71° 20.0' W	41° 10.0' N	71° 30.0' W
41107110*	41° 20.0' N	71° 10.0' W	41° 10.0' N	71° 20.0' W
41007310**	41° 10.0' N	73° 10.0' W	41° 00.0' N	73° 20.0' W
41007300**	41° 10.0' N	73° 00.0' W	41° 00.0' N	73° 10.0' W
41007250**	41° 10.0' N	72° 50.0' W	41° 00.0' N	73° 00.0' W
41007240*	41° 10.0' N	72° 40.0' W	41° 00.0' N	72° 50.0' W
41007230*	41° 10.0' N	72° 30.0' W	41° 00.0' N	72° 40.0' W
41007220*	41° 10.0' N	72° 20.0' W	41° 00.0' N	72° 30.0' W
41007210*	41° 00.0' N	72° 10.0' W	41° 00.0' N	72° 20.0' W
41007200*	41° 10.0' N	72° 00.0' W	41° 00.0' N	72° 10.0' W
41007150*	41° 10.0' N	71° 50.0' W	41° 00.0' N	72° 00.0' W
41007140*	41° 10.0' N	71° 40.0' W	41° 00.0' N	71° 50.0' W
41007130*	41° 10.0' N	71° 30.0' W	41° 00.0' N	71° 40.0' W
41007120*	41° 10.0' N	71° 20.0' W	41° 00.0' N	71° 30.0' W
41007110*	41° 10.0' N	71° 10.0' W	41° 00.0' N	71° 20.0' W
40507310*	41° 00.0' N	73° 10.0' W	40° 50.0' N	73° 20.0' W
40507300*	41° 00.0' N	73° 00.0' W	40° 50.0' N	73° 10.0' W
40507250*	41° 00.0' N	72° 50.0' W	40° 50.0' N	73° 00.0' W
40507140*	41° 00.0' N	71° 40.0' W	40° 50.0' N	71° 50.0' W
40507130*	41° 00.0' N	71° 30.0' W	40° 50.0' N	71° 40.0' W
40507120*	41° 00.0' N	71° 20.0' W	40° 50.0' N	71° 30.0' W

TABLE 4-1 (continued)
Ten-Minute Square Coordinate Designations within the Project Waterway

Block Number	North	East	South	West
40507110*	41° 00.0' N	71° 10.0' W	40° 50.0' N	71° 20.0' W
40407140*	40° 50.0' N	71° 40.0' W	40° 40.0' N	71° 50.0' W
40407130*	40° 50.0' N	71° 30.0' W	40° 40.0' N	71° 40.0' W

Source: NOAA 2005b
* - Blocks associated with the proposed LNG carrier transit routes
** - Blocks associated with the proposed YMS, FSRU, and pipeline

TABLE 4-2
Species with Identified EFH within the Project Waterway

Species	Scientific Name	Egg	Larvae	Juvenile	Adult
Albacore tuna*	*Thunnus alalunga*			X	
American plaice*	*Hippoglossoides platessoides*		X	X	X
Atlantic butterfish*	*Peprillus triacanthus*	X	X	X	X
Atlantic cod*	*Gadus morhua*	X	X	X	X
Atlantic mackerel	*Scomber scombrus*	X	X	X	X
Atlantic salmon	*Salmo salar*			X	X
Atlantic sea herring	*Clupea harengus*		X*	X	X
Atlantic sea scallop*	*Placopecten magellanicus*	X	X	X	X
Basking shark*	*Cetorhinus maximus*			X	X
Black sea bass	*Centropristus striata*			X	X*
Blue shark*	*Prionace glacua*		X**	X	X
Bluefin tuna*	*Thunnus thynnus*			X	X
Bluefish	*Pomatomus saltatrix*	X*	X*	X	X
Cobia	*Rachycentron canadum*	X	X	X	X
Common thresher shark*	*Alopias vulpinus*		X	X	X
Dusky shark*	*Charcharinus obscurus*		X**	X	
Haddock*	*Melanogrammus aeglefinus*		X	X	

TABLE 4-2 (continued)
Species with Identified EFH within the Project Waterway

Species	Scientific Name	Egg	Larvae	Juvenile	Adult
King mackerel	*Scomberomorus cavalla*	X	X	X	X
Little skate	*Leucoraja erinacea*			X	X
Long finned squid*	*Loligo pealei*			X	X
Monkfish*	*Lophius americanus*	X	X	X	X
Ocean pout	*Macrozoarces americanus*	X	X	X	X
Ocean quahog*	*Artica islandica*			X	X
Offshore hake*	*Merluccius albidus*		X		
Pollock	*Pollachius virens*			X	X
Red hake	*Urophycis chuss*	X	X	X	X
Sand tiger shark	*Odontaspis taurus*		X**		
Sandbar shark*	*Charcharinus plumbeus*		X**	X	X
Scup	*Stenotomus chrysops*	X	X	X	X
Shortfin mako shark*	*Isurus oxyrhyncus*		X**	X	X
Silver hake (Whiting)	*Merluccius bilinearis*	X*	X*	X*	X
Skipjack tuna*	*Katsuwonus pelamis*				X
Spanish mackerel	*Scomberomorus maculatus*	X	X	X	X
Spiny dogfish*	*Squalus acanthias*			X	X
Summer flounder	*Paralicthys dentatus*	X*	X*	X	X*
Surf clam*	*Spisula solidissima*			X	X
Tiger shark*	*Galeocerdo cuvieri*		X**	X	
White hake*	*Urophycis tenuis*			X	X
White shark*	*Charcharadon carcharias*			X	
Windowpane flounder	*Scopthalmus aquosus*	X	X	X	X
Winter flounder	*Pleuronectes americanus*	X	X	X	X
Winter skate	*Leucoraja ocellata*			X	X
Witch flounder*	*Glyptocephalus cynoglossus*	X	X		X

TABLE 4-2 (continued)
Species with Identified EFH within the Project Waterway

Species	Scientific Name	Egg	Larvae	Juvenile	Adult
Yellowfin tuna*	*Thunnus albacares*			X	X
Yellowtail flounder*	*Pleuronectes ferruginea*	X	X	X	X

Source: NOAA 2005b

* - Species and or lifestages associated with the LNG carrier transit route

** - Lifestages listed as larvae represent the neonate stage in these organisms

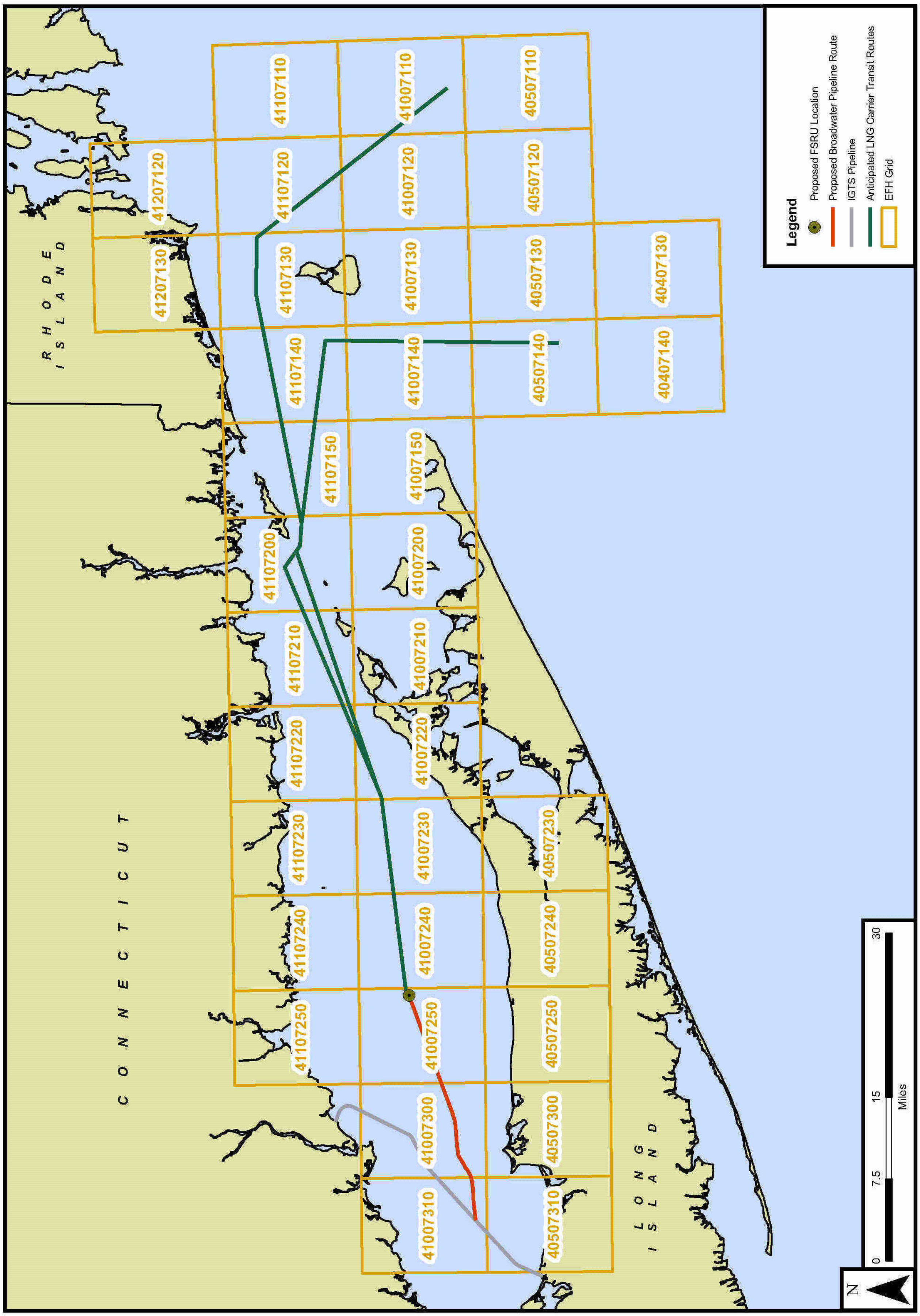
To provide additional focus for conservation efforts, the MSA also requires that FMCs identify EFH - Habitat Areas of Particular Concern (HAPCs). For an EFH to be identified as a HAPC, they must meet the following criteria: (1) the importance of the ecological function provided by the habitat; (2) the extent to which the habitat is sensitive to human-induced environmental degradation; and (3) whether, and to what extent, development activities are, or will be, causing stress to the habitat type (NEFMC 1998). No HAPCs have been identified along the proposed pipeline route, at the proposed YMS and FSRU site, or along the proposed LNG carrier transit route.

4.1 LIFE HISTORY DESCRIPTIONS OF FEDERALLY MANAGED SPECIES

In reviewing the proposed Project, designated EFH occurs in the area of the proposed YMS, FSRU, and pipeline for various lifestages of 19 species. Nine species have designated EFH for every lifestage; ocean pout, red hake, winter flounder, windowpane flounder, scup, Atlantic mackerel, king mackerel, Spanish mackerel, and cobia. Designated EFH occurs within the LNG carrier transit route for various lifestages of 30 species. Eight species have designated EFH for every lifestage; bluefish, summer flounder, silver hake (whiting), Atlantic cod, yellowtail flounder, Atlantic sea scallop, monkfish, and Atlantic butterfish. None of these managed stocks are federally or state-listed endangered or threatened. Managed species are summarized in Table 4-2 and discussed below. Additional discussion on the duration and magnitude of potential impacts to EFH and EFH-managed species associated with construction and operation of the FSRU, YMS, and pipeline are provided in Section 6.0.

The managed species have also been grouped by habitat requirements to differentiate those that typically are found near the seafloor (demersal species), and those typically associated with the water column (pelagic species).

In addition, there could potentially be impacts to EFH-managed species along the LNG transit routes leading to and from the proposed FSRU (Project Waterway). Those EFH-managed species that are limited to the proposed LNG carrier transit routes are discussed in Section 4.1.2. These species have been grouped in the following groups; migratory sharks, migratory tuna, bivalves, flatfishes, and codfish. Six species (Atlantic sea herring, bluefish, monkfish, long finned squid, Atlantic butterfish, and spiny dogfish) could not be grouped into the previously listed categories and are discussed individually.



Source: NOAA 2005b

Figure 4.1
Broadwater LNG Project
Essential Fish Habitats in the Project Waterway

4.1.1 EFH-Managed Species Associated with the Project Waterway

4.1.1.1 Demersal Species

Ocean Pout

EFH supporting all lifestages of ocean pout have been identified in the proposed Project Waterway. The ocean pout is a bottom dwelling and cool-temperate species found on the Atlantic continental shelf from Labrador to Virginia. This species spawns in protected habitats, such as rock crevices and man-made artifacts, where it lays its eggs and guards them. Ocean pout spawn from late summer to early winter, peaking August through October. Eggs are typically present in Long Island Sound from late fall through winter. Larvae ocean pout are typically present in Long Island Sound from late fall to spring. It is believed that larvae stay on or near the bottom.

Juveniles are typically found in shallow coastal waters near rocks and other similar structures. Adults are demersal and do not make extensive migrations. Adult ocean pout feed on a variety of benthic invertebrates such as polychaetes, mollusks, crustaceans, and echinoderms (Steimle et al. 1999a).

Potential direct construction impacts to ocean pout EFH could affect all four lifestages. The proposed winter installation would minimize impacts to most other species however, it could affect eggs and larvae of the ocean pout. Ocean pout eggs are found on hard-bottom substrates from late fall to winter. Since this type of habitat is limited within the area of the proposed YMS, FSRU, and pipeline, any impacts as a result of construction would be expected within the 4,000-foot crossing of Stratford Shoal. Larval ocean pout prefer smooth-bottom habitats and are typically found along the bottom of Long Island Sound from late fall to spring. Therefore, larval ocean pout may be impacted by installation of the proposed YMS and construction of the proposed pipeline. However, any impacts are expected to be minor and temporary since the area of the proposed YMS and pipeline includes a small portion of the available habitat within Long Island Sound. Juvenile and adult ocean pout are bottom-dwelling fish that may be within the area of proposed pipeline construction. However, any impacts to juvenile and adult ocean pout during construction are expected to be minor and temporary since the proposed pipeline would affect a small portion of the available habitat within Long Island Sound. Also, suitable habitat is readily available adjacent to the proposed pipeline route and YMS. Potential indirect impacts to ocean pout EFH could affect juvenile and adult lifestages. Construction of the proposed pipeline could result in a short-term loss of the benthic forage organisms along the proposed pipeline corridor that juvenile and adult ocean pout feed upon. However, ocean pout are opportunistic feeders and can forage for additional prey items along areas surrounding the proposed YMS, FSRU, and pipeline that are not under construction or undisturbed areas in the vicinity of the proposed YMS, FSRU, and pipeline. Approximately 264 acres of Long Island Sound would be under construction during the installation of the proposed YMS and pipeline. This accounts for approximately 0.03 percent of the available acreage in Long Island Sound (approximately 844,800 acres).

Operational impacts from the proposed YMS, FSRU and pipeline as well as the associated LNG carriers are not anticipated since ocean pout are a demersal species.

Red Hake

EFH supporting all lifestages of red hake have been identified in the proposed Project Waterway. Red hake is a demersal fish that occurs from North Carolina to Newfoundland. The highest population of red hake can be found from Georges Bank to New Jersey. This species makes seasonal migrations that are temperature dependent. They are commonly found in depths less than about 328 feet (100 m) during the warmer months and at greater depths during colder months. Spawning typically occurs from May through November. Red hake eggs are buoyant and float near the surface of the water. Larvae are common from May through December with peaks in September and October. However, red hake eggs and larvae are not present in Long Island Sound (Stone et al. 1994). Juvenile red hake are initially pelagic but become demersal as they mature. They feed on benthic and pelagic crustaceans such as shrimp, mysids, euphausiids, and amphipods. Adults are demersal and commonly found on soft sediments (Steimle et al. 1999b). Juveniles and adults are commonly found in Long Island Sound from March through November (Stone et al. 1994). They feed on crustaceans, demersal and pelagic fish, and squid (Steimle et al. 1999b).

Since juvenile and adult red hake are demersal they could be impacted by installation of the proposed YMS and pipeline. However, since juveniles and adults are highly mobile they are expected to leave the area of active construction, thereby avoiding impacts. These disturbances to red hake habitat are expected to be short term and minor. Installation of the proposed YMS and pipeline could result in a short-term loss of the benthic forage organisms that juvenile and adult red hake feed upon. However, red hake can forage for additional prey items along areas surrounding the proposed YMS and pipeline location that are not under construction or in the vicinity of the proposed YMS, FSRU, and pipeline. Approximately 264 acres of Long Island Sound would be directly impacted during installation of the proposed YMS and pipeline. Adult red hake predominately feed upon pelagic species, which would not be impacted during installation of the proposed YMS and pipeline.

Operational impacts from the proposed YMS, FSRU, pipeline, and LNG carriers are not anticipated since red hake are a demersal species.

Winter Flounder

EFH supporting all lifestages of winter flounder have been identified in the proposed Project Waterway. Winter flounder is an important commercial and recreational species. Winter flounder can be found along the Atlantic coast from Labrador to North Carolina and Georgia. This species spawns in nearshore areas from winter through spring, with peaks occurring during February and March. Winter flounder eggs are demersal and adhesive. Hatching generally occurs in two to three weeks. Larvae are initially planktonic but become bottom-oriented as they mature. Since the early lifestages are nondispersive, spawning and nursery grounds are essentially the same (Pearcy 1962). Winter flounder are omnivorous and opportunistic. They will consume a wide variety of prey (Pereira et al. 1999). Larvae are commonly found in Long Island Sound from February through June (Stone et al. 1994). Adults migrate inshore in the fall and early winter to spawn. Afterwards, adults tend to leave inshore spawning areas when temperatures begin to rise (Pereira et al. 1999). Adults and juvenile winter flounder can be found in Long Island Sound in all months of the year (Stone et al. 1994).

Potential direct construction impacts to winter flounder EFH could affect all lifestages. Siting the proposed YMS and pipeline in the central waters of Long Island Sound would aid in minimizing impacts to eggs and larvae since they inhabit inshore spawning and nursery areas. However, the proposed winter construction schedule could result in impacts to juvenile and adult winter flounder. Since juvenile and adult winter flounder are bottom-dwelling species they could be impacted during the proposed pipe-laying, pipe-lowering, and backfilling. However, since these lifestages are highly mobile, it is expected that they would avoid active construction areas, thereby minimizing any impacts. Indirect impacts on winter flounder EFH are expected to be temporary and minor. Installation of the proposed YMS and pipeline could result in a short-term loss of the benthic forage organisms that juvenile and adult winter flounder feed upon. However, winter flounder are opportunistic feeders and can forage for additional prey items along areas surrounding the proposed YMS and pipeline that are not under construction or in the undisturbed areas in the vicinity of the proposed YMS, FSRU, and pipeline. Approximately 264 acres of Long Island Sound would be under construction during the proposed Project, which accounts for less than 0.1 percent of the benthic habitat of Long Island Sound.

Operational impacts from the proposed YMS, FSRU, pipeline, and LNG carriers are not anticipated since winter flounder are a demersal species.

Summer Flounder

EFH supporting juvenile summer flounder have been identified in the proposed Project Waterway. Summer flounder is a demersal fish that is an important commercial and recreational species. Summer flounder inhabit estuarine and shelf waters of the Atlantic Ocean from Nova Scotia to Florida. However, the highest population is found from Cape Cod, Massachusetts to Cape Hatteras, North Carolina. Juvenile summer flounder begin to move into estuarine areas in March and April. They are typically found in Long Island Sound from June through November but have been observed year-round. They feed primarily on mysid shrimp and small fish (Grimes et al. 1989).

Potential direct construction impacts to juvenile summer flounder EFH include temporary disturbance during installation of the proposed YMS and pipeline. Since juvenile summer flounder are bottom-dwelling species they could be impacted during the construction. However, since these lifestages are highly mobile, it is expected that they would avoid active construction areas, thereby minimizing any impacts. Indirect impacts on winter flounder EFH are expected to be short-term and minor. Installation of the proposed YMS and pipeline could result in a short-term loss of the benthic forage organisms that juvenile summer flounder feed upon. However, summer flounder can forage for additional prey items along areas surrounding the proposed YMS and pipeline that are not under construction or in the undisturbed areas in the vicinity of the proposed YMS, FSRU, and pipeline.

Operational impacts from the proposed YMS, FSRU, pipeline, and LNG carriers are not anticipated since summer flounder are a demersal species.

Windowpane Flounder

EFH supporting all lifestages of windowpane flounder have been identified in the proposed Project Waterway. Windowpane flounder are found from the Gulf of Saint Lawrence to Florida. Populations of windowpane flounder are highest from Georges Bank to the Chesapeake Bay. They tend to inhabit waters less than about 360 feet (110 m) with sandy substrates (Chang et al. 1999a). Adult windowpane flounder typically spawn from April through August in Long Island Sound (Stone et al. 1994). Eggs are buoyant and spherical, usually hatching in about eight days. Larvae are initially pelagic but become demersal as they mature (usually when they reach 0.4 inches total length) (Chang et al. 1999a). They are commonly found in Long Island Sound from May through October (Stone et al. 1994). Larvae windowpane flounder inhabit the polyhaline (high salinity usually 30 ppt to 35 ppt) portion of estuaries in the spring but migrate to the continental shelf in the fall (Chang et al. 1999a). Juvenile and adult windowpane flounder can be found in Long Island Sound during all months of the year (Stone et al. 1994).

EFH supporting all lifestages of windowpane flounder have been identified in the area of the proposed YMS, FSRU, and pipeline. Since windowpane eggs are present in Long Island Sound from April through August, they would not be present during proposed construction. Windowpane flounder eggs and larvae are pelagic and could be impacted by water intakes at the proposed FSRU. However, Broadwater proposes to withdraw water from approximately 20 to 40 feet below the surface of the water. The intakes for the LNG carriers would be approximately 20 feet deep (or more), and the intakes for the proposed FSRU would be at a depth of approximately 40 feet. The proposed FSRU water intake velocity would be limited to 0.5 ft/sec or less, thus reducing the potential for impingement and/or entrainment of plankton and ichthyoplankton. Since juvenile and adult windowpane flounder are bottom-dwelling species, they could be impacted during the construction. However, since these lifestages are highly mobile, it is expected that they would avoid active construction areas, thereby minimizing any impacts. Indirect impacts on windowpane flounder EFH are expected to be short-term and minor. Installation of the proposed YMS and pipeline could result in a short-term loss of the benthic forage organisms that juvenile and adult windowpane flounder feed upon. However, these lifestages can forage for additional prey items along areas surrounding the proposed YMS and pipeline that are not under construction or in the undisturbed areas in the vicinity of the proposed YMS, FSRU, and pipeline.

Operational impacts from the proposed YMS, FSRU, pipeline, and LNG carriers are not anticipated since windowpane flounder are a demersal species.

Little Skate

EFH supporting juvenile and adult little skate have been identified in the proposed Project Waterway. Little skate are a demersal fish that occur from Nova Scotia to Cape Hatteras. The highest populations of little skate are found in the northern section of the Mid-Atlantic Bight and on Georges Bank. The little skate does not make extensive migrations but will make short seasonal migrations from nearshore to offshore (Packer et al. 2003a). Juvenile and adult little skate are highly abundant in Long Island Sound year round (Stone et al. 1994). Little skates feed primarily on invertebrates such as decapod crustaceans and amphipods. This species is generally found on sandy or gravelly bottoms, but may be also found on mud substrates (Packer et al. 2003a).

Potential direct construction impacts to little skate EFH could affect juveniles and adults. Since little skates are bottom-dwelling organisms they could be impacted during installation of the proposed pipeline and YMS. However, since these lifestages are highly mobile, they are expected to vacate areas of active construction, which would minimize impacts. Therefore, direct impacts would be minor and short-term. Installation of the proposed YMS and pipeline could result in a short-term loss of the benthic forage organisms that juvenile and adult little skate feed upon. However, these lifestages can forage for additional prey items along areas surrounding the proposed YMS and pipeline that are not under construction or in the undisturbed areas in the vicinity of the proposed YMS, FSRU, and pipeline.

Operational impacts from the proposed YMS, FSRU, pipeline, and LNG carriers are not anticipated since little skate are a demersal species.

Winter Skate

EFH supporting juvenile and adult winter skate have been identified in the proposed Project Waterway. Winter skate are a demersal fish that occur from Newfoundland to Cape Hatteras. The highest populations of winter skate are found in the northern section of the Mid-Atlantic Bight and on Georges Bank. In both areas, the winter skate is usually second in abundance to little skate. Winter skate are generally found from the shoreline to depths of approximately 1,000 feet. Like little skate, winter skate tend to inhabit sandy to gravelly substrates, but have been found over mud bottoms. Winter skate feed primarily on polychaetes, amphipods, decapods, isopods, bivalves, and fishes (Packer et al. 2003b). Juvenile and adult winter skate are highly abundant in Long Island Sound year round (Stone et al. 1994).

Potential direct construction impacts to winter skate EFH could affect juveniles and adults. Since winter skates are bottom-dwelling organisms they could be impacted during installation of the proposed pipeline and YMS. However, since these lifestages are highly mobile, they are expected to vacate areas of active construction, which would minimize impacts. Therefore, direct impacts would be minor and short-term. Installation of the proposed YMS and pipeline could result in a short-term loss of the benthic forage organisms that juvenile and adult winter skate feed upon. However, these lifestages can forage for additional prey items along areas surrounding the proposed YMS and pipeline that are not under construction or in the undisturbed areas in the vicinity of the proposed YMS, FSRU, and pipeline.

Operational impacts from the proposed YMS, FSRU, pipeline, and LNG carriers are not anticipated since winter skate are a demersal species.

Black Sea Bass

EFH supporting juvenile black sea bass have been identified in the area of the proposed YMS, FSRU, and pipeline. Black sea bass are a warm temperate species that tend to inhabit structured habitats such as reefs and shipwrecks. Black sea bass spawn on the continental shelf from the spring through the fall. Early juvenile black sea bass begin migrations to estuarine nurseries. Juveniles are visual predators that feed primarily on small benthic crustaceans such as isopods, amphipods, small crabs, sand shrimp, and copepods. They will also eat epibenthic estuarine and coastal organisms and small fish (Drohan et al. 2007). Juvenile black sea bass are commonly found in Long Island Sound from April through November (Stone et al. 1994).

Potential direct impacts from construction to black sea bass juveniles would be limited to habitat disturbances. Since black sea bass juveniles tend to inhabit structured habits, they would be more prevalent at the Stratford Shoal area of the proposed pipeline route. Any impacts to habitat are expected to be temporary and minor. There may also be an indirect impact on prey species of the juvenile black sea bass that inhabit structured areas. However, the structured areas of the proposed YMS location and pipeline route are small, and the fish could readily find suitable habitat in the rest of Long Island Sound. In addition, the proposed YMS (FSRU mooring tower) may provide additional structured habitat for the black sea bass population.

Operational impacts from the proposed YMS, FSRU, pipeline, and LNG carriers are not anticipated since black sea bass are a demersal species.

Silver Hake

EFH supporting adult silver hake have been identified in the proposed Project Waterway. Silver hake are a demersal fish that occur in the Atlantic Ocean from Newfoundland to Cape Fear, North Carolina. This species is most abundant from Nova Scotia to New Jersey. Adult silver hake spawn from May through October with peaks in August. Silver hake feed primarily on fish, crustaceans, and squid. This species makes seasonal migrations from the continental slope during the fall and winter to nearshore waters during the spring and summer. Silver hake have been found on most substrates (gravel to fine silt and clay) but are more common on silt and clay substrates. Silver hake occur in all areas of Long Island Sound but are more abundant during the spring (Lock and Packer 2004).

Potential direct construction impacts to silver hake EFH could affect adults. Since adult silver hake are most abundant within Long Island Sound during the spring they could be present during installation of the proposed YMS and pipeline. However, the area under construction would be small relative to suitable silver hake habitat within Long Island Sound. Adult hake are also highly mobile and would be expected to avoid active construction areas. Therefore, any direct impacts are expected to be temporary and minor. Installation of the proposed YMS and pipeline could result in a short-term loss of the benthic forage organisms that adult silver hake feed upon. However, hake can forage for additional prey items along areas surrounding the proposed YMS and pipeline that are not under construction or in the undisturbed areas in the vicinity of the proposed YMS, FSRU, and pipeline.

Operational impacts from the proposed YMS, FSRU, pipeline, and LNG carriers are not anticipated since silver hake are a demersal species.

Scup

EFH supporting all lifestages of scup have been identified in the proposed Project Waterway. Scup are a temperate finfish that occurs from Massachusetts to South Carolina. Adult scup spawn on the inner continental shelf from May through August. Eggs are small, buoyant, and hatch in two to three days. They are commonly found in Long Island Sound from May through July (Stone et al. 1994). Scup larvae move into coastal waters during the warmer months to feed on small zooplankton. It is during this lifestage that scup settle to the seafloor and become demersal (Steimle et al. 1999c). Larvae are commonly found in Long Island Sound from May through August (Stone et al. 1994). Juvenile scup generally feed during the day on polychaetes, epibenthic amphipods, mollusks, and fish eggs and larvae (Steimle et al. 1999c). Juveniles are found in Long Island Sound from May through November (Stone et al. 1994). Adult scup are generally found in schools and on a range of substrates including sandy and structured (such as mussel beds or reefs) (Steimle et al. 1999c). Adults are present in Long Island Sound from May through November (Stone et al. 1994).

Potential direct construction impacts to scup EFH could affect all lifestages. Scup eggs and larvae can be found in Long Island Sound from May through August. They could be impacted by the water intakes associated with the proposed FSRU. However, Broadwater proposes to withdraw water from 20 to 40 feet below the surface of the water, and limit water intake velocity to 0.5 ft/sec or less, thus reducing the potential for impingement and/or entrainment of plankton and ichthyoplankton. Juvenile and adult scup can be found in Long Island Sound from May through November. They could be impacted during installation of the proposed YMS and pipeline. However, since construction is proposed in the winter and spring, any impacts associated with juvenile and adult scup would be minimized. In addition, since these lifestages are highly mobile, they are expected to avoid areas of active construction. Therefore, any direct impacts associated with the proposed YMS and pipeline are expected to be minor and temporary. Potential indirect impacts on scup EFH are expected to be limited to the short-term loss of the benthic forage organisms that juvenile and adult scup feed upon. However, these lifestages can forage for additional prey items along areas surrounding the proposed YMS and pipeline that are not under construction or in the undisturbed areas in the vicinity of the proposed YMS, FSRU, and pipeline.

Operational impacts from the proposed YMS, FSRU, pipeline, and LNG carriers are not anticipated since scup are a demersal species.

4.1.1.2 Pelagic Species

Atlantic Salmon

EFH supporting juvenile and adult Atlantic salmon have been identified in the proposed Project Waterway. Atlantic salmon spend most of their life cycle in saltwater, but spawn in freshwater (anadromous). They occur from North Quebec to the Delaware River (Boschung et al. 1983). Adults spawn from mid October to mid November in gravel areas of freshwater streams (Oanie et al. 1984). Juveniles begin life in the freshwater streams where they were spawned. As they mature, they begin migrating to the ocean. Juvenile salmon feed primarily on mayfly larvae, stonefly larvae, chironomids, caddisflies, aquatic annelids, and mollusks (Oanie et al. 1984). Juvenile Atlantic salmon are rarely found in Long Island Sound from April through July (Stone et al. 1994). Adult Atlantic salmon spend their lives in the sea. They migrate to freshwater rivers to spawn. Adult Atlantic salmon primarily feed on herring, lance, alewives, capelin, smelt, and other fishes (Oanie et al. 1984). Adult Atlantic salmon are rarely found in Long Island Sound from February through November (Stone et al. 1994).

Since juvenile and adult Atlantic salmon are rarely found in Long Island Sound and they could readily avoid construction areas and impingement/entrainment, any impacts from the proposed YMS, FSRU, and pipeline would be negligible.

Impacts to juvenile and adult Atlantic salmon from LNG carriers are not expected since these lifestages are highly mobile and would be expected to avoid LNG carriers. In addition, these lifestages would not be susceptible to impingement/entrainment due to their size.

Atlantic Sea Herring

EFH supporting juvenile and adult Atlantic sea herring have been identified in the proposed Project Waterway. The Atlantic sea herring is a pelagic schooling fish that occurs from Labrador to Cape Hatteras. Spawning takes place in the area of the Gulf of Maine and Georges Bank during the summer and fall. Atlantic sea herring of all lifestages are opportunistic feeders. They will feed on any prey that is of an appropriate size for their jaws (Stevenson and Scott 2005). Juveniles are commonly found in Long Island Sound during all months of the year (Stone et al. 1994). Adult Atlantic sea herring make extensive seasonal migrations between summer spawning grounds (Gulf of Maine and Georges Bank) and wintering areas in south New England and the Mid-Atlantic Bight (Stevenson and Scott 2005). Adult Atlantic sea herring are present in Long Island Sound throughout the year (Stone et al. 1994).

Potential direct impacts to Atlantic sea herring EFH could affect juveniles and adults during construction and operation. However, these lifestages are pelagic and mobile and would be expected to avoid active construction areas and LNG carriers. Given that Atlantic sea herring are opportunistic feeders, any indirect impacts associated with prey items would also be expected to be negligible since suitable prey species would be found in adjacent non-disturbed areas.

Bluefish

EFH supporting juvenile and adult bluefish have been identified in the proposed Project Waterway. Bluefish are a pelagic finfish that occurs from Nova Scotia to Argentina. Spawning takes place on the Mid-Atlantic Bight from June through August. Juvenile and adult bluefish feed primarily on any prey items that are locally available (Shepherd and Packer 2006). Juvenile bluefish are abundant in Long Island Sound from August to October (Stone et al. 1994). Juvenile and adult bluefish inhabit a variety of habitats. Adult bluefish are present in Long Island Sound from August through November (Stone et al. 1994). Bluefish are warm water migrants. They migrate north in the spring and summer and migrate to southern New England and further south in the fall and winter (Shepherd and Packer 2006).

Juvenile bluefish are abundant in Long Island Sound from August to October while adults are abundant from August through November (Stone et al. 1994). Juvenile and adult bluefish can be found in north Atlantic estuaries from June to October (NMFS No Date). Therefore, any direct construction impacts to these lifestages are expected to be minimal since they would not be present during construction (winter and spring). In addition, these lifestages are pelagic and mobile and would be expected to avoid active construction areas. Any indirect impacts associated with prey items would also be expected to be negligible since suitable prey species would be found in adjacent non-disturbed areas.

Operational impacts from the proposed YMS, FSRU, pipeline, and LNG carriers are not expected to impact these highly mobile and pelagic lifestages of bluefish.

Atlantic Mackerel

EFH supporting all lifestages of Atlantic mackerel have been identified in the proposed Project Waterway. Atlantic mackerel are a pelagic fish that occurs in the Atlantic Ocean from the Gulf of St. Lawrence to Cape Lookout, North Carolina. Adults spawn on the shoreward half of the continental shelf waters during the spring and summer (Studholme et al. 1999). Eggs are pelagic and present in Long Island Sound from April through June (Stone et al. 1994). Egg and larvae Atlantic mackerel can be found in Rhode Island Sound and Block Island Sound from April through July (Studholme et al. 1999). Atlantic mackerel larvae feed primarily on zooplankton. Larvae can be found in Long Island Sound in May and June (Stone et al. 1994). Larval Atlantic mackerel can be found in the Rhode Island Sound and Block Island Sound from May to July (Studholme et al. 1999). Juveniles feed primarily on small crustaceans and pelagic mollusks. Adults feed on the same prey items as juveniles but also include larger prey items such as euphausiids, shrimp, and the larvae of many marine organisms (Studholme et al. 1999). Atlantic mackerel juveniles and adults are present in Long Island Sound from April through November (Stone et al. 1994).

Since Atlantic mackerel eggs and larvae are present in the proposed Project Waterway during the summer they would not be expected to be impacted by installation of the proposed YMS and pipeline. However, they could be impinged/entrained by the water intakes at the proposed FSRU and the LNG carriers. However, water intakes for the proposed FSRU and LNG carriers would be located approximately 20 feet below the surface of the water, potential impacts from impingement and/or entrainment would be reduced. Juvenile and adult Atlantic mackerel are present in Long Island Sound from April through November. Since they would not be in Long Island Sound during the primary construction period (winter to early spring) impacts would not be expected. Atlantic mackerel juveniles and adults are also pelagic and highly mobile and would be expected to avoid active construction areas. Therefore, any indirect impacts on the prey items of Atlantic mackerel would also not be expected.

Operational impacts from the LNG carriers are not expected to impact these highly mobile and pelagic lifestages of Atlantic mackerel.

Pollock

EFH supporting juvenile and adult pollock have been identified in the proposed Project Waterway. Pollock occur in the Atlantic Ocean from the Gulf of St. Lawrence to New Jersey. The highest populations are observed in the Georges Bank area (Boschung et al. 1983). Adults spawn in three principal spawning locations: western Gulf of Maine, Great South Channel, and on the Scotian Shelf. Spawning tends to occur over rocky substrates from September to April. Juveniles have been found over a variety of substrates such as sand, mud, vegetation, and rock. They feed primarily on crustaceans (Cargnelli et al. 1999). Juvenile pollock are present in Long Island Sound from December through March (Stone et al. 1994). Adult pollock feed primarily on euphausiids, fish, and mollusks. Pollock adults have little preference for substrate (Cargnelli et al. 1999). They are present in Long Island Sound from December through March (Stone et al. 1994).

Since juvenile and adult pollock are present within Long Island Sound from December through March, they would be present during the proposed construction period. However, these lifestages are pelagic and mobile and would be expected to avoid active construction areas. Any indirect impacts associated with prey items would also be expected to be negligible since suitable prey species could be found in adjacent non-disturbed areas.

Operational impacts from the proposed YMS, FSRU, pipeline, and LNG carriers are not expected to impact juvenile and adult pollock. Operational impacts from FSRU and LNG carrier water intakes would not be expected to affect these highly mobile and pelagic lifestages.

Sand Tiger Shark

EFH supporting the early lifestage of sand tiger shark (technically neonates) have been identified in the proposed Project Waterway. Sand tiger sharks occur in the Atlantic Ocean from the Gulf of Maine to Argentina. EFH for neonate/early juveniles is designated as shallow coastal waters from Barnegat Inlet, New Jersey south to Cape Canaveral, Florida to the 25-meter isobath (NOAA 2005c). Little is known about the neonate stage. Sand tiger sharks were not collected during the 2002 Poletti ichthyoplankton survey or the 2005-2006 Broadwater ichthyoplankton surveys. In addition, neonate sand tiger sharks are a minimum of approximately 3 feet long (100 cm), and thus could readily escape construction areas and would not be susceptible to impingement or entrainment. Thus, the proposed YMS, FSRU, pipeline, and LNG carriers would be expected to have a negligible (or no) impact on this species.

Coastal Migratory Pelagic Species

King mackerel, Spanish mackerel, and cobia are considered highly migratory species by NMFS. EFH has been designated for all lifestages of these species in the proposed Project Waterway. The listed EFH includes: sandy shoals of capes and offshore bars, high-profile rocky bottoms, and barrier island ocean-side waters, from the surf to the shelf-break zone, including coastal inlets (NOAA 2005c).

King Mackerel

EFH supporting all lifestages of king mackerel have been identified in the proposed Project Waterway. King mackerel are a pelagic fish that inhabit the Atlantic Ocean from the Gulf of Maine to Brazil (Boschung et al. 1983). This species is considered highly migratory by the NMFS. Adult king mackerel prefer warm waters that seldom fall below 68°F.

Since king mackerel are considered south Atlantic species for EFH purposes (NOAA 1998) and CTDEP trawl surveys indicate that they are uncommon in Long Island Sound, impacts from the proposed YMS, FSRU, pipeline, and LNG carriers are not expected.

Spanish Mackerel

EFH supporting all lifestages of Spanish mackerel have been identified in the proposed Project Waterway. Spanish mackerel are a pelagic fish that inhabit the Atlantic Ocean from the Gulf of Maine to the Yucatan Peninsula (Boschung et al. 1983). This species is considered highly migratory by the NMFS. This species tends to feed on bait fishes such as anchovies (Boschung et al. 1983).

Since Spanish mackerel are considered south Atlantic species for EFH purposes (NOAA 1998) and CTDEP trawl surveys indicate that they are uncommon in the Long Island Sound, impacts from the proposed YMS, FSRU, pipeline, and LNG carriers are not expected.

Cobia

EFH supporting all lifestages of cobia have been identified in the proposed Project Waterway. Cobia are pelagic fish that inhabit the Atlantic Ocean from the Mid-Atlantic states to Argentina (Boschung et al. 1983). Cobia is a southern species that overwinters near Florida and migrates in the spring and summer to the Mid-Atlantic region to spawn. Adults are rarely found as far north as Massachusetts (Richards 1967). This species is considered highly migratory by the NMFS. Cobias have been known to frequent fishing holes where they will eat any bait (fish, squid, or crustacean) (Boschung et al. 1983).

Since the Project Waterway is at the northern end of this specie's range, only occasional visits by adult lifestages are expected. Therefore, no impacts from the proposed YMS, FSRU, pipeline, and LNG carriers would be expected.

4.1.2 Additional EFH-Managed Species Associated with the LNG Carrier Transit Routes

This section discusses additional EFH-managed species that are limited to areas traversed by the proposed LNG carrier transit routes.

4.1.2.1 Demersal

Black Sea Bass

EFH supporting adult black sea bass have been identified in the area of the proposed LNG carrier transit routes. Black sea bass is a warm temperate species that tends to inhabit structured habitats such as reefs and shipwrecks. In Long Island Sound, adult black sea bass generally inhabit structurally complex habitats with sandy areas rather than muddy substrate (Drohan et al. 2007). Black sea bass spawn on the continental shelf from the spring through the fall. Black sea bass adults are carnivores that feed on infaunal and epibenthic invertebrates (American lobster, crabs, and shrimp), small fish, and squid (Drohan et al. 2007). Adult black sea bass are highly mobile and are rarely found in Long Island Sound throughout the year (Stone et al. 1994). According to NMFS (No Date), adult black sea bass can be found from November to April in waters over the Continental Shelf from the Gulf of Maine to North Carolina.

Codfish

The codfish located in EFH blocks within the LNG carrier transit routes are silver hake, Atlantic cod, haddock, offshore hake, and white hake.

EFH supporting eggs, larvae, and juvenile silver hake have been identified in the area of the proposed LNG carrier transit routes. Silver hake are a demersal fish that occur in the Atlantic Ocean from Newfoundland to Cape Fear, North Carolina. This species is most abundant from Nova Scotia to New Jersey. Adult silver hake spawn from May through October with peaks in August. Eggs and larval silver hake are pelagic. Silver hake larvae descend to the bottom when they reach approximately 0.8 inches (Lock and Packer 2004). Silver hake larvae primarily feed on copepod larvae and copepodites. Juvenile silver hake make seasonal migrations from the continental slope during the fall and winter to nearshore waters during the spring and summer (Lock and Packer 2004). Juvenile silver hake feed primarily on fish, crustaceans, and squid (Lock and Packer 2004). According to NMFS (No Date), eggs, larvae, and juvenile silver hake can be found along the continental shelf from southern New England to North Carolina. Eggs and larvae can be found year round with peaks from June to October and July to September, respectively.

EFH supporting all lifestages of Atlantic cod have been identified in the area of the proposed LNG carrier transit routes. Atlantic cod are a demersal fish that occurs in the Atlantic Ocean from Cape Chidley, Labrador to Cape Henry, Virginia (Lough 2004). Adults spawn near the bottom during the winter and early spring (Lough 2004). Eggs are pelagic and rare in Long Island Sound from December through March (Stone et al. 1994). The larvae are also pelagic until approximately 3 months, when they descend to the bottom. Atlantic cod larvae are rare in Long Island Sound in December through June (Stone et al. 1994). Early juveniles feed primarily on pelagic invertebrates, medium sized cod feed primarily on benthic invertebrates and fish and larger sized cod consume larger amounts of fish (Lough 2004). Atlantic cod juveniles and adults are also rare in Long Island Sound from December through March (Stone et al. 1994). According to NMFS (No Date), all lifestages of Atlantic cod can be found in the eastern portion of the continental shelf off of southern New England.

EFH supporting larval and juvenile haddock have been identified in the area of the proposed LNG carrier transit routes. Haddock can be found from Cape Charles, Virginia north to Labrador, Canada (Brodziak 2005). Juvenile haddock are demersal. They are usually found at depths between 130 and 490 feet (40-150 meters) with a preference for 165 to 330 feet (50-100 meters) (Brodziak 2005). Larval haddock are not found in Long Island Sound during any time of year and juvenile haddock are rare in Long Island Sound from November through June (Stone et al. 1994). According to NMFS (No Date), larval haddock can be found from January to July with peaks in April and May.

EFH supporting larval lifestages of offshore hake have been identified in the area of the proposed LNG carrier transit routes. Offshore hake larvae are pelagic and have been collected during all months of the year. Offshore hake larvae tend to concentrate at depths from 230 to 426 feet (70-130 meters) (Chang et al. 1999b). Larval offshore hake feed primarily upon phytoplankton, copepods, and invertebrate eggs in the upper water column (Chang et al. 1999b). According to NMFS (No Date), larval offshore hake can be found year round on the outer continental shelf from southern New England south to Chesapeake Bay.

EFH supporting juvenile and adult white hake have been identified in the area of the proposed LNG carrier transit routes. White hake can be found from the Gulf of St. Lawrence to the Middle Atlantic Bight. Early juveniles are pelagic while older juveniles and adults are demersal (Chang et al. 1999c). Juvenile white hake feed on polychaetes, shrimps, and other crustaceans. Adult white hake feed primarily on fish including juvenile white hake (Chang et al. 1999c). According to NMFS (No Date), juvenile and adult white hake can be found on southern New England to the middle Atlantic.

Silver hake eggs and larvae, Atlantic cod eggs and larvae, haddock larvae, and white hake eggs, larvae and early juveniles, are pelagic and could be impacted by LNG carrier water intakes. However, LNG carrier water intakes would be approximately 20 feet deep (or more), thus reducing the potential for impingement and/or entrainment of the early life stages of silver hake, Atlantic cod, haddock, offshore hake, and white hake. However, any impingement/entrainment impacts would be minor and would not affect these species at the population level. Since offshore hake larvae are generally found at depths of 230 to 426 feet, impacts from LNG carrier intakes would not be expected.

Monkfish

EFH supporting all lifestages of monkfish have been identified in the area of the proposed LNG carrier transit routes. Monkfish (also known as goosefish) are found from the Gulf of St. Lawrence south to Cape Hatteras, North Carolina. They inhabit sand, mud, and broken shell bottoms from inshore areas to depths greater than 2,300 feet (800 meters) (MDNR 2007). Monkfish typically spawn from spring through the early fall depending on latitude in both inshore and offshore waters (Bigelow and Schroeder 2002). Eggs are non-adhesive, buoyant, and float in a mass along the water's surface. Larval and juvenile monkfish are pelagic for several months before settling to the bottom when they are about 3 inches in length. Monkfish are voracious predators and feed on other benthic fishes (MDNR 2007). According to NMFS (No Date), eggs and larval monkfish can be found from southern New England to North Carolina from March to September. Juvenile and adult monkfish can be found on the outer continental shelf in the middle Atlantic and the mid-shelf off southern New England.

Flatfishes

The flatfishes located in EFH blocks within the LNG carrier transit routes are summer flounder, witch flounder, yellowtail flounder, and American plaice.

EFH supporting eggs, larvae, and adult summer flounder have been identified in the area of the proposed LNG carrier transit routes. Summer flounder is a demersal fish that is an important commercial and recreational species. Summer flounder inhabit estuarine and shelf waters of the Atlantic Ocean from Nova Scotia to Florida. However, the highest population is found from Cape Cod, Massachusetts to Cape Hatteras, North Carolina. Spawning occurs in the open ocean over the continental shelf during the fall and winter (Packer et al. 1999). Summer flounder eggs are buoyant and pelagic with the greatest abundance occurring during the fall and winter. Larval summer flounder are planktonic until settling to the bottom. Larval to juvenile metamorphosis typically begins when larval summer flounder are between 0.3 inches and 0.7 inches in length. They settle onto the bottom and bury into the sediment to finish the transition into juveniles (Packer et al. 1999). Larval summer flounder primarily feed upon zooplankton and small crustaceans. According to Stone et al. (1994), egg and larval summer flounder are not present in Long Island Sound. Adult summer flounder in the northern ranges migrate to deeper offshore waters during the fall and winter. Summer flounder adults are opportunistic predators primarily feeding upon fish and crustaceans. Adult summer flounder are rarely found in Long Island Sound throughout the year (Stone et al. 1994). According to NMFS (No Date), eggs, larvae, and adult summer flounder can be found along the continental shelf from the Gulf of Maine to North Carolina. Summer flounder eggs are present from October to May, larvae from September through February (NMFS No Date).

EFH supporting eggs, larvae, and adults of witch flounder have been identified in the area of the proposed LNG carrier transit routes. Witch flounder (also known as gray sole) can be found from the Gulf of St. Lawrence south to Virginia (at moderate depths) and to Cape Hatteras, North Carolina (at deeper depths) (Bigelow and Schroeder 2002). Witch flounder is a deepwater fish that once it becomes demersal, is seldom caught in waters less than 60 feet to 90 feet deep (Bigelow and Schroeder 2002). Witch flounder spawn from May through September and eggs are buoyant. According to Bigelow and Schroeder (2002), the free-drifting larval stage may last as long as 4 to 6 months. Witch flounder typically feed on invertebrates. According to NMFS (No Date), eggs and larval witch flounder can be found along the continental shelf off southern New England south to North Carolina. Eggs are present from March to October while larvae are present from March to November with peaks from May to July (NMFS No Date). Adult witch flounder can be found along the continental shelf off southern New England to Delaware Bay (NMFS No Date).

EFH supporting all lifestages of yellowtail flounder have been identified in the area of the proposed LNG carrier transit routes. Yellowtail flounder can be found from the Gulf of St. Lawrence south to lower Chesapeake Bay (Bigelow and Schroeder 2002). Yellowtail flounder prefers deep water and is typically caught in waters from 30 feet to 240 feet deep (Bigelow and Schroeder 2002). Yellowtail flounder spawn from June through August and eggs and larvae are pelagic. Yellowtail flounder feed on smaller crustaceans, small shellfish, and small fish (Bigelow and Schroeder 2002). All lifestages of yellowtail flounder can be found along the southern New England continental shelf south to the Delaware Bay (NMFS No Date). Eggs are present from mid-March to July while larvae are present from March to April.

EFH supporting larvae, juveniles, and adult American plaice have been identified in the area of the proposed LNG carrier transit routes. American plaice can be found from the Gulf of St. Lawrence south to Montauk Point, NY. American plaice larvae are found at relatively constant depths between February and May, primarily between 130 and 395 feet (40 to 120 meters). During the summer months, larvae are typically found in deeper waters. Juveniles have been observed between 20 and 280 feet (6 to

85 meters) throughout Massachusetts inshore waters, primarily between approximately 150 and 215 feet (45 to 65 meters). Elsewhere throughout the Atlantic distribution of the American plaice, juveniles are found at depths ranging from 36 feet to 1,056 feet (11 to 400 meters). Adults migrate from the deeper waters to spawn in the spring, normally at depths less than 295 feet (90 meters). Spawning occurs at or near the seafloor. In Rhode Island offshore waters, plaice are found at depths of 295 to 590 feet (90 to180 meters) and are not normally found at depths shallower than 80 to 115 feet (25 to 35 meters) (Johnson et al. 2004). According to NMFS (No Date), larvae American plaice can be found between January and August with peaks in April and May.

Spiny Dogfish

EFH supporting juvenile and adult spiny dogfish have been identified in the area of the proposed LNG carrier transit routes. Distribution of juvenile and adult spiny dogfish along the Atlantic Coast varies by season and water temperature. In the winter, populations are found as far south as North Carolina while in the fall, populations are found as far north as the Gulf of Maine (McMillan and Morse 1999). Spiny dogfish typically spend summer months in nearshore waters while overwintering in deeper, offshore waters at depths greater than 2,640 feet (McMillan and Morse 1999). Spiny dogfish are voracious and opportunistic predators, usually swimming in packs and attacking schools of smaller fish (McMillan and Morse 1999). Males reach sexual maturity by the age of six, while females reach sexual maturity at 12 years of age (FLMNH 2007). In New England, females give birth to live young offshore in the winter (McMillan and Morse 1999).

Due to the size of juvenile and adult spiny dogfish, impacts from LNG carrier intakes are not expected. Indirect impacts to prey species would not be expected since they primarily feed on small fishes and crustaceans which would not be impacted by the LNG carriers. Spiny dogfish are also opportunistic predators and could feed on additional prey species if any were impacted by the LNG carrier transits. In addition, impacts from the LNG carriers are expected to be minimal since they would not differ from other vessels that typically traverse Long Island Sound.

Bivalves

The bivalves located in EFH blocks within the LNG carrier transit routes are surf clam and ocean quahog. EFH supporting juvenile and adult surf clam and ocean quahog have been identified in the area of the proposed LNG carrier transit routes.

Juvenile and adult surf clam and ocean quahog are bivalve species that reside entirely within the benthos of Long Island Sound. Therefore, impacts from LNG carriers would not be expected.

4.1.2.2 Pelagic

Atlantic Sea Herring

EFH supporting larval Atlantic sea herring have been identified in the area of the proposed LNG carrier transit routes. The Atlantic sea herring is a pelagic schooling fish that occurs from Labrador to Cape Hatteras. Spawning takes place in the area of the Gulf of Maine and Georges Bank during the summer and fall. Atlantic sea herring of all lifestages are opportunistic feeders. They will feed on any prey that is of an appropriate size for their jaws (Stevenson and Scott 2005). A few days after hatching, Atlantic sea herring larvae become pelagic and feed on planktonic organisms. Atlantic sea herring larvae are then transported away from spawning areas to overwinter (for 4 to 8 months) in inshore bays and estuaries before becoming juveniles (Stevenson and Scott 2005). Larval Atlantic sea herring are rare in Long Island Sound from March through May (Stone et al. 1994). According to NMFS (No Date), larval

Atlantic sea herring can be found from southern New England to just south of Long Island Sound. Larvae are present from August through April with peaks from September to November.

Bluefish

EFH supporting egg and larval lifestages of bluefish have been identified in the area of the proposed LNG carrier transit routes. Bluefish are a pelagic finfish that occurs from Nova Scotia to Argentina. Spawning takes place on the Mid-Atlantic Bight from June through August. Bluefish eggs and larvae are pelagic. According to Stone et al. (1994), eggs and larvae bluefish do not occur within Long Island Sound. Larval bluefish occur in open oceanic waters, near the edge of the continental shelf in southern Mid-Atlantic Bight and over the middle of the continental shelf in the northern Mid-Atlantic Bight (Shepherd and Packer 2006). Bluefish larvae primarily feed upon copepods (Shepherd and Packer 2006). According to NMFS (No Date), bluefish eggs and larvae are typically found from Montauk Point, NY south to North Carolina from April to September.

Atlantic Butterfish

EFH supporting all lifestages of Atlantic butterfish have been identified in the area of the proposed LNG carrier transit routes. Atlantic butterfish are a pelagic fish that occurs in the Atlantic Ocean from the Gulf of St. Lawrence to the Atlantic coast of Florida (Cross et al. 1999). Northern populations of Atlantic butterfish migrate in response to changing water temperatures. Atlantic butterfish migrate north and inshore during the summer to feed on planktonic fish, squid, crustaceans, jellyfish and to spawn. Atlantic butterfish are broadcast spawners (Cross et al. 1999). Butterfish eggs and larvae are pelagic and can be found from the outer continental shelf to the lower high salinity parts of Middle Atlantic Bight estuaries. Butterfish eggs are common from June through August and rare in September within Long Island Sound (Stone et al. 1994). Butterfish larvae are common from June through August and rare from September through November in Long Island Sound (Stone et al. 1994). Juvenile and adult Atlantic butterfish are also pelagic and form loose schools near the surface (Cross et al. 1999). According to Cross et al. (1999), Atlantic butterfish primarily feed on planktonic prey such as squids, crustaceans, polychaetes, and small fishes. Juvenile and adult butterfish are commonly found in Long Island Sound from May through June. They are abundant to highly abundant from July through November becoming commonly found again in December in Long Island Sound (Stone et al. 1994). According to NMFS (No Date), all lifestages of Atlantic butterfish can be found over the continental shelf from the Gulf of Maine to North Carolina. Butterfish eggs are present in the spring and summer, larvae in the summer and fall, juveniles and adults in the winter (NMFS No Date).

Migratory Tuna

The migratory tuna located in EFH blocks within the LNG carrier transit routes are bluefin tuna, yellowfin tuna, skipjack tuna, and albacore tuna.

EFH supporting juvenile and adult bluefin tuna have been identified in the area of the proposed LNG carrier transit routes. Bluefin tuna are a highly migratory, epipelagic, and oceanic fish that occur in the western North Atlantic Ocean from Labrador, Canada to Northern Brazil (FLMNH 2007). They have been observed both above and below the thermocline and found at depths of over 6 miles (9,850 meters) (FLMNH 2007). Bluefin tuna feed on smaller schooling fish, primarily anchovies. Juveniles reach sexual maturity after 4 to 5 years. In the Atlantic, spawning occurs in the Mediterranean and the Gulf of Mexico and typically occurs between April and August.

EFH supporting juvenile and adult yellowfin tuna have been identified in the area of the proposed LNG carrier transit routes. Yellowfin tuna are found world wide in tropical and subtropical waters. They are a highly migratory fish generally found in the upper 330 feet (100 meters) of the water column (FLMNH 2007). They are strong schoolers and tend to school with organisms of the same size. Yellowfin tuna feed on other fish (e.g., dolphin and other tunas), squid, octopus, shrimp, lobster, and crabs. Juveniles reach maturity after 1 to 3 years, depending on the geographic region.

EFH supporting juvenile and adult juvenile and adult skipjack tuna have been identified in the area of the proposed LNG carrier transit routes. These highly migratory and epipelagic tuna are distributed world wide and are found in water temperatures ranging between 58 and 86°F. Skipjack tuna mainly swim at the water surface during the day, but descend to depths of up to 850 feet at night (FLMNH 2007). Schools are often found near convergences and upwellings. Skipjack tuna are opportunistic feeders with a diet consisting of smaller fish, crustaceans, and mollusks (FLMNH 2007). Sexual maturity may be reached as early as 15 inches, but typically occurs later. Spawning occurs. Spawning occurs year round near the equator and during warmer months elsewhere (FLMNH 2007).

EFH supporting juvenile albacore tuna have been identified in the area of the proposed LNG carrier transit routes. Albacore tuna highly migratory and are abundant in tropical and temperate surface waters at temperatures of 60°F to 67°F (15.6 °C to 19.4°C) and are known to concentrate along thermal discontinuities. They can be found in water depths up to approximately 1,970 feet (specifically 600 meters). Albacore tuna feed on smaller fishes, crustaceans, and squids. Juveniles reach sexual maturity when they are approximately 35 inches in length (Collette and Nauen 1983).

Migratory Sharks

The migratory sharks located in EFH blocks within the LNG carrier transit routes are thresher shark, blue shark, basking shark, white shark, dusky shark, shortfin mako shark, sandbar shark, and tiger shark.

EFH supporting neonate, juvenile and adult lifestages of thresher sharks have been identified in the area of the proposed LNG carrier transit routes. In the western North Atlantic Ocean the highly migratory thresher shark is found from Newfoundland to Cuba. Even though it is found along the entire U.S. Atlantic Coast, they are rarely observed south of New England (FLMNH 2007). Adult thresher sharks usually reside in the open ocean, while juveniles tend to stay in coastal bays and nearshore waters. Thresher sharks are seen mainly at the water surface but can inhabit waters at depths down to 1,800 feet (FLMNH 2007). They typically feed on bony fish, including bluefish, butterfish, menhaden, and mackerel. Sexual maturity is reached in males at 10.5 feet and in females at 8.5 to 14.8 feet. Females will have between 2 and 4 young per litter with each pup ranging in size from 3.7 feet to 5.0 feet (FLMNH 2007).

EFH supporting neonates, juveniles and adults of blue sharks have been identified in the area of the proposed LNG carrier transit routes. Blue sharks are found world wide in temperate and tropical waters. In the western North Atlantic the highly migratory blue shark is found from Newfoundland to Argentina (FLMNH 2007). Blue sharks rarely come near shore as they prefer cooler water temperatures. They can be found at depths ranging from the water surface to 1,148 feet (350 meters). Blue sharks feed on small bony fishes and invertebrates and often scavenge fishing nets (FLMNH 2007). Males mature after 4 to 5 years (approximately 6 to 9 feet) while females mature after 5 to 6 years (about 7.3 to 10.6 feet) (FLMNH 2007). Adult female blue sharks average 25 to 50 pups per litter, each pup averaging 16 to 20 inches in length (FLMNH 2007).

EFH supporting juvenile and adult basking sharks have been identified in the area of the proposed LNG carrier transit routes. Basking sharks are pelagic and can be found in temperate and arctic waters along continental shelves in both the Atlantic and Pacific Oceans. They are highly migratory and along the Atlantic coast of the United States they can be found from North Carolina to New York in the spring, from New England to Canada in the summer, and are rarely seen in the fall and winter (FLMNH 2007). Basking sharks are filter feeders and primarily feed on large zooplankton. Females reach sexual maturity between 11 and 16 years, however not much is known regarding the sexual maturity of males (FLMNH 2007).

EFH supporting juvenile white sharks have been identified in the area of the proposed LNG carrier transit routes. White sharks occur in temperate waters and in the western North Atlantic are found from Newfoundland to Florida. White sharks are primarily epipelagic, residing in the upper part of the water column, and are likely to be seen patrolling offshore reefs, banks and shoals, and rocky headlands (FLMNH 2007). They typically spend their time either at the surface of the water or the seafloor, at depths over 775 feet (250 meters). White sharks are highly migratory and primarily feed on marine mammals. Male sharks reach sexual maturity when they are approximately 10.5 feet in length while females reach maturity at about 14.0 ft in length. Birthing has been observed in temperate shelf waters during spring and late summer months (FLMNH 2007).

EFH supporting neonate and juvenile lifestages of dusky sharks have been identified in the area of the proposed LNG carrier transit routes. In the western North Atlantic Ocean, dusky sharks range from Nova Scotia to Cuba (FLMNH 2007). The dusky shark is found along continental coastlines in tropical and temperate waters from shallow inshore waters to the outer continental shelf. They are typically bottom feeders, but have been observed from the surface to depths up to 1,240 feet (400 meters) (FLMNH 2007). Dusky sharks feed on a variety of fishes and invertebrates, such as herring, eel, tuna, flatfish, crab, squid, and starfish. Both the male and female dusky sharks mature when they are approximately 8.5 feet in length. It is estimated that it takes approximately 20 years for a dusky shark to reach maturity. Mating occurs in the spring months in the western Atlantic Ocean. Female dusky sharks give birth to live young in litters of 6 to 10 pups, which range in size from 33 to 39 inches (FLMNH 2007). Juveniles seek shelter in shallow coastal waters in estuaries and bays from New Jersey to Cape Hatteras, North Carolina (FLMNH 2007).

EFH supporting neonate, juvenile, and adult lifestages of shortfin mako sharks have been identified in the area of the proposed LNG carrier transit routes. The migratory shortfin mako is widely distributed throughout the world in tropical and temperate waters. In the United States they are commonly seen in offshore waters from Cape Cod, Massachusetts to Cape Hatteras, North Carolina. The shortfin mako is pelagic in nature and prefers water temperatures between 17°C and 20°C (FLMNH 2007). They feed on other pelagic fishes, such as tuna and swordfish, as well as squid. Sexual maturity of both the male and female is reached between 4 and 6 years of age (FLMNH 2007). The average shortfin mako shark lives about 20 years (FLMNH 2007). The gestation period lasts 15 to 18 months with a typical litter size of 8 to 10 pups that are approximately 27 inches to 28 inches in length (FLMNH 2007).

EFH supporting neonate, juvenile, and adult lifestages of sandbar sharks have been identified in the area of the proposed LNG carrier transit routes. The sandbar shark is a highly migratory coastal pelagic fish that inhabits temperate and tropical waters. It is the most abundant large shark species in the Western Atlantic Ocean. It is a bottom dwelling species that is rarely seen at the water surface. The sandbar shark migrates seasonally. In the western North Atlantic, adults travel north as far as Cape Cod during the warmer summer months and return to southern waters during cooler months (FLMNH 2007). Sandbar sharks are opportunistic bottom-feeders, primarily feeding on small fishes, mollusks, and crustaceans. . Males usually reach sexual maturity when they are 4.0 feet to 5.5 feet and females reach sexual maturity when they are between 4.5 feet and 5.5 feet. In the north, mating occurs in late spring between May and June. In the western Atlantic, females give birth between June and August in shallow water habitats that provide a nursery for young sharks. Bays and estuaries from Delaware to North

Carolina are prime nursery areas. Juveniles stay in these shallow areas until late fall when they form schools and move south and further offshore until summer (FLMNH 2007).

EFH supporting neonate and juvenile tiger sharks have been identified in the area of the proposed LNG carrier transit routes. Tiger sharks are found throughout the world in temperate and tropical waters. They live in both the open ocean and shallow, coastal waters, with a preference for murky waters in coastal areas, river estuaries, harbors, and other inlets. Tiger sharks have been reported at depths of 1,085 feet (350 meters) (FLMNH 2007). They feed on all different types of prey, including marine mammals, fishes, crustaceans, and carrion. Males reach sexual maturity when they are between 7 feet and 9 feet, while females reach maturity between 8 and 10 feet. In the Northern Hemisphere, the mating season is between March and May and the young are born the following spring between April and June. At birth, pups range from 1 foot to 1.5 feet in length and the litter size is usually between 10 and 80 pups (FLMNH 2007).

Long Finned Squid

EFH supporting juvenile and adult long finned squid have been identified in the area of the proposed LNG carrier transit routes. The long finned squid occurs from Newfoundland south to the Gulf of Venezuela. In the United States they are abundant between Georges Bank and Cape Hatteras. Adult long finned squid inhabit the continental shelf to depths of over 1,000 feet. They migrate offshore in late fall, overwinter in warmer waters, and return offshore by early or late spring (Cargnelli et al. 2005). Sexual maturity is reached at about 3 inches to 5 inches. The juvenile stage lasts for about one month and consists of two sub-stages: juvenile and sub adult. Juveniles inhabit surface waters until they reach approximately 2 inches in length, then shift to a demersal lifestyle. The lifespan of the long finned squid is estimated to be less than a year with adults averaging approximately 12 inches in length (Cargnelli et al. 2005).

5.0 EFH IN THE PROPOSED PROJECT WATERWAY

Impacts to habitats associated with the proposed Project in the vicinity of the proposed YMS, FSRU, and subsea pipeline would be limited to the seafloor sediment and water column since they would be sited in the central waters of Long Island Sound. The proposed LNG carrier transit routes would extend through the offshore waters of the Atlantic Ocean, Rhode Island Sound, Block Island Sound, Montauk Channel, and central and eastern Long Island Sound. Therefore, there would be no impacts to other types of EFH such as eelgrass beds, live hard bottom habitats, or vegetated wetlands resulting from the normal operations of the proposed Project within the Project Waterway. Impacts to EFH seafloor sediment and the water column due to LNG carrier transits through the Project Waterway are discussed in Section 6.1.3.3. In addition, there could be minimal impacts to seafloor sediment and the water column associated with vessel docking and maneuvering at the dock for the onshore facilities. Any impacts of support vessel activities would be minor and negligible.

5.1 SEAFLOOR SEDIMENT ASSOCIATED WITH THE AREA OF THE PROPOSED YMS AND PIPELINE

Four types of bottom sedimentary environments have been identified in Long Island Sound. Fine-grained material covers about 50 percent of the area, primarily large portions of the central and western Sound (including the locations of the proposed YMS and pipeline). Areas of sediment sorting cover approximately 22 percent, and course-grained materials approximately 16 percent of the area. Coarse-grained material is present mainly in the east-central portion of Long Island Sound.

Impacts to EFH seafloor sediment due to LNG carrier transits through the Project Waterway are discussed in Section 6.1.3.3.

5.2 ESTUARINE WATER COLUMN ASSOCIATED WITH THE AREA OF THE PROPOSED YMS AND PIPELINE

Estuarine waters occur throughout Long Island Sound, where fully saline seawater mixes with freshwater from inland sources. The estuarine water column can be viewed as a dynamic array of habitats distinguished by vertical and horizontal gradients of several parameters, including salinity, temperature, dissolved oxygen, nutrients, and turbidity. Nutrient levels are relatively high due to the input from freshwater and upland sources. Many marine species are directly or indirectly dependent on the estuarine water column. Many marine species utilize the estuarine water column as larvae where they thrive on blooms of plankton and relative lack of predators. Other marine species are indirectly dependent on estuaries because many of their prey items spend a portion of their lives in estuaries.

There is no inshore, nearshore, or shallow water estuarine habitat in the area of the proposed YMS, FSRU, and pipeline. The proposed FSRU would be located at a water depth of 95 feet and the minimum water depth along the proposed pipeline route is 55 feet.

5.3 WATERWAY FOR LNG MARINE TRAFFIC

During normal operations, Project-related vessel traffic would have no significant adverse impact on EFH seafloor sediments and the estuarine water column. LNG marine traffic, including LNG carriers and associated support vessels, would be far from shore along the majority of the transit routes, and operating at speeds of approximately 12 to 15 knots. Because vessel traffic would be operating at low speeds far from shore, wakes would not increase the potential for shoreline erosion along the transit routes. Because LNG is less dense than water and would vaporize upon contact with water and air, there would be no significant adverse impacts to EFH along the LNG carrier transit routes from an ignited or un-ignited LNG spill in Hazard Zones 1 and 2 (hazard zones are defined in Section 3.10 of the EIS and Section 1.4.4 of the WSR in Appendix C of the EIS).

If an unignited marine LNG spill were to occur along the transit route, given that LNG is lighter than water, the LNG would float on the water until it had vaporized. No significant impacts to water quality would be expected from an unignited release of LNG because LNG is not soluble in water and the cryogenic liquid would vaporize rapidly upon contact with the air and water. Within Hazard Zone 1, the water's surface within the LNG pool may be temporarily impacted by sudden localized lowering of temperature until the LNG had vaporized.

If a pool fire were to occur, no impacts would be expected to directly occur to EFH seafloor sediments in Hazard Zones 1, 2, or 3. Any pool fire in Hazard Zones 1 and 2 would not impact EFH seafloor sediments since the fire would be located at and above the water surface. If an associated pool fire were to occur with the release of LNG, the water's surface temperature could increase within Hazard Zones 1 and 2. Hazard Zones 1 and 2 do not encroach upon land along the LNG carrier route. While a vapor cloud could extend to the outer limits of Hazard Zone 3, it would not be expected to impact EFH or EFH-managed species.

Because of the extensive operational experience of LNG shipping, the structural LNG carrier design, and the navigational safety and security controls further described in the WSR, the likelihood of the above marine LNG spill scenarios occurring would be extremely remote and therefore would be highly unlikely to impact EFH.

6.0 ASSESSMENT OF IMPACTS

6.1 IMPACTS TO ESTUARINE ESSENTIAL FISH HABITAT

Broadwater has conducted various biological, habitat, and geophysical surveys to identify important marine resources in the area of the proposed YMS, FSRU, and pipeline. For those resources that could not be avoided, various project- and site-specific construction technologies and mitigation measures have been proposed by Broadwater in coordination with federal, state, and local resource agencies to limit impacts to EFH and EFH-managed species. We have also identified measures or recommendations in coordination with various resource agencies to further avoid or minimize potential impacts to managed resources in general and specifically EFH. These measures are described below and summarized in Section 8.0. The types of impacts would be comparable to those described for the habitat and fisheries of Long Island Sound as described in Sections 3.1, 3.2 and 3.3 of the EIS. Therefore, construction and operation of the proposed YMS, FSRU, and pipeline would result in both direct and indirect minor impacts to EFH.

The environmental consequences of constructing and operating the proposed pipeline Project would vary in duration and significance. Four levels of impact duration were considered: temporary, short-term, long-term, and permanent. Temporary impact generally occurs during active construction with the resource returning to pre-construction conditions almost immediately afterward. Short-term impact would continue for several months to approximately three years following construction. Impact was considered long-term if the resource would recover, but would require more than about three years to recover. A permanent impact would occur as a result of any activity that modifies a resource to the extent that it would not return to pre-construction conditions, such as with the placement of concrete mats at utility crossings. Specific impacts expected for EFH and EFH-managed species in the proposed Project Waterway are discussed in the following sections.

6.1.1 Direct Impacts

Direct impacts to EFH would occur from removal of habitat during excavation, disturbance or destruction of habitat from anchoring and pipeline installation, and conversion of seafloor substrate along some portion of the proposed pipeline (soft bottom substrate would be converted to hard structure at the placement of the YMS, and concrete mats at the utility crossing and tie-ins to the IGTS pipeline) (Table 6-1).

FERC commissioned an independent assessment of Broadwater's proposed anchoring impact estimates. The independent assessment (Jaap and Watkins 2007 [Appendix G]) estimated that the use of mid-line buoys on all eight anchors would reduce cable sweep and anchor impacts to 64.1 acres (Table 6-2). Therefore, total seafloor impacts due to installation of the proposed YMS and pipeline would be reduced from 2,235.5 acres to 263.6 acres. See Section 3.1.2.2 of the EIS for a more detailed discussion.

TABLE 6-1
Summary of Impacts by Construction Method According to Broadwater

Construction Feature	Total Bottom Direct Impacts (acres)
Pipeline lowering via plow	197.3
AT&T Cable Crossing	0.4
Cross Sound Cable Crossing	0.4
FSRU Tie-in	0.2
Check & Isolation Valve Spool	<0.1
IGTS Tie-in	0.3
Anchor Footprint – Pipeline Installation	16.0
Anchor Cable Sweep	2,020.0
YMS structure footprint	0.3
Anchor Footprint – YMS Installation	<0.5
Total Impacts	**2,235.5**

TABLE 6-2
Summary of Estimated Impacts

Scenario	Broadwater Estimate			Expert Assessment Estimate		
	Anchor Impacts (acres)	Cable Sweep (acres)	Total Impacts (acres)	Anchor Impacts (acres)	Cable Sweep (acres)	Total Impacts (acres)
No mid-line buoys	16	6,810	6,810	37.0	61.7	98.7
Mid-line buoys on quarter anchor cables	16	2,020	2,036	N/A	N/A	N/A
Mid-line buoys on all anchor lines	N/A	1,031	1,031	32.0	32.1	64.1
Dynamically positioned lay barge	0	0	0	0	0	0

6.1.1.1 Trenching

Trenching of sediment to install the proposed pipeline and FSRU would directly impact EFH through disturbance and/or conversion of seafloor habitat. As a result of the proposed Project, including our recommendations for reducing impacts, approximately 264 acres would be disturbed as result of installation of the proposed pipeline and YMS. Broadwater proposes to allow most of the pipeline trench (19 miles) to naturally backfill and has reported that natural backfilling would fill most of the trench within 1 year and virtually all of the trench within 3 years. However, resource agencies have reported that some results from other post-construction monitoring surveys for at least one existing linear project

(Eastchester Extension) in Long Island Sound have found that the trenches did not naturally backfill as predicted. Therefore, to avoid and minimize potential impacts of an open trench and exposed pipeline during natural backfilling, we recommend that Broadwater develop a plan with the appropriate agencies to actively backfill the trench with excavated spoil material following pipeline installation and conduct post-construction monitoring surveys to document success (Section 3.1.2.2 of the EIS). Therefore, the trench would be backfilled following construction to avoid potential impacts of a persistent trench, such as a migration obstacle to biota and/or limited thermal impacts of an exposed pipeline during operation. Backfilling of the proposed trench could be accomplished by pushing the excavated material back into the trench via a backfill plow or backfilling the trench with imported clean fill. The first method could result in additional sedimentation and turbidity impacts from the subsea plow that would be used to push the excavated material into the trench (turbidity and sedimentation impacts would be expected to be similar to those associated with pipeline installation as discussed in Section 6.1.2.1). Thus, there could be some temporary to short-term impacts associated with active backfilling, but these impacts would be expected to result in less potential impact than relying on natural backfilling. The second backfilling method would be to fill the proposed trench with imported clean material. This method could result in permanent substrate conversion if clean rock was used to backfill rather than substrate similar to native sediments.

It is anticipated the benthic community would recover, from trenching and mechanical backfilling impacts, within one to two years (Newell et al. 1998). Construction impacts to EFH would be the greatest during active construction and immediately following construction and the extent and magnitude of any impacts would gradually decrease during the remainder of the subsequent one to two years.

6.1.1.2 Anchoring

Impacts to the seafloor habitat of Long Island Sound during construction could occur as a result of anchors being laid directly on the bottom, or from anchor line sweep as waves and currents affect vessel positions.

Approximately 2,036.5 acres of seafloor would be impacted by anchoring and associated cable sweeps during construction of the pipeline, as proposed by Broadwater. Almost all of this acreage would be associated with cable sweep (2,020 acres). With implementation of our recommendation to use mid-line buoys on all anchor cables, the extent of anchoring and anchor cable sweep would total 64.1 acres, based on the expert assessment (Jaap and Watkins 2007 [Appendix G]). Benthic impacts as a result of cable sweep would be expected to recover within a few months to one to two years (Newell et al. 1998).

Impacts from anchoring are expected during construction and would not occur during operation of the proposed pipeline and FSRU.

6.1.1.3 YMS Footprint

Installation of the proposed YMS would initially result in direct disturbance of approximately 0.8 acre of benthic habitat including about 0.5 acre associated with anchoring and 0.3 acre associated with the footprint of the YMS on the seafloor. This footprint would include the physical structure of the proposed YMS itself, including the YMS jackets or legs and a mud mat. The mud mat would be a latticework of wooden slats used to stabilize the legs during installation, and the mud mat would penetrate into the sediment upon YMS installation and be left there to decay.

6.1.1.4 Maintenance

Proposed general pipeline maintenance during operations would require minimal daylighting of buried facilities, with excavation by a submersible pump or by divers using hand-jetting or air-lifting equipment. It is expected that general maintenance of the proposed pipeline would occur once every 5 to 7 years. These activities could result in localized disturbance of the seafloor habitat and redistribution of sediments. Direct impacts to the seafloor habitat would be very localized, and recovery could take from a few months to one to two years (Newell et al. 1998).

6.1.1.5 Hydrostatic Testing

Broadwater would hydrostatically test the proposed pipeline with approximately 3.9 million gallons of filtered seawater from Long Island Sound.

Impacts from hydrostatic testing could occur from toxic effects of chemical additives after discharge of the used test water. Prior to testing, water would be treated with biocides and oxygen inhibitors to prevent corrosion. Broadwater is proposing the use of biocides 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, which would result in direct mortality of organisms entrained in the pipeline. After approximately 8 months, the hydrostatic test water with biocide would be pumped to holding tanks on a support vessel for treatment and neutralization prior to its discharge into Long Island Sound. Hydrostatic test water would be treated, and discharges would be conducted in accordance with SPDES requirements. Therefore, any impacts to EFH associated with the use of biocides would be highly localized and temporary. Additional discussion on potential impacts to EFH-managed species is provided in Section 6.2.1.3.

6.1.1.6 Cumulative Water Intakes

During operation, Broadwater has stated that the annual daily average intake volume for the proposed FSRU would be 5.5 million gallons per day (mgd; for ballasting, desalination, bilge and general services pumps, and the side-shell water curtain). Actual daily intake would fluctuate due to variability in LNG loading, gas sendout, and fire system testing activities. Some of the proposed intake water would be treated with a continuous dose of sodium hypochlorite. By comparison, Long Island Sound has an influx of approximately 444,000 mgd of fresh and saltwater (CTDEP 1989). All water intakes to the proposed FSRU would be conducted in accordance with SPDES permit requirements.

6.1.1.7 Cumulative Water Discharge

The cumulative daily water discharges for the proposed FSRU would vary, based on the frequency of LNG carriers off-loading. The annual average daily discharge would be approximately 5.5 mgd, with a maximum daily discharge of 17.2 mgd. The maximum daily discharge volume would occur an average of 118 days per year and would result primarily from the need to discharge ballast water while LNG is being loaded onto the proposed FSRU. 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 to be necessary during the life of the proposed Project, discharges could be associated with the 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 chlorine concentrations would be monitored via a colorimetric assay. The initial residual chlorine concentration (between 10 and 50 ppb) would readily decrease due to rapid breakdown of the chlorine, and it is not expected to affect water quality. Preliminary modeling indicates that water discharges with chlorine concentrations between

10 and 50 ppb of chlorine would mix with surrounding waters and dilute to less than 5 ppb in 16 feet to 78 feet from the point of discharge, depending on the initial concentration. In addition, all discharges would be conducted in accordance with SPDES requirements. If the SPDES requirements establish a mixing zone (the typical regulatory mixing zones for facilities such as LNG terminals usually extend approximately 330 feet [specifically 100 meters] from the discharge point), it is anticipated the chlorine concentrations would attenuate readily in the open waters of Long Island Sound due to the periodic nature of discharges (approximately twice per week), use of minimum effective concentrations of sodium hypochlorite in the discharge water, and the volume and hydrodynamic of the surrounding water in Long Island Sound. Preliminary modeling indicates that water discharges with chlorine concentrations between 10 and 50 ppb would mix with surrounding waters and dilute to less than 5 ppb in 16 to 78 feet from the point of discharge, depending on the initial concentration.

The temperatures of all of these typical operational discharges for the FSRU would be comparable to ambient water temperatures. Broadwater would develop a specific water quality sampling program in conjunction with NYSDEC in order to characterize the effect of discharges from the FSRU and berthed LNG carriers, and ensure that SPDES requirements are met. For these reasons, any impacts to EFH associated with water discharges during operations are considered minor but long term because they would continue for the life of the proposed Project. Additional discussion on potential impacts to EFH-managed species is provided in Section 6.2.2.2.

6.1.1.8 LNG Carriers

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 other large diesel- and steam-powered commercial vessels currently using Long Island 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. Between the territorial sea (12 nautical miles offshore) to the proposed location of the FSRU, the incremental increase in marine traffic associated with the average 118 LNG carrier visits per year would not be expected to influence the need for dredging, shoreline erosion, or sedimentation along the transit corridor.

Ballast Water

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 million gallons of ballast water, which also would support routine operational needs such as generation of freshwater and side-shell curtain. In the future, larger diesel-powered LNG carriers (250,000 m^3 capacity) would require nearly twice as much ballast water (25.6 million gallons) as the smaller, steam-powered LNG carriers currently in use today. Ballast water would be obtained in Long Island Sound while off-loading LNG and then would be transported out of Long Island Sound when the carrier departs. Any impacts to water quality and volume associated with LNG carrier water intakes are considered minor but long term because they would continue for the life of the proposed Project. Additional discussion on potential impacts to EFH-managed species is provided in Section 6.2.2.1.

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 order to minimize the likelihood of introducing invasive species from foreign waters. 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 2006).

Other 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). Discharges would occur throughout the transit route from the territorial sea to the proposed location of the FSRU. 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 150,000 m^3 steam-powered LNG carrier would be 19.4°F higher at the point of discharge than ambient water temperatures, but water temperatures would readily comply with NYSDEC thermal water quality criteria within approximately 75 feet of the discharge point (within 1.5°F) due to mixing. Because the cooling water intake would be at ambient temperature, which is seasonally dependent, the relative increase in water temperature of the discharge would be expected to remain relatively constant throughout the year. All other LNG carrier water discharges would approximate ambient temperatures and would not alter the temperature of the water in the vicinity of the vessel.

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 desalinization 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 an average of 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 an average of 118 carriers per year over 365 days. Future diesel-driven LNG carriers would require significantly less water than current steam-driven LNG carriers.

LNG carrier intakes (associated with ballast and cooling water) could impact the pelagic eggs, larvae, and early juveniles of EFH-managed species and their prey (juvenile and adult lifestages large and mobile and would be expected to avoid the intakes). LNG carrier water intakes would be approximately 20 feet deep (or more), thus reducing the potential for impingement and/or entrainment of nektonic lifestages. In addition, these impacts would be minor and would not be expected to affect the EFH-managed species population with the proposed Project Waterway. Impacts from LNG carrier transits would be expected to be minimal since they would not differ from other vessels currently traversing the proposed Project Waterway.

6.1.2 Indirect Impacts

Installation of the proposed pipeline and YMS could result in increased suspended solids and turbidity, the release of potential contaminants contained within the sediments, and a reduction in the dissolved oxygen concentrations in the area due to the release of oxygen demanding materials (decomposing organic materials contained within the sediments). In addition, EFH could be indirectly impacted by LNG carriers transiting the proposed Project Waterway.

6.1.2.1 Turbidity and Sedimentation

Broadwater conducted sediment transport modeling to determine the extent of turbidity and sedimentation as a result of installation of the proposed pipeline using standard modeling methods (Section 3.2.3.1 of the EIS). Results of the sediment transport modeling showed that turbidity (measured as total suspended solids or TSS) in the upper and middle depth strata of Long Island Sound were predicted to be less than 10 mg/L and mostly less than 5 mg/L during active plowing. The highest TSS concentrations would occur near the bottom. Bottom depth strata TSS values typically ranged from 1 mg/L to 14 mg/L with the highest values at the location of active plowing. The highest TSS concentration recorded by the model was 80 mg/L. This concentration was modeled in the bottom depth strata, centered along the proposed pipeline route, approximately 0.2 miles wide, and was of short duration. The model results also indicated that any Project-related TSS concentrations would be assimilated into Long Island Sound within about 12 hours of when the sediments were suspended during construction. Modeling to assess impacts from excavation activities associated with the specialized methods (e.g., IGTS and proposed FSRU tie-ins) were also examined. The model results showed turbidity values were 0 mg/L within one hour after the cessation of dredging.

Broadwater has proposed to use various methods to monitor turbidity during trenching including periodic optical backscatter techniques, continuous acoustic doppler current profiling, and collecting TSS grab samples. The exact frequency, location, and concentrations of concern associated with this monitoring would be determined as part of the SPDES permitting process.

Based on the modeling results, construction and monitoring methods that are proposed, and the limited amount of sediment excavated, it is expected that increases in TSS concentrations would have minimal impacts and any increase in TSS concentrations would be readily assimilated into Long Island Sound.

As mentioned above, general pipeline maintenance would require minimal daylighting of buried pipeline facilities, with excavation by a submersible pump or by divers using hand-jetting or air-lifting equipment. Maintenance operations would not significantly affect the seafloor habitat due to the highly localized and infrequent maintenance activities (approximately every 5 to 7 years) and the temporary nature of impacts when they would occur.

6.1.2.2 Potential Sediment Contamination

The distribution of metal contaminants in surface sediments of Long Island Sound 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 Long Island Sound and chemically analyzed. Results in the general vicinity of the proposed pipeline route were generally within background ranges and below federal benchmarks (effects range-low or ER-L) for most contaminants (Mecray et al. 2000). Broadwater conducted site-specific sediment sampling along the proposed route and documented that contaminant concentrations were below ER-Ls for nearly all constituents with the exception of iron and magnesium. Therefore, any impact associated with contaminated sediments, if such sediments are present, would be insignificant and temporary.

6.1.2.3 Dissolved Oxygen

Low dissolved oxygen levels have been reported to occur in the bottom waters of some portions of Long Island Sound in late summer. Dissolved oxygen concentrations along the proposed pipeline route could theoretically be reduced due to the release of oxygen demanding materials (decomposing organic materials contained within the sediments). However, pipeline construction would occur during the fall and winter, and any impacts would be expected to rapidly dissipate due to the tides and currents within Long Island Sound. Therefore, any impacts would be localized and temporary.

6.1.3 Unexpected Impacts

Broadwater has proposed a pipeline route and construction methods intended to minimize the potential for unexpected impacts. However some potential sources of unexpected impacts include fuel spills and uncontrolled anchors or pipe segments.

6.1.3.1 LNG, Fuel, and Other Hazardous Fluids

Impacts to the pelagic water column could occur as a result of accidental spills of LNG, petroleum lubricants and fuel during pipeline construction. These spills could originate from accidental spills from construction barges or support boats, loss of fuel during fuel transfers, or accidents resulting from collisions. Spills of toxic materials would result in a decrease in water quality. We have included a recommendation in Section 3.2.2.1 of the EIS that Broadwater provide an offshore-specific Spill Prevention, Containment, and Countermeasures (SPCC) Plan for construction activities. Since the LNG loading system would direct any LNG spills that may occur overboard, the majority of LNG from a spill would quickly disperse and vaporize on the sea surface. Additional information regarding spills can be found in Section 3.10 of the EIS.

6.1.3.2 Uncontrolled Anchors or Pipe Segments

Other unexpected impacts may result from uncontrolled anchors or pipeline sections. However, construction and monitoring procedures have been developed to minimize the likelihood of these events and to contain them to minimize their extent if they do occur.

6.2 IMPACTS TO MANAGED SPECIES

Impacts from construction and operation of the proposed Project could occur to the managed species for which EFH has been designated. Life history characteristics for these species and potential impacts specific to each species and lifestage are provided in Section 4.1. Impacts that may occur to these species during construction and operation could include mortality; displacement due to loss of habitat; decreases in forage efficiency or reproductive success; impingement/entrainment associated with water intakes; or toxic effects from hazardous chemicals and LNG spills.

6.2.1 Construction Impacts

6.2.1.1 Habitat Loss

Habitat could be lost to demersal species because of physical disturbance of the surface sediment (e.g. trenching), or replacement of the surface substrate (such as importation of backfill for limited portions of the pipeline trench, concrete mats, or YMS legs) in the area surrounding the proposed FSRU and pipeline. There are several EFH-managed demersal species that could utilize the area surrounding the proposed YMS, FSRU, and pipeline such as ocean pout, red hake, winter flounder, summer flounder, windowpane flounder, little skate, winter skate, silver hake, black sea bass, and scup. Installation of the proposed YMS and pipeline would be conducted in fall, winter, and early spring, thus avoiding the primary spring and summer spawning months for most species. Organisms that are not able to escape the area during construction could be removed or smothered along with their habitat, resulting in direct mortality of these organisms. The number of organisms impacted in this way would be minor, and would not result in population level impacts. In general, adult and juvenile lifestages of managed species would be able to escape the construction area. Mortality of mobile species and lifestages would not be expected, but these species would be temporarily displaced from their habitat. The amount of EFH that would be directly impacted would total approximately 264 acres - less than 0.1 percent of the benthic habitat in Long Island Sound (approximately 844,800 acres). Of this total, Broadwater proposes to convert approximately 7.5 acres of the seafloor from softbottom sediment to hard substrate due primarily to backfilling approximately 2 miles of the pipeline trench with imported rock (approximately 6.1 acres), use of concrete mats at the 2 utility crossings (total of 0.8 acre), and placement of the YMS on the seafloor (0.3 acre). In addition to recommending that Broadwater coordinate with the appropriate agencies for mechanically backfilling the trench, we have also included a recommendation that Broadwater coordinate with the appropriate federal and state resource agencies to backfill the first 2 miles of pipeline trench. These plans may include the use of imported or engineered backfill to surround the pipeline, and incorporate overlaying the imported backfill with native sediment from the spoil piles, as appropriate, to minimize the amount of sediment conversion that would occur (Section 3.1.2.2. of the EIS). Conversion of the habitat from soft to hard substrate could adversely impact some EFH-managed species or their prey (benthic community), but benefit other EFH-managed species such as pollock and scup, which use rocky substrates for spawning and habitat.

Broadwater shall develop and implement backfilling plans for the 2-mile pipeline section closest to the FSRU in coordination with appropriate federal and state resource agencies. These plans may include the use of imported or engineered backfill to surround the pipeline, and incorporates overlaying the imported backfill with native sediment form the spoil piles, as appropriate, to minimize the amount of sediment conversion that would occur.

6.2.1.2 Turbidity and Sedimentation

Increased turbidity in the water column during installation of the proposed YMS and pipeline could affect the ability of visual predators to forage efficiently (Newcombe and Jensen 1996). It is likely that these species would avoid the area until turbidity subsided. Those species that could not avoid the area might show a reduction in feeding rates or exhibit physiological effects, such as increased respiration, until turbidity levels subside. The extent of turbidity is very small and would be of short duration. Species would return to impacted areas surrounding the proposed YMS and pipeline shortly after turbidity levels decreased, and foraging ability would be expected to readily return to normal. Therefore, turbidity impacts to managed species would be highly localized and temporary. Increased turbidity and sedimentation are not expected along the proposed LNG carrier routes.

Increased turbidity levels or hazardous chemicals could impact spawning behavior and success. Potential impacts include increased egg or larval mortality, delayed hatching, or decreased growth rate. The proposed construction schedule would avoid most of the spring, summer, and/or fall spawning seasons of managed species. The primary exception would be winter flounder, which generally spawn from winter through spring.

Additional mortality associated with construction and operation of the proposed pipeline would be negligible compared to natural mortality levels, and impacts to the reproductive success of managed species, including winter flounder, would not be evident at the population level.

As suspended sediments settle, benthic organisms could experience increased levels of sedimentation. Most EFH-managed species are highly mobile and would be able to escape the area or shed any sediment accumulation. Those species or lifestages that could not shed accumulated sediment could experience physiological stress, such as decreased feeding rates, decreased respiration rates, increased metabolic activity, or mortality. These effects would be limited to the area experiencing elevated sedimentation rates. Sedimentation would occur for a few days and most organisms along the proposed route would likely recover from sedimentation within a few days to weeks. Localized decreases in species composition and abundance would likely occur along the proposed pipeline route, but to a limited extent because only small portions of the habitat in the area of the proposed YMS and pipeline would be impacted. Modeling results indicate that sedimentation no greater than 0.2 inches would occur outside the 75-footwide corridor along the proposed route.

6.2.1.3 Hydrostatic Testing

Ichthyoplankton could suffer physical injury or mortality from hydrostatic testing of the proposed pipeline due to physical impingement/entrainment, or elevated chemical concentrations in the water column. 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 that is treated with biocide, 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. The hydrostatic test would use 74-micron mesh screen (mesh opening 0.003 inches) to reduce the potential for entrainment of ichthyoplankton and plankton.

There would only be one occurrence of hydrotest water intake, and coupled with the mid-depth location of the intake and small screen size on the intake, the impacts of this testing on potential EFH-managed species would represent a negligible impact to the ichthyoplankton/plankton population of Long Island Sound.

Broadwater is proposing to use biocides 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 testing, which would result in direct mortality of organisms entrained in the pipeline. After approximately 8 months, the hydrostatic test water with biocide would be pumped to holding tanks on a support vessel for treatment and neutralization prior to its discharge into Long Island Sound. Hydrostatic test water would be treated, and discharges would be conducted in accordance with SPDES requirements. Therefore, any impacts associated with the use of biocides would be temporary and highly localized in the area immediately surrounding the discharge point.

6.2.1.4 Noise

Finfish species and ichthyoplankton could be affected by acoustical disturbances associated with pile-driving used during installation of the proposed YMS. Although 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, frequency, and species. In addition, the size and condition of the fish also play a role in tolerance since small fish are more prone to injury by intense sound waves than are larger fish of the same species. The presence of predators can also influence how a fish might be affected by pile-driving (e.g., fish stunned by pile-driving activities may be more susceptible to predators). According to Broadwater, either a vibratory hammer or a conventional pile-driver would be used to install the four legs of the YMS into the seafloor, however, the geologic investigations have not been completed to assess specific driving conditions. The legs would be installed one by one, and installation would require approximately 1 week for each leg. During installation, pile-driving would be limited to 12 hours per day and would not occur at night. According to Hastings (2002), sound pressure levels below 190 dB will not harm fish. NMFS has established a threshold of 180 dB for physical harm to fish for other projects (NOAA 2004a, 2004b). Currently, Level A harassment (potentially injurious to a marine mammal or marine mammal stock in the wild) for a marine mammal is defined at 180 dB_{rms} (decibel root mean square) re: 1 µPa for both continuous and impulse sound. Level B harassment (potentially disturbing a marine mammal or marine mammal stock in the wild by causing disruption to behavioral patterns) is 160 dB_{rms} re: 1 µPa for an impulse sound and 120 dB_{rms} re: 1 µPa for a continuous sound (U.S. Government Printing Office [GPO] 2005).

According to Popper et al. (2006), recent research indicated that 180 dB is considerably lower than the sound pressure levels that could cause actual injury in three taxonomically diverse species of fish. Popper et al. (2006) proposes the use of a combined single strike criterion for pile-driving of a sound exposure level (SEL) of 187 dB re: 1 μPa^2 sec (at standard reference sound pressure of 1 microPascal) and a peak sound pressure of 208 dB re: 1 μPa_{peak} as measured 33 ft (10 m) from the source. Gausland (1998) stated that physical damage to fish (eggs, larvae, as well as larger fishes) would occur at a sound pressure level of around 230 dB (re: 1 µPa). Pile driving associated with the proposed YMS, based upon Neptune modeling results (See Section 3.3.2.2 of the EIS), sound exposure levels greater than 170 dB would not be expected at a distance greater than 0.3 mi (500 m) from the source of pile-driving. In comparison, typical fishing vessels noise is about 150-160 dB re: 1 µPa/Hz (1 microPascal/Hertz) at 1 m distance and noise output of a large supertanker is 170-180 re: 1 µPa/Hz at 1 m (Gausland 1998).

There are mitigation measures, such as ramping-up, bubble curtains, and air filled cofferdams, which can be used to reduce pile driving impacts. Broadwater has proposed to "ramp-up" pile driving operations by commencing with a lower force and increasing to a full-capacity force to allow marine mammals to leave active pile-driving areas. A bubble curtain consists of a circular or square shaped air manifold which is connected to a compressor. The compressor distributes air through the manifold which creates a curtain of bubbles around the pile driving area. Bubble curtains or sleeves surrounding the pile can reduce underwater sound pressures by 3 dB to as much as 20 dB (Wursig 2000, WADOT 2006b). An air filled cofferdam, is a temporary waterproof enclosure constructed around a pile driving area to create a dry construction area. Cofferdams are typically constructed by driving sheet piles into the ground and pumping the enclosed area dry. According to Reyff (2003), an air filled cofferdam reduced pile driving noise by 30 dB. However, an air filled cofferdam would not be feasible at the proposed YMS location due to the depth of water (approximately 95 feet).

Therefore, we recommend in Section 3.3.2.2 of the EIS that Broadwater coordinate with NMFS to identify appropriate mitigation measures as they relate to Level A and Level B harassment thresholds for construction and operational noise.

Juvenile and adult finfish are highly mobile and are expected to avoid the proposed YMS construction area. It is anticipated that impacts to finfish communities would largely be limited to younger, less mobile lifestages (eggs and larvae); and pile-driving activities are proposed to occur in October, when egg and larval densities would be relatively low. With implementation of our recommendation, any impacts of noise to fisheries resources during construction of the proposed YMS would be minor and temporary.

6.2.2 Operational Impacts

The primary operational impact to EFH-managed species during operation of the proposed FSRU and pipeline would be impingement and/or entrainment in the water intakes of the proposed FSRU and associated LNG carriers. Additional impacts could be associated with water discharges, the use of anti-fouling paint, and underwater noise. In addition, EFH-managed species could be indirectly impacted by LNG carriers transiting the proposed Project Waterway.

6.2.2.1 Impingement/Entrainment at the FSRU

Nine EFH-managed species have early lifestages (eggs and/or larvae) that may be present in Long Island Sound, and most if not all of them could theoretically be located in the area of the proposed FSRU and associated pipeline. These species could be impinged and/or entrained by the water intakes associated with the proposed FSRU and associated LNG carriers.

The best available information on potential ichthyoplankton abundance and diversity in the area of the proposed FSRU include the 2002 Poletti ichthyoplankton survey, site-specific ichthyoplankton sampling conducted by Broadwater, and species life history information, as described in Section 4.1.

The Poletti survey was conducted throughout various regions of Long Island Sound, and the results were presented based on region and habitat depth. For purposes of this assessment, we evaluated the results for regions within the central basin. The Poletti results were presented based on the overall water depth of the area: shallow (seafloor depths up to 20 feet), intermediate (seafloor depths 20 to 98-feet deep), and deep (seafloor depths over 98 feet deep). Although samples from each area were collected near the surface, mid-depth, and near the bottom, the samples from the different depths were composited to provide overall densities and diversity by area based on total seafloor depth. Bi-weekly surveys were conducted during the day between March and early August 2002 to cover the primary spawning period for most finfish species. There was little sampling conducted in the immediate vicinity of the proposed YMS.

For this assessment, abundance and diversity information for the deep stratum from the Poletti survey were used to assess abundance and diversity as well as estimate impingement/entrainment values since the deep stratum would better represent the expected ichthyoplankton community at the FSRU than the intermediate stratum. While the YMS location (approximately 95 feet deep) would technically be within the intermediate stratum, the intermediate stratum also includes sampling results from more shallow, nearshore habitats (as little as 20 feet deep), and the ichthyoplankton diversity and abundance in these more nearshore waters would be less representative of the fisheries community than would be expected in the deeper offshore waters at the proposed YMS site. The EFH-managed lifestages of 4 species were collected during the entire Poletti surveys (approximately 350 trawls) (Atlantic mackerel, scup, windowpane flounder, and winter flounder) in either the deep or intermediate stratum.

The 2002 Poletti ichthyoplankton survey was only collected during the day between March and August in the general area of the proposed YMS, and samples were composited across water depths. To better evaluate the potential ichthyoplankton community that could be impacted by operations of the proposed FSRU, Broadwater conducted depth-stratified surveys during day and night in the immediate vicinity of the proposed FSRU location. Six ichthyoplankton surveys were conducted between August 2005 and May 2006, and one lobster larvae survey was conducted in July 2006. These surveys documented the occurrence of EFH-managed lifestages for four species: Atlantic mackerel, black sea bass, windowpane flounder, and winter flounder.

Density estimates were determined during each sampling period for both surveys, and used to calculate annual standing crop in the central basin, and annual losses associated with impingement/entrainment through operations of the proposed FSRU and berthed LNG carrier. It is recognized that this approach may overestimate the exact impingement/entrainment of some species, and underestimate that of other species, but it provides a useful approximation of total abundance. As described in Section 3.3.2 of the EIS and summarized below, this approach is likely to overestimate potential impacts to EFH-managed species, thereby providing conservative estimates of potential impacts.

Annual impingement/entrainment estimates were calculated by multiplying the average densities (by species) by the annual daily water intake rate for the proposed Project including the FSRU and berthed LNG carriers (28.2 mgd). To develop annual estimates, this approach incorporated the results of the 2002 Poletti survey for the deep stratum between March and early August (averaged across water depths) and the 2005-06 Broadwater quarterly survey results for the mid-depth stratum between August and March. These annual impingement/entrainment losses for each EFH-managed species collected during the surveys are presented in Table 6-3.

TABLE 6-3
Annual Entrainment Estimates for EFH-Managed Species Collected during the 2002 Poletti and 2005-06 Broadwater Ichthyoplankton Surveys

Species	Eggs		Larvae	
	Number	Percentage	Number	Percentage
Atlantic Mackerel	22,716	0.6	495,294	9.3
Black sea bass*	0	0	176,190	3.3
Scup	1,963,833	55.2	2,212,906	41.4
Windowpane Flounder	1,568,083	44.1	868,988	16.3
Winter Flounder	5,081	0.1	1,586,763	29.7
TOTAL	**3,559,713**		**5,340,141**	

* = Entrainment estimates were only reported for March through August

The annual losses of EFH-managed species for the Broadwater Project during operations would total approximately 3.5 million eggs and 5.3 million larvae. Overall, the loss of EFH-managed species would compose approximately 3 percent of the ichthyoplankton losses for the overall finfish community (both eggs and larvae). Based on the average fish densities and water volume of the central basin, this loss would not be expected to have any significant impact on these species since it would constitute less than 0.1 percent of the total standing crop of the central basin of Long Island Sound. These estimates were calculated for those EFH-managed species that were collected in the 2002 Poletti survey and the 2005-2006 Broadwater quarterly survey. Additional EFH-managed species as identified in Table 4-2 as well as any species that may at a later date become EFH-managed species could also be impacted by the proposed Project. Impacts would be expected to be less than 0.1 percent of the total standing crop of the central basin of Long Island Sound. However, these impacts would continue for the life of the proposed Project.

As described in the species-specific life history descriptions in Section 4.1, the density of eggs and larvae for most EFH-managed species, would generally be at a minimum at mid-depth and therefore not generally be susceptible to impingement/entrainment by the FSRU. For each of the EFH-managed species reported during the 2002 Poletti and 2005-2006 Broadwater surveys, EFH-managed eggs are either buoyant (Atlantic mackerel, black sea bass, scup, and windowpane flounder) or demersal (winter flounder). Similarly EFH-managed larvae for the species documented to occur in the area of the proposed

FSRU tend to be demersal (scup, windowpane flounder, and winter flounder). Therefore, while EFH-managed species may be present in the general vicinity of the proposed FSRU, the vast majority of the eggs and larvae would not be expected to occur at mid-depth (where the water intakes would be), except during settlement to the bottom.

In addition to locating intakes at depths where minimum ichthyoplankton densities have been observed, Broadwater proposes to limit water intake velocity to 0.5 foot per second or less to reduce the potential for impingement and/or entrainment of ichthyoplankton. These general measures are recommended by NOAA to reduce impingement and entrainment impacts associated with LNG terminal siting and design (NOAA 2005a).

Because the estimated impingement/entrainment represents such a small percentage of the general standing crop of EFH-managed species of central Long Island Sound, these impingement/entrainment losses are not expected to affect the general finfish population within Long Island Sound, nor specifically the EFH-managed species. Actual losses would be expected to be substantially lower than the estimated losses with implementation of the measures to minimize impacts (mid-depth intakes and relatively low intake velocities).

6.2.2.2 Water Discharge

Managed species could come in contact with various chemicals from operation of the proposed FSRU. These include impacts associated with biocides. Water intakes at the proposed FSRU would withdraw water from Long Island Sound. Biocide (such as sodium hypochlorite) would also be added to some of these intakes. The residual chlorine concentration would range between 10 and 50 ppb. Broadwater would monitor sodium hypochlorite concentrations through sampling of overboard water prior to discharge into Long Island Sound, and would only discharge in accordance with SPDES requirements. Chlorine concentrations would be determined using a colorimetric assay. This residual chlorine concentration is not expected to affect water quality because any discharge would be in accordance with SPDES requirements and dilution would occur rapidly due to the volume of water in Long Island Sound and mixing by the tides. Therefore, impacts associated with biocides would not be expected.

The cooling water for the LNG carriers (as is standard in the shipping industry) would be injected with a low dose of biocide (expected to be sodium hypochlorite) 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.

The temperature of the water discharges from the FSRU would be comparable to ambient temperatures. Broadwater estimates that the discharged cooling water from the 150,000 m^3 steam-powered LNG carrier would be 19.4°F higher at the point of discharge than ambient water temperatures, but water temperatures would readily comply with NYSDEC thermal water quality criteria within approximately 75 feet of the discharge point (within 1.5°F) due to mixing. Broadwater would develop a specific water quality sampling program in conjunction with NYSDEC in order to characterize the effect of discharges from the FSRU and berthed LNG carriers, and ensure that SPDES requirements are met. For these reasons, any impacts to EFH associated with water discharges during operations are considered minor but long term because they would continue for the life of the proposed Project.

6.2.2.3 Anti-Fouling Paint

Broadwater would initially use anti-fouling paint on the proposed FSRU structure. Anti-fouling paint would be applied to the proposed FSRU hull at the shipyard. There would be no re-application of anti-fouling paint for the life of the proposed Project. 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, in order to prevent the growth of nuisance organisms during construction and transport from a foreign port that could inadvertently be transported into Long Island Sound. Typically, anti-fouling paints retard biological growth by leaching an element such as copper, that is toxic to marine life, which discourages the growth of marine organisms on the structure's surface. The paint itself slowly erodes away as the copper dissolves, which continually exposes new copper. However, we have included a recommendation that Broadwater use a silicon-based paint that does not contain toxic compounds or elements, but is effective at prohibiting growth of nuisance organisms because it makes the surface of the structure too smooth to allow for substantial growth to become established (Section 3.2.3.1 of the EIS). Therefore, EFH-managed species would not be impacted by anti-fouling paint.

6.2.2.4 Noise

Broadwater estimated underwater noise impacts due to operation of the proposed Project from data for the Gulf Gateway Deepwater Port. Broadwater considered operational underwater noise impacts from the Gulf Gateway Deepwater Port to be similar to the Broadwater Project. Underwater noise associated with the proposed FSRU would be generated by regasification machinery, ballast water exchanges, normal hoteling operations, thrusters and power generation. According to Broadwater, the proposed FSRU would generate continuous underwater noise levels from 108 dBL to 120 dBL. LNG carriers would also generate underwater noise while moored at the FSRU from machinery to offload LNG, generate power, and maintain facilities. Underwater noise associated with the LNG carriers operations while at the proposed FSRU are expected to range from 160 dBL to 170 dBL. Broadwater states that underwater noise levels for LNG carriers are expected to be at or below 120 dBL less than 0.7 mile [0.4 square mile (1 square kilometer)] from the facility and within the Coast Guard designated safety and security zone.

Therefore, we recommend in Section 3.3.2.2 of the EIS that Broadwater coordinate with NMFS to identify operational noise thresholds and any appropriate measures that are protective of marine resources.

6.2.2.5 Waterway for LNG Marine Traffic

Potential impacts to EFH-managed species that result from any incremental increase in Project-related vessel traffic would be similar to impacts for general fisheries resources as discussed in Section 3.3.2.2 of the EIS. Entrainment of EFH-managed species eggs and larvae would be possible during transit as a result of the withdrawal of water for vessel engine cooling. However, because vessels would be constantly moving, this impact would be expected to be minimal at any specific location and insignificant along the proposed Project Waterway. Given the proposed Project Waterway is already used quite heavily; noise associated with the incremental increase in shipping traffic would have minimal effects on EFH-managed species.

Potential impacts to EFH-managed species from an un-ignited LNG spill are discussed in Section 6.1.3.1.

6.2.3 Impact Summary

Overall, impacts to EFH-managed species from installation of the pipeline would be generally minor and temporary. Areas with habitat conversion associated with limited portions of the pipeline route and the YMS (soft bottom habitat to hard structure) would have more long-term to permanent impacts. Highly mobile organisms would be displaced, but would be expected to return shortly after construction ended. Less mobile species would be exposed to construction-related impacts, such as physiological stress, decreased reproductive or feeding success, or mortality. Many of these effects would be temporary or short-term from which organisms could recover. Displaced species would not be habitat limited, while impacts to benthic species would occur over a small portion of their range. Construction related impacts would not be evident at the population level.

Operational impacts such as impingement/entrainment and water quality impacts would be minor but long-term, extending for the life of the proposed Project. Discharge parameters (including temperature and chlorine concentration) from the proposed FSRU would be monitored according to SPDES permit requirements to minimize potential impacts to ambient water quality. Impingement and entrainment impacts from operation of the FSRU and LNG carriers would affect about 0.1 percent of the ichthyoplankton in the central basin. This small impact may overestimate actual impacts and would not be evident at the population level.

7.0 CUMULATIVE IMPACTS ANALYSIS

The purpose of this cumulative impact analysis is to identify and describe cumulative impacts to EFH that could potentially result from implementation of the proposed Project. In general terms, cumulative impacts represent the incremental effects of the proposed action when added to other past, present, or reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a given period of time. The direct and indirect impacts of the proposed Project are discussed in other sections of this EFH assessment.

Inclusion of other projects within this cumulative impacts analysis is based on identifying common attributes between impacts from other projects and potential impacts from this proposed Project. 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.

Other actions considered in the cumulative analysis may vary from the proposed Project in nature, magnitude, and duration. The projects included are based on the likelihood of completion and only "reasonably foreseeable" future actions are evaluated as part of the cumulative analysis. Therefore, based on the anticipated geographic and temporal impacts of the proposed Project and other actions, other actions that were not expected to affect similar resources during the duration of effects resulting from the proposed Project were excluded from further consideration. Anticipated cumulative impacts were based upon NEPA documentation, agency and public input, and best professional judgment.

We identified three types of past, present, and reasonably foreseeable future projects that could potentially result in a cumulative impact to EFH when considered with the proposed Project. For the purposes of this cumulative impact analysis, we considered the proposed Project area to be the offshore waters of Long Island Sound.

A total of 12 projects are either in place, are under construction, or are reasonably foreseeable future projects in the Project area. These projects consist of two existing and one proposed natural gas pipeline, five existing subsea telecommunication or electric transmission cables, two offshore oil transfer platforms, and two proposed offshore dredged material disposal sites.

7.1.1 Pipeline Projects

7.1.1.1 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, however construction has been delayed for several years because the State of Connecticut has 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. In May 2007, the U.S. District Court, District of Connecticut ruled that the project is not required to obtain a state permit under Connecticut's Structures, Dredging, and Fill Act because FERC's certificate supersedes this state permit requirement. On August 15, 2007, however, a U.S. District Judge remanded the U.S. Commerce Department's decision to overrule the State of Connecticut's coastal zone consistency.

While it is not certain if or when this action will occur, it was considered further due to its similarity and proximity to the proposed Broadwater subsea pipeline. Table 7-1 presents a comparison of the two projects and the cumulative total impact.

7.1.1.2 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 installed using a combination of horizontal directional drilling (in nearshore shallow water areas outside the Project area) and subsea plowing. Construction activities included attempts at mechanically backfilling the trench. Existing post-construction surveys indicate that the mechanical backfilling methods employed did not result in complete backfilling of the trench, but acreage estimates are not available. In addition, no quantitative information is available on the status of benthic recovery.

TABLE 7-1
Cumulative Impacts of Broadwater LNG, 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[a]	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)	263.6[b]	3,106	3,369.6

[a] Assumes that the proposed plow method will be successful through the Stratford Shoal segment of the Project.

[b] Includes incorporation of our recommendations.

7.1.2 Telecommunication and Electric Transmission Cables

Five subsea telecommunication and electric transmission cable occur in the area of the proposed FSRU and pipeline. 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. 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.

7.1.2.1 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 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 system with a system of solid dielectric cables that do not contain alkylbenzene. In August 2007, CTDEP issued a permit for this cable replacement (CTDEP 2007). The replacement cables would be laid on the bottom then buried to a depth of 6 feet below the seafloor via subsea jetting. Installation of the replacement cable would be expected to result in some localized impacts to benthic resources as well as temporary and localized increases in turbidity.

7.1.2.2 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 the 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. These depressions ranged from 2 to 8 feet wide and up 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).

7.1.2.3 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.

There is no known information on any continuing environmental impacts associated with construction of the AT&T Cable.

7.1.2.4 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).

There is no known information on any continuing environmental impacts associated with construction of the MCI Cable.

7.1.2.5 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).

There is no known information on any continuing environmental impacts associated with construction of the FLAG Atlantic 1 North Fiber Optic Cable.

7.1.3 Dredged Material Disposal Sites

The U.S. Army Corps of Engineers (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 has been in use since 1982 and covers approximately 1,262 acres. It 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, has been in use since 1941 and covers approximately 2,037 acres. It is located in Connecticut waters approximately 3 miles northwest of the proposed Broadwater FSRU location.

Both proposed dumpsites 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 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.

7.1.4 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 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 (KeySpan 2006).

ConocoPhillips operates a similar oil receiving platform approximately 1.8 miles offshore of Riverhead, New York. Approximately 50 tankers visit each year (Gianfalla 2006).

Although both the KeySpan and ConocoPhillips platforms are located in shallow, nearshore waters outside of the area of the proposed FSRU and pipeline, tanker activity at these locations has the potential to result in a cumulative impact on air quality and marine transportation within the proposed Project Waterway.

7.1.5 Potential Cumulative Impacts of the Proposed Action

Potential cumulative impacts to EFH and EFH-managed species are grouped by resource area. The potential impacts that are most likely to be cumulatively significant to EFH and EFH-managed species are related to water intakes, water discharges, and benthic disturbance.

7.1.5.1 Water Intake

As described in Section 6.2.2.1, impacts to EFH related to water resources associated with water intakes are considered minor, but long term because they would continue for the life of the proposed Project. Similarly, impingement/entrainment of ichthyoplankton would affect a very small percentage of the standing crop of EFH-managed species of central Long Island Sound, and these losses are not expected to affect the finfish population within Long Island Sound.

As described in Section 6.2.2.5, impacts to EFH-managed species from impingement/entrainment associated with water intakes for the FSRU and berthed LNG carriers would be minimal but long term since they would continue for the life of the proposed Project. Since transiting LNG carriers would be constantly moving, any impingement/entrainment impacts would be minimal at any specific location and insignificant along the Project Waterway.

As described in Section 3.11 of the EIS, except for the Broadwater Project, the only other source of impingement/entrainment in the Project area would be marine vessels that were not associated with the Broadwater Project. During operation, Project-related vessel traffic would result in an approximately 1-percent increase in the vessel traffic in Long Island Sound. Therefore it is expected that the Broadwater Project would not significantly add to the cumulative impact to ichthyoplankton in the proposed Project Waterway.

Outside of the Project area, other sources of water intake impacts to Long Island Sound include KeySpan's power generation facilities at Northport facility (Suffolk County, New York) and the Ravenswood Generating Station (Queens County, New York). Daily seawater intake at these facilities is much greater than the proposed Project. For example, the Northport facility is designed to intake approximately 1,867 mgd of cooling water from Long Island Sound (EPA 2004). The water intake impacts of the Broadwater Project would be approximately 1 percent of the volume used by one of these projects. Thus, the contribution to cumulative impacts associated with the proposed Project would not be significant.

7.1.5.2 Water Discharges

During construction, surface water quality would primarily be affected by turbidity caused by pipeline installation as part of the Broadwater Project. Turbidity modeling has demonstrated these impacts would dissipate within approximately 12 hours of construction activities. The primary impacts to water quality during operation of the Broadwater Project would be associated with water discharges. These discharges would comply with the recommended mitigation measures in this EIS and SPDES requirements but 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 Long Island Sound; however, these impacts are expected to be localized (EPA 2004).

Elements of the proposed Broadwater Project, the Islander East Pipeline Project, and the dredged material disposal sites, with potential to affect water quality would be subject to review and approval under Section 404 of the CWA, as administered by COE; and 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. Thus, it is not expected that turbidity or water quality associated with the Broadwater Project would significantly impact water resources in association with other projects in the proposed Project Waterway.

In addition to water chemistry, water temperature would be affected during the operation of the proposed Project, but on a very limited basis, as described below. The proposed pipeline would be coated with 3 inches of concrete except along the descent through the mooring tower. Natural gas is expected to enter the pipeline roughly between 100°F and 130°F at the top of the mooring tower and to fall to a temperature between 100°F and 120°F at the bottom of the mooring tower, 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.

Water temperatures would return to ambient levels within 4 feet of the riser. 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 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 150,000 m^3 steam-powered LNG carrier would initially be 19.4°F higher than ambient water temperatures, but would comply with NYSDEC thermal water quality criteria within approximately 75 feet of the discharge point (within 1.5°F). Because the cooling water intake would be at ambient temperature, which is seasonally dependent, the relative increase in water temperature of the discharge would be expected to remain relatively constant throughout the year. All other LNG carrier water discharges would approximate ambient temperatures and would not alter the temperature of the water in the vicinity of the vessel. Therefore, impacts associated with cooling water discharge are expected to be highly localized and minor with a regulatory mixing zone.

Although not located in the offshore waters of Long Island Sound, other sources of thermal impacts to Long Island Sound include KeySpan's power generation facilities at Northport, Port Jefferson, Ravenswood, as well as the nuclear power facility known as Millstone in Connecticut. 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 2006). 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 2006). Thus, the negligible thermal impacts of the Broadwater Project on EFH would not measurably contribute to cumulative impacts and therefore when considered with other projects would not be significant.

7.1.5.3 Benthic Disturbance

If the Islander East Pipeline were constructed during the same season as the proposed Project, it is possible that benthic and demersal EFH-managed species could be cumulatively affected by physical disturbance and increased levels of turbidity and sedimentation. These impacts largely would be limited to the immediate vicinity of each of the two projects, and it is not expected that the benthic impacts associated with the two projects would overlap in space or time. 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 of time 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. Previous construction of the Eastchester Expansion Project resulted in unsuccessful backfilling of the trench. Potential future construction of the Islander East Project and the Broadwater Project would incorporate active backfilling of the excavated trench using improved methods based on previous linear projects in Long Island Sound, and impacts to the benthic habitat are expected to be short term. The available information on these completed pipeline and cable projects indicates that the benthic habitat in offshore areas recovers within 1 to 2 years (Newell et al. 1998). 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 (approximately 264 acres for Broadwater and approximately 3,106 acres for Islander East) (considerably less than 1 percent of the seafloor in Long Island Sound [approximately 844,800 acres]), and the geographic and potentially temporal separation of the projects.

7.1.6 Conclusions

We conclude that only the Islander East Pipeline Project has the potential to contribute any significant cumulative impacts to the proposed Project area. Both the proposed Broadwater Project and the Islander East Pipeline Project would be within the same general offshore area. Additionally, the type of project, construction methods, and impacts would be similar for the two projects. While the actual schedule for construction of the Islander East project is not known, the most recent schedule proposed was to complete construction in 2007. Therefore, construction of the two projects would not overlap unless Islander East was delayed for either 2 or 3 years. Each of these projects would result in temporary and minor effects during construction, but each project would be designed and permitted to avoid or minimize impacts to water quality, EFH, and EFH-managed species. 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 the 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 careful project routing, utilization of specialized construction techniques to cross sensitive resources, 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.

8.0 AVOIDANCE, MINIMIZATION, AND MITIGATION OF IMPACTS

NMFS employs a three-tiered approach to protect resources under their jurisdiction from impact. Primary consideration is given to the total avoidance of impacts to EFH and managed species. When avoidance is not possible, NMFS stresses minimization of impacts to the extent practical. Finally, NMFS requires mitigation for any remaining, unavoidable impacts. We believe that Broadwater's proposed actions along with implementation of the recommendations identified in the EIS, especially those summarized in this document, has appropriately applied this three-step process to avoid and minimize impacts to EFH and managed species associated with the proposed Project, and to mitigate any expected, unavoidable impacts.

Various biological and geophysical surveys have been conducted in the area of the proposed YMS, FSRU, and pipeline to identify important marine resources in an attempt to avoid and minimize impacts to valuable resources. During the permitting process, Broadwater and FERC have periodically consulted with NMFS and other federal and state resource agencies. This coordination has resulted in various Project- and site-specific construction methodologies and mitigation measures to avoid and minimize impacts from construction and operation of the proposed pipeline and FSRU. An overview of the proposed methods to avoid, minimize, and mitigate impacts to EFH from construction and operation of the proposed pipeline and FSRU is presented below.

8.1 GENERAL PROJECT SITING AND DESIGN

As discussed in the alternatives section of this document (Section 3.0), several types of LNG terminals were evaluated as alternatives to the FSRU technology including onshore terminals, nearshore terminals, and SRV terminals. Onshore and nearshore terminals would each result in increased impacts to onshore and nearshore resources including potential impacts to EFH and EFH-managed species relative to FSRU technology in the middle of Long Island Sound. SRV technology and an associated pipeline would also increase potential impacts to onshore, nearshore, and potentially offshore resources including EFH and EFH-managed species. In accordance with NOAA guidance (2005a), the proposed YMS and FSRU location and general design would avoid nearshore impacts associated with channel dredging, pipeline installation, and water intake and discharge. In addition, the use of an FSRU design would substantially reduce permanent seafloor conversion relative to a GBS design (0.3 acre and 16.9 acres respectively).

Different vaporization techniques were also evaluated including various open-loop (ORV) and closed-loop (STV) technologies. ORV technology would significantly increase the volume of operational water intakes and corresponding impingement/entrainment as well as significantly increase potential impacts due to thermal discharges. The STV technology was selected by Broadwater, in part, because it minimizes impingement/entrainment impacts by eliminating the need for any water for regasification. Thus, significantly reducing impingement /entrainment relative to ORV technology. In addition, NOAA (2005a) has determined that closed-loop regasification, such as STV, represents the best available technology to avoid and minimize impacts to sensitive fisheries habitats and resources.

The proposed pipeline route was selected to avoid impacts to nearshore habitats and resources including avoidance of wetlands, shellfish beds, and eelgrass beds. Impacts to EFH and EFH-managed species have been limited by siting the proposed Project in the offshore waters of Long Island Sound on softbottom habitat away from nearshore spawning and nursery areas, or heavily contaminated sediments. In addition, the proposed pipeline route avoids critical habitat for threatened and endangered species, wetlands, wildlife refuges, national or state parks, or residential areas. As proposed, pipeline installation would require no dredging or blasting, and the pipeline would tie in with the existing pipeline infrastructure in the middle of Long Island Sound so as to minimize new construction (as recommended in NOAA 2005a).

8.2 CONSTRUCTION

8.2.1 Trenching

Several trenching methods were evaluated including subsea plow, subsea jet sled, and pre-lay dredge (Section 4.0 of the EIS). Relative to the alternative methods, the proposed use of a subsea plow would reduce the extent and duration of turbidity and/or sedimentation. The subsea plow would also reduce the extent of the benthic EFH impacted by construction by approximately 50 percent relative to the pre-lay dredge (197 and 395 acres respectively).

NOAA recommends the use of a subsea plow because it would greatly reduce collateral damage to the seafloor and habitat recovery time (NOAA 2005a). In addition, the subsea plow has also been identified by NYSDEC as the preferred installation method. The slow speed, narrow spoil area, and limited turbidity and sedimentation of the subsea plow also aid in limiting impacts.

8.2.2 Other Measures

Broadwater has also proposed to employ the following measures to avoid and minimize impacts of the proposed Broadwater Project:

- Construction activities in Long Island Sound would be limited to the fall through early spring period to avoid the peak spawning period of most fish species including most EFH-managed species;
- Water quality monitoring would be conducted during construction using optical backscatter techniques, acoustic doppler current profiling, and TSS grab sampling
- Backfilling of trenched areas with clean imported material in the vicinity of the FSRU, IGTS tie-in, and utility crossings as approved by COE; and
- Mid-line buoys would be used on all quarter anchor lines.

In addition, we recommend that

- Broadwater use mid-line buoys on all anchor lines of all construction vessels used for pipeline installation (or use a dynamically positioned lay barge), which would virtually eliminate impacts from anchor cable sweep and reduce the impacts to benthic EFH by approximately 88 percent;
- Broadwater mechanically backfill the remaining trench, according to an agency approved plan, following pipeline installation and conduct post-construction monitoring instead or relying on natural backfilling in order to avoid the persistence of an open trench that could impede migration and movements, and minimize the recovery period of the benthic community;
- Broadwater to coordinate with resource agencies to backfill the first 2 miles of the pipeline trench with imported backfill covered by native substrate so as to reduce sediment conversion from 7.5 acres to about 1.4 acres.
- Broadwater coordinate with NMFS to identify construction noise thresholds that are protective of marine resources, especially marine mammals;
- Broadwater conduct pile driving operations from December through March so as to avoid impacts to sea turtles;
- Broadwater use and file a material safety and data sheet for the silicon-based anti-fouling paint to be used on the hull of the FSRU; and
- Broadwater develop and implement a Project-specific offshore SPCC Plan.

8.2.3 Project Operations

In addition to the operational measures identified above as part of the general siting and design discussion in Section 8.1 and those identified in Section 8.2.2 to minimize impacts during and following construction, Broadwater has proposed to limit potential impacts to EFH and EFH-managed species during operation by:

- Manually cleaning the FSRU hull and intake screens;

- Adhering to a Project-specific SPCC Plan (as recommended by FERC);
- Implementation of emergency response designs, plans, and procedures developed in concert with FERC, the U.S. Coast Guard, and the U.S. Department of Homeland Security;
- Implementing best available technology to reduce impingement/entrainment associated with water intakes including a mid-depth position of the water intakes in the water column and limiting intake flow velocities to 0.5 foot per second;
- Limiting sodium hypochlorite concentrations to the minimum effective concentration;
- Monitoring water discharges in accordance with SPDES Permits; and
- Broadwater coordinate with NMFS to identify operational noise thresholds that are protective of marine resources, especially marine mammals;

9.0 CONCLUSIONS

The proposed Project siting, design, and construction and operation methods have been developed to avoid and minimize impacts to EFH and other important resources. Broadwater has proposed several measures to limit and minimize impacts to EFH and EFH-managed species. In addition, we have recommended additional measures to further avoid and minimize impacts. Compensatory mitigation, as appropriate, could be required for any unavoidable impacts to EFH and/or EFH-managed species. Broadwater would also be required to apply for and adhere to all applicable federal and state permits.

9.1 SUMMARY OF IMPACTS

Essential fish habitat and the managed species that utilize these areas occur throughout the proposed Project area including the areas associated with the FSRU, YMS, pipeline, and LNG vessel transit routes.

Impacts to managed species during construction would be minimal and largely temporary. Construction would initially impact approximately 264 acres of benthic habitat. It is expected that most juvenile and adult EFH-managed species would avoid active construction areas. Displacement of species would be minor, as species would rapidly re-colonize these areas following construction. For early lifestages of some EFH-managed species, there could be constraints on their ability to avoid construction impacts, but most EFH-managed species and lifestages are mobile and could seek shelter or shed the limited amount of expected sediment deposition.

During construction, turbidity and sedimentation may result in fish egg and larval mortality, and decreased feeding in juvenile and adult fish. Results of sediment transport modeling showed that the highest TSS concentrations would occur near the bottom during active plowing, with virtually no elevated TSS or sedimentation greater than 0.2 inches beyond the 75 foot construction corridor. The model results also indicated that any Project-related TSS concentrations would be assimilated into Long Island Sound within about 12 hours of when the sediments were suspended during construction. Any impacts associated with turbidity would be temporary during and immediately following active construction; sedimentation could result in temporary to short-term impacts. Therefore, no impacts would occur to the large majority of EFH in Long Island Sound as a result of turbidity and sedimentation.

EFH-managed species could be affected by acoustical disturbances associated with pile-driving used during installation of the proposed YMS. According to Broadwater, either a vibratory hammer or a conventional pile-driver would be used to install the four legs of the YMS into the seafloor. According to Broadwater, the proposed Project would generate continuous underwater noise levels from 108 dBL to

120 dBL. Broadwater also estimated that LNG carriers would generate continuous underwater noise levels associated with berthing and unberthing operations could range from 160 dBL to 170 dBL in the immediate area of the LNG carrier and the FSRU. However, Broadwater estimates that underwater noise levels associated with LNG carriers would be at or below 120 dBL in less than 0.4 square mile (1 square kilometer) from the proposed FSRU and likely within the COAST GUARD designated safety and security zone. Therefore, we recommend in Section 3.3.2.2 of the EIS that Broadwater coordinate with NMFS to identify operational noise thresholds and any appropriate measures that are protective of marine resources. Juvenile and adult finfish are highly mobile and are expected to avoid the proposed YMS construction area. It is anticipated that impacts to finfish communities would largely be limited to younger, less mobile lifestages (eggs and larvae); and pile-driving activities are proposed to occur in the fall, when egg and larval densities would be relatively low. With implementation of our recommendation, any impacts of noise to fisheries resources during construction of the proposed YMS and operation of the proposed FSRU would be minor and temporary.

Installation of the YMS would result in the permanent conversion of less than 0.1 acre of the seafloor of Long Island Sound from softbottom habitat to hard structure. However, conversion of the habitat from soft to hard surface could benefit some EFH-managed species such as pollock and scup. Other construction-related impacts could include hydrostatic testing. However, this one-time event would be conducted in accordance with SPDES permit requirements and FERC requirements, and any impacts would be highly localized and temporary.

Adherence to our recommendation to use a silicon based anti-fouling paint on the proposed FSRU would eliminate any impacts to EFH and EFH-managed species from anti-fouling paint.

Impacts to benthic habitat would total less than 0.1 percent of the benthic habitat of Long Island Sound, and turbidity modeling results indicate turbidity would temporarily impact less than 1 percent of the acreage of Long Island Sound. Therefore, displaced species would not be habitat limited, and any lethal impacts to young lifestages and non-mobile species would be localized and negligible on a population level.

During operations, it is conservatively estimated that approximately 3.5 million eggs and 5.3 million larvae of EFH-managed species would be impinged/entrained annually due to operations at the proposed Project including the FSRU and berthed LNG carriers (28.2 mgd). These losses would compose less than 0.1 percent of the standing crop of the central basin of Long Island Sound based on average ichthyoplankton density and the volume of the central basin. Actual losses would be expected to be substantially less with implementation of the standard mitigation measures designed to minimize potential impacts to ichthyoplankton including mid-depth position of FSRU water intakes, and reduced water velocity into water intakes. While these losses would continue for the life of the proposed Project, they would constitute a negligible impact to the EFH-managed populations within Long Island Sound.

Water discharges from the FSRU would be comparable to ambient temperatures. LNG carrier water discharges would initially be 19.4°F higher than ambient water temperatures, but would comply with NYSDEC thermal water quality criteria within approximately 75 feet of the discharge point (within 1.5°F). 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 throughout the year. All other LNG carrier water discharges would approximate ambient temperatures and would not alter the temperature of the water in the vicinity of the vessel. Therefore, thermal impacts associated with cooling water discharge are expected to be negligible. Any temperature increase associated with the pipeline riser between the FSRU and the subsea pipeline would return to ambient temperature within 4 feet of the riser, and the buried subsea pipeline would not impact water temperatures in Long Island Sound.

The cooling water for the LNG carriers (as is standard in the shipping industry) would be injected with a low dose of biocide (expected to be sodium hypochlorite) to prevent the growth of marine organisms. As with FSRU discharges, this residual chlorine concentration is not expected to significantly affect water quality.

Impacts could occur from fuel spills. However, it is not possible to quantify these impacts. Since, the LNG loading system would direct any LNG spills that may occur overboard, the majority of LNG from a spill would quickly disperse and vaporize on the sea surface. In addition, we have included a recommendation in Section 3.2.2.1 of the EIS that Broadwater provide an offshore-specific SPCC Plan for construction activities to minimize impacts. Additional information regarding spills can be found throughout Section 3.0 of the EIS.

During normal operations, Project-related vessel traffic would have no significant adverse impact on EFH seafloor sediments and the estuarine water column. Since LNG carrier traffic would be operating at low speeds far from shore, wakes would not increase the potential for shoreline erosion in the area of the proposed Project. Because LNG is less dense than water and would vaporize upon contact with water and air, there would be no significant adverse impacts to EFH seafloor sediments and estuarine water column along the LNG carrier transit routes from an ignited or un-ignited LNG spill in Hazard Zones 1 and 2 (hazard zones are defined in Section 3.10 of the EIS and Section 1.4.4 of the WSR in Appendix C). Within Hazard Zone 1, the water's surface within the LNG pool may be temporarily impacted by sudden localized lowering of temperature until the LNG had vaporized.

Entrainment of EFH-managed species eggs and larvae would be possible during LNG carrier transit as a result of the withdrawal of water for vessel engine cooling. However, because vessels would be constantly moving, this impact would be minimal at any specific location and insignificant along the Project Waterway. Given the Project Waterway is already used quite heavily; noise associated with the incremental increase in shipping traffic would have minimal effects on EFH-managed species. In addition, we have included a recommendation in Section 3.3.2.2 of the EIS requiring Broadwater coordinate with the NMFS to develop construction and operational noise thresholds that are protective of marine resources to further minimize impacts.

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